KEMENTERIAN SAINS, TEKNOLOGI DAN INOVASI

NUKLEAR MALAYSIA

Refleksi

Elemen simbolik ekspresi Nuklear Malaysia

2024

Refleksi

Elemen simbolik ekspresi Nuklear Malaysia

PENERBITAN
Habibah Adnan
Dr. Haizum Ruzanna Sahar

REKA LETAK
Halit Alias

PENDIGITALAN
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SEKALUNG BUDI

Bahagian Pengurusan Maklumat (BPM)
Bahagian Teknologi Perubatan (BTP)
Bahagian Teknologi Industri (BTI)
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KANDUNGAN	MUKA SURAT

Refleksi

Elemen simbolik ekspresi Nuklear Malaysia

PRAKATA

Majalah Refleksi 2024 kali ini memuatkan 162 koleksi poster hasil gabungan idea kreatif dan berinformasi dari Agensi Nuklear Malaysia (Nuklear Malaysia). Kesemua poster ini telah dipamerkan semasa program pameran, seminar dan konvensyen Agensi Nuklear Malaysia. Antara program yang terlibat adalah seperti Minggu Sains Negara, *Technology Preview & Showcase,* Hari Inovasi Agensi Nuklear Malaysia, Seminar R&D Agensi Nuklear Malaysia dan Forum Iklim Kebangsaan.

Majalah Refleksi berperanan menyampaikan ilmu serta mempromosi perkhidmatan dan penyelidikan yang dilaksanakan oleh Nuklear Malaysia. Ini adalah selaras dengan matlamat kerajaan melalui Dasar Sains, Teknologi dan Inovasi Negara 2021-2030 untuk mewujudkan masyarakat yang mampan, inklusif & saintifik ke arah negara berteknologi tinggi. Diharapkan majalah ini dapat memberi manfaat kepada semua golongan terutamanya mereka yang terlibat dalam bidang penyelidikan sains nuklear. Selain itu, usaha ini secara langsung menyokong aktiviti pengurusan pengetahuan dengan memudahkan pencarian maklumat agar lebih efektif dan efisyen.

Sejuta penghargaan diucapkan kepada semua yang telah menyumbang tenaga, idea dan masa, demi merealisasikan majalah Refleksi 2024. Semoga kerjasama erat dan sokongan dari semua pihak dapat diteruskan lagi pada masa akan datang.

Nuklear Malaysia berharap agar majalah Refleksi menjadi platform perkongsian ilmu yang dipercayai dan terus kekal relevan dalam era digital kini.

Sekian, terima kasih.

Sidang Editorial

Technology Preview & Showcase (TPS) Johor

27 Februari 2024

Technology Preview & Showcase (TPS) Johor

PUSAT KHIDMAT KUMPULAN TEKNOLOGI BAHAN (MTEG)

MTEG menjalankan aktiviti R&D&I&C dalam bidang seramik, metalurgi, perlindungan kakisan, bahan nano, biomaterial, pelindung radiasi, kerosakan radiasi, bahan elektronik, mineral, sensor, pemeliharaan warisan, pemprosesan mineral, instrumen nuklear serta pemodelan dan simulasi.

MTEG memperoleh kepercayaan yang baik dan pendekatan inovatif dalam melakukan pelbagai pencirian dan ujian terhadap sifat mekanikal, struktur mikro, morfologi, terma, fizikal dan kimia bahan dalam pelbagai keadaan. MTEG bukan sahaja mampu bertindak sebagai penyelesai masalah teknikal pelanggan dalam sains dan kejuruteraan bahan, malah ia juga merupakan pusat perkhidmatan sehenti yang menyediakan perkhidmatan pencirian bahan yang penting untuk kajian bahan, pembangunan dan pengkomersialan produk.


Kajian morfologi bahan dengan teknik FESEM


Kajian struktur bahan nano dengan teknik SAXS


Kajian kristalografi bahan dengan teknik XRD


Kajian sifat mekanik bahan dengan menggunakan peralatan UTM


Penentuan kadar kakisan dalam bahan dengan menggunakan teknik penganalisa kakisan

Penentuan unsur kimia dalam bahan dengan teknik XRF

Senarai peralatan yang digunakan di MTEG dalam khidmat pencirian bahan:

1. Pendaflor Sinar-X (XRF)
2. Serakan Sinar-X Sudut Kecil (SAXS)
3. Spektrometer Pembelauan Sinar-X (XRD)
4. Mikroskop Elektron Imbasan Pancaran Medan (FESEM)
5. Spektrometer Sinar-X Serakan Tenaga (EDX)
6. Mikroskop Daya Atom (AFM)
7. Spektrometer RAMAN
8. Spektrofotometer Ultralembayung/ Nampak (UV-Vis)
9. Spektroskopi Spektrum Cahaya (Photoluminescence/PL)
10. Penganalsisa kakisan
11. Penganalisis Terma Serentak (STA)
12. Penganalisis Saiz Zarah (PSA)
13. Universal Testing Machines (UTM)

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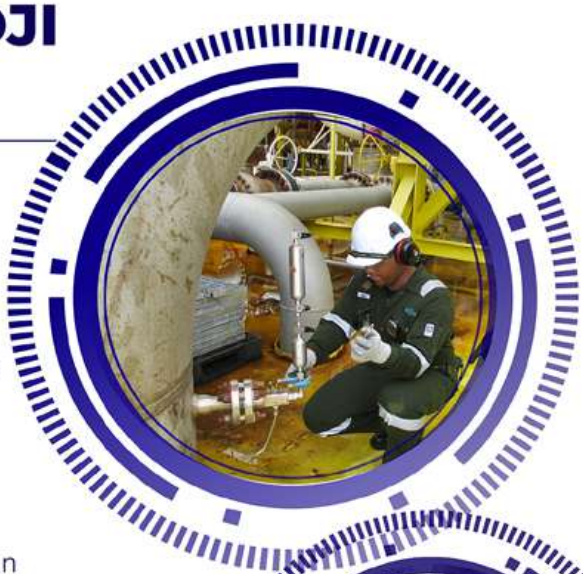
Technology Preview & Showcase (TPS) Johor

KUMPULAN TEKNOLOGI PENILAIAN LOJI (PAT)

Kumpulan Teknologi Penilaian Loji (PAT) menyediakan perkhidmatan di lapangan antaranya mengimbas loji dan paip menggunakan sinar gama, menentukan aras antara bahan menggunakan neutron serta menggunakan teknik penyurih industri bagi loji petrokimia, kemudahan industri, loji rawatan air dan kemudahan lain.



Kumpulan Teknologi Penilaian Loji (PAT) juga memiliki makmal X-ray dan Gamma Tomografi Berkomputer yang menawarkan perkhidmatan imbasan sampel menggunakan sinar-X.

Pemeriksaan menggunakan teknik penyurih bagi industri

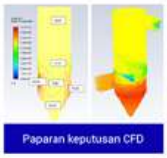
Imbasan MUI di loji minyak

Senarai Khidmat di Lapangan:

1. Imbasan Turus (*Column Scanning*)
2. Imbasan Paip (*Pipe Scanning*)
3. Teknologi Penyurih bagi Industri (*Industrial Tracer*)
4. *Moisture Under Insulation Detection* (MUI)
5. *Corrosion Under Insulation Detection* (CUI)
6. Imbasan Paras Teknik Serak Balik Neutron (NBT)
7. *Computional Fluid Dynamics* (CFD) ANSYS
8. X-ray Tomografi Berkomputer
9. X-ray Mikro Tomografi Berkomputer

Imbasan X-ray Mikro Tomografi Berkomputer di makmal

Pemeriksaan menggunakan X-Ray Tomografi Berkomputer di makmal



Paparan keputusan CFD

Imbasan *sand level* di loji minyak

Imbasan Turus di loji minyak

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KUMPULAN *MATERIAL STRUCTURAL INTEGRITY* (MSI-NDT)

Pusat Khidmat Kumpulan *Material Structural Integrity* (MSI-NDT) menawarkan servis dan konsultasi berkaitan keutuhan struktur menggunakan teknik Ujian Tanpa Musnah (NDT) untuk bahan metalik/ bukan metalik spesifik untuk industri kejuruteraan awam, perkapalan dan juga minyak/gas. Pengujian biasanya terdiri daripada sampel ataupun pengujian dijalankan secara *in-situ* di lapangan.

Teknik NDT yang digunakan adalah bergantung kepada keperluan kerja samada memerlukan sumber radioaktif ataupun tidak.

Senarai Khidmat:

1. Ujian Tanpa Musnah untuk kejuruteraan awam (Bangunan, jambatan, terowong, empangan)
2. Pengesanan objek bawah tanah (kebocoran paip, lapisan tanah, harta karun, pemetaan)
3. Mengenalpasti ketidak selanjaran material (permukaan kapal, kualiti kimpalan, tangki simpanan, keadaan dalaman objek)
4. Infrastruktur pengujian kualiti kimpalan spesifik untuk '*crawler*' untuk industri minyak/gas
5. Infrastruktur latihan untuk pengujian '*underwater ultrasonic*'
6. Infrastruktur latihan untuk *ground penetrating radar*
7. Infrastuktur Pusat Kecemerlangan Aliran (pergerakan cecair dalam paip industri)

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Technology Preview & Showcase (TPS) Johor

KUMPULAN TEKNOLOGI UJIAN TANPA MUSNAH TERMAJU (LENDT)

Kumpulan Teknologi LENDT menawarkan khidmat dan kemudahan Ujian Tanpa Musnah (NDT) Termaju untuk menilai integriti dan kualiti bahan, komponen atau struktur. Antara teknologi yang digunakan ialah *Radiographic Testing - Digital* (RT-D), *Phased Array Ultrasonic Testing* (PAUT) dan *Infrared Thermography Testing* (IRT).

Terdapat 3 makmal utama di LENDT, Agensi Nuklear Malaysia iaitu:

1. ***Radiographic Testing- Digital* (RT-D)**
2. ***Phased Array Ultrasonic Testing* (PAUT)**
3. ***Infrared Thermography Testing* (IRT)**

Kumpulan Teknologi LENDT menyediakan khidmat sokongan teknikal dan kepakaran berkaitan Ujian Tanpa Musnah Termaju kepada sektor industri dalam bidang *Radiographic Testing - Digital* (RT-D) dan *Phased Array Ultrasonic Testing* (PAUT) dan *Infrared Thermography Testing* (IRT). Kumpulan Teknologi LENDT juga menawarkan penilaian keselamatan, khidmat nasihat, kursus, latihan dan perkhidmatan dalam Ujian Tanpa Musnah Termaju.

Kumpulan Teknologi LENDT telah dlantik sebagai pusat kerjasama untuk penyelidikan, latihan dan pembangunan dalam Ujian Tanpa Musnah Termaju oleh International *Atomic Energy Agency* (IAEA).

Perkhidmatan LENDT:

1. Khidmat nasihat melaksanakan ujian radiografi (filem dan digital).
2. Pembangunan prosedur NDT untuk ujian radiografi (filem dan digital) dan PAUT berasaskan keperluan kod, piawaian, atau spesifikasi.
3. Pemeriksaan paip atau objek datar (plat) yang disambung melalui proses sekunder (kimpalan atau pateri).
4. Pengukuran baki ketebalan dinding paip atau lain-lain spesimen.
5. Latihan dan kursus untuk melaksanakan ujian PAUT dan radiografi digital (ISO 9712).

6. Pemeriksaan bangunan (keutuhan dinding, kebocoran bumbung dan lain-lain).
7. Pemeriksaan sistem pemasangan elektrik (MCB, LV *cable, transformer*).

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Technology Preview & Showcase (TPS) Johor

MAKMAL RADIOKIMIA DAN ALAM SEKITAR (RAS)

Makmal Radiokimia dan Alam Sekitar (RAS) menyediakan perkhidmatan radioanalisis untuk keperluan agensi kerajaan dan swasta. Makmal RAS mengamalkan QA/QC dan mempunyai prosedur pengurusannya sendiri yang mana makmal ini telah diakreditasi dengan MS ISO/IEC 17025: 2017 sejak Disember 2005 oleh Jabatan Standard Malaysia bagi skop analisis keradioaktifan gama.

Makmal RAS merupakan makmal kebangsaan yang diluluskan dan diiktiraf oleh Kementerian Kesihatan Malaysia (KKM) untuk melakukan analisis pengukuran keradioaktifan dalam sampel makanan untuk tujuan eksport dan air mineral serta air minuman berbungkus sebagai sebahagian daripada syarat perlesenan KKM.

Sijil Akreditasi MS ISO/IEC 17025:2017


Sistem Spektrometri Gama


Sistem Pembilang Gros Alfa/Gros Beta


Sistem Spektrometri Alfa


Sistem Pembilang Sintilasi Cecair

Senarai Khidmat:

1. Pengukuran pemancar gama dalam sampel makanan
2. Pengukuran pemancar gama dalam sampel alam sekitar/industri
3. Pengukuran Am-241 dalam pengesan asap
4. Pengukuran gross alfa/beta dalam pelbagai sampel
5. Pengukuran gross alfa/beta dalam *air borne/ particulate*', penapis dan '*smear test*'
6. Pengukuran Po-210/Pb-210 dalam pelbagai sampel
7. Pengukuran U-234, U-235 dan U-238 dalam pelbagai sampel
8. Pengukuran Th-228, Th-230 dan Th-232 dalam pelbagai sampel
9. Pengukuran Pu-239+240 dalam pelbagai sampel
10. Pengukuran H-3 dalam air/ais
11. Pengukuran Sr-90 dalam pelbagai sampel

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Technology Preview & Showcase (TPS) Johor

KUMPULAN APLIKASI PENYURIH ALAM SEKITAR (E-TAG)

Pusat khidmat e-TAG (*Environmental Tracer Application Group*) menyediakan khidmat penyelidikan yang merangkumi penggunaan teknologi nuklear serta disokong oleh teknik konvensional berkaitan. Penggunaan teknik/aplikasi penyurih yang disediakan oleh kumpulan ini untuk kajian pengurusan air adalah satu-satunya yang terdapat di Malaysia. Penggunaan teknik penyurih dan juga teknik isotop stabil dalam kajian alam sekitar membantu dalam pengurusan serta pencirian sumber air tanah dan juga permukaan. Penggunaan teknik ini juga telah membantu meningkatkan pengurusan sumber air di banyak negara di seluruh dunia. Penggunaan bersama teknik penyurih dan teknik konvensional seperti Geofizik digunakan dalam kajian penyelidikan seperti eksplorasi tapak, hidrologi, Kajian '*fingerprinting*', pengukuran aliran dan arah air tanah/permukaan, sedimentologi, pencemaran air tanah dan sebagainya. Bagi khidmat Geofizik, pusat khidmat ini mempunyai pakar dalam bidang geologi bertauliah yang di iktiraf oleh *Board of Geology* Malaysia.

Makmal utama yang menyediakan perkhidmatan adalah WDXRF (*Wavelength Dispersive X-ray Fluorescence*) serta *Liquid Water Isotope Analyser* (LWIA).

Senarai Khidmat Penyelidikan yang ditawarkan:

1. Kajian '*fingerprinting*' menggunakan teknik penyurih
2. Kajian alam sekitar menggunakan teknik Geofizik:
   - *i.* ***Electrical Resistivity Imaging*** – khidmat penyiasatan geologi sub-permukaan, potensi serta pencemaran air tanah, penyiasatan awal penerokaan tanah/empangan
   - *ii.* ***Seismik*** - kaedah penerokaan geofizik menggunakan prinsip seismologi untuk menganggarkan sifat-sifat bawah permukaan bumi daripada gelombang seismik yang dipantulkan
3. Pengukuran aliran dan arah air tanah/ permukaan (kadar aliran & halaju)
4. Kajian resapan/kebocoran
5. Kajian punca bahan cemar di sekitaran
6. Analisis isotop stabil 2H, 170 & 180 (cecair)
7. Penentuan elemen yang terkandung dalam unsur (cecair @ pepejal)

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Technology Preview & Showcase (TPS) Johor

NUKLEAR MALAYSIA

TPS TECHNOLOGY PREVIEW & SHOWCASE

KUMPULAN FIZIK KESIHATAN (KFK)

Kumpulan Fizik Kesihatan menyediakan khidmat kepakaran dalam pemantauan dan analisis dalam bidang keselamatan sinaran dan nuklear.

Kepakaran kami merangkumi bidang keselamatan radiologi dan keselamatan alam sekitar. Misi kami adalah untuk memastikan tempat kerja selamat dan sihat kepada pekerja, orang awam dan alam sekitar.

Senarai khidmat yang terdapat di KFK:

1. Khidmat Ujian Kebocoran Punca Radioaktif Terkedap
2. Khidmat Perundingan Radiologi
3. Pemantauan Radiologi Industri
4. Pemantauan Radiologi Alam Sekitar
5. Pemantauan Aras Cemaran
6. Sewaan Alat Meter Tinjau Cemaran

N.U.R

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Technology Preview & Showcase (TPS) Johor

LOJI ALURTRON

ALURTRON menawarkan khidmat penyinaran alur elektron (EB) ke atas produk untuk tujuan taut silang, pengubahsuaian polimer, rawatan permukaan, rawatan air, litografi, pendopan elekron dan lain-lain tujuan untuk menyokong pertumbuhan sektor industri/komersil dan aktiviti penyelidikan dan pembangunan (R&D). Proses penyinaran menghasilkan keseragaman dos yang baik, output yang tinggi dalam masa yang pantas dengan kos operasi yang rendah dan mesra alam. ALURTRON juga menyediakan perkhidmatan ujian makmal dan diperakui dengan pensijilan Sistem Pengurusan Kualiti (QMS) ISO 9001.

Senarai khidmat ALURTRON
Perkhidmatan Penyinaran Alur Elektron:

1. Wayar/kabel dan tiub
2. Semikonduktor Silikon wafer
3. Filem dan lembaran
4. Produk hidrogel
5. Pembangunan produk baru (R&D)

Perkhidmatan penyinaran wayar & kabel

Ujian Makmal dan Kawalan Kualiti:

1. Ujian *Hot Set*
2. Ujian *Gel Content*
3. Ujian Dosimetri

Penyinaran produk

Ujian *Hot Set*

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Technology Preview & Showcase (TPS) Johor

KUMPULAN *NON-IONIZING RADIATION* (NIR)

Sinaran Tidak Mengion (NIR) adalah radiasi bertenaga rendah, di mana spektrumnya meliputi radiasi frekuensi lampau rendah {*Extremely Low Frequency* (ELF)}, frekuensi radio {(*Radio Frequency* (RF)}, sinaran inframerah, cahaya nampak, LASER (*Light Amplification by Stimulated Emission of Radiation*) dan Ultra-ungu {*Ultraviolet*(UV)}.

Terdapat 3 makmal utama di NIR, Agensi Nuklear Malaysia iaitu:

1. Makmal Frekuensi Radio (RF) & Gelombang Mikro
2. Makmal Frekuensi Lampau Rendah (ELF)
3. Makmal Ultraviolet & LASER

Kumpulan NIR bertanggungjawab untuk menyediakan khidmat sokongan teknikal dan kepakaran berkaitan NIR kepada sektor industri, agensi-agensi kerajaan dan orang awam. Kumpulan NIR juga menawarkan penilaian keselamatan, khidmat nasihat, kursus, latihan dan perkhidmatan dalam Sinaran Tidak Mengion (NIR) dari julat ELF sehingga UV.

Kumpulan NIR telah diakreditasikan dengan MS ISO/IEC 17020 untuk Penilaian Keselamatan Frekuensi Radio (RF).

1. Perkhidmatan Penilaian Keselamatan Sinaran Tidak Mengion (NIR) meliputi ELF, RF, LASER & UV
2. Perkhidmatan Penilaian Keselamatan Sinaran Tidak Mengion (ELF, RF, LASER & UV) Barangan Pengguna
3. Projek Kerjasama dengan syarikat dalam bidang keselamatan Sinaran Tidak Mengion (NIR)
4. Program Kesedaran Awam & Pembangunan kapasiti

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Technology Preview & Showcase (TPS) Johor

LOJI MINTEC - SINAGAMA

Loji Penyinaran MINTec-Sinagama menggunakan tenaga pengion dalam bentuk sinaran gamma dari sumber Kobalt-60. Loji penyinaran ini beroperasi dengan kemudahan iradiasi JS10000 (IR-219) yang mampu menyinari pelbagai produk yang memerlukan dos yang berbeza secara serentak.

Merupakan loji penyinaran gamma yang beroperasi pada skala komersial bagi pensterilan atau dekontaminasi peranti perubatan, makanan, rempah ratus, herba dan buah-buahan. Penggunaan sinaran gamma ini akan meningkatkan kualiti mikrobiologi produk-produk berkenaan yang secara langsung akan meningkatkan keselamatan produk serta meningkatkan jangka hayat produk.

MINTec-Sinagama juga menyediakan perkhidmatan pensterilan tisu dan tulang melalui penyinaran gamma untuk tujuan perbankan tisu kepada pihak berkuasa yang berkaitan seperti hospital dan Bank Tisu Negara serta pembasmian serangga dalam komoditi pertanian, termasuk untuk tujuan kuarantin.

Perkhidmatan Penyinaran SINAGAMA:

1. Pensterilan Peranti Perubatan, Bahan Pembungkusan dan Makmal
2. Pensterilan Produk Farmaseutikal
3. Produk Veterinar
4. Makanan, Herba dan Rempah
5. Produk kosmetik
6. Sampel untuk tujuan R&D

Pengiktirafan:

1. ISO 9001
2. ISO 13485
3. Lesen Premis Iradiasi Makanan

Logo RADURA

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MAKMAL FIZIK PERUBATAN (MPL)

Berpengalaman lebih daripada 20 tahun, Agensi Nuklear Malaysia merupakan salah satu pemegang Lesen Juruperunding Kelas H di bawah Akta Perlesenan Tenaga Atom 1984 (Akta 304) bagi maksud Perubatan dari Kementerian Kesihatan Malaysia (KKM) dimana MPL telah dipertanggungjawabkan memberi perkhidmatan untuk tujuan perundingan bagi aktiviti pengujian dan pengesahan (ujian kawalan mutu) radas penyinaran perubatan serta kemudahan berkaitan, pengujian dan pengesahan penentuan ketebalan plumbum bagi perisaian bilik X-ray perubatan dan bilik-bilik berkaitan serta pengujian kemudahan berkaitan dose calibrator perubatan nuklear di seluruh Malaysia. MPL juga merupakan satu-satunya makmal standard tentukuran radas ujian kawalan mutu (QC *test tools*) radiologi diagnostik di Malaysia dan Asia Tenggara yang mematuhi piawaian MS ISO/IEC 17025 dan diakreditasi oleh Skim Akreditasi Makmal Malaysia (SAMM) semenjak tahun 2013. Selain itu, MPL juga ada menawarkan perkhidmatan ujian ketebalan kesetaraan plumbum sampel perisai perlindungan sinaran, ujian intergriti PPE, ujian serakan sinaran, tentukuran pembilang tiroid. Perkhidmatan yang ditawarkan MPL adalah seperti berikut:

Perkhidmatan ujian kawalan mutu (QC) radas x-ray diagnostik perubatan dan kemudahan berkaitan

1. Pengujian dan pengesahan dibawah skop lesen kelas H yang merangkumi modaliti x-ray seperti x-ray am, Pergigian, Angiografi, densitometer tulang, C-Arm, Fluoroskopi, Mamografi dan Pengimbas CT.
2. Pemeriksaan bilik gelap
3. Ujian integriti peralatan perlindungan diri (PPE) x-ray perubatan
4. Ujian serakan radiasi.

Perkhidmatan tentukuran *dose calibrator* perubatan nuklear

1. Pengujian dan pengesahan dose calibrator perubatan nuklear. dibawah skop lesen kelas H KKM.
2. Perkhidmatan tentukuran pembilang tiroid.

Perkhidmatan tentukuran peralatan ujian kawalan mutu (QC *test tools*) radiologi diagnostik

1. Tentukuran dosemeters dalam radiologi diagnostik untuk kualiti x-ray RQR, RQA dan RQT yang mematuhi Standard IEC 61267 dan TRS 457 serta telah diiktiraf mengikut piawaian ISO / IEC 17025 oleh SAMM.
2. Tentukuran kualiti mammografi Mo/Mo
3. Tentukuran meter kVp dan pemasa (timer),
4. Tentukuran densitometer dan sensitometer.

Perkhidmatan perlindungan sinaran

1. Ujian ketebalan kesetaraan plumbum (LET) bagi perisaian bilik x-ray perubatan dan bilik-bilik berkaitan dibawah skop lesen kelas H KKM.
2. Ujian ketebalan kesetaraan plumbum sampel perisai perlindungan sinaran dan PPE,
3. Ujian integriti PPE
4. Pengukuran dos pesakit (diagnostik)
5. Pemonitoran perlindungan sinaran
6. Perkhidmatan rundingan

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Technology Preview & Showcase (TPS) Johor

MAKMAL TEKNOLOGI SINARAN (MTS)

ANALISIS TERMA POLIMER

MTS menawarkan analisis haba yang sangat boleh dipercayai. Menggunakan model suhu yang terkini, data yang jitu dan tepat dapat diperoleh dari ujian seperti Suhu Peralihan Kaca (Tg), Suhu Lebur (Tm), Peralihan Fasa, Pekali Pengembangan Terma Linear (CTE), Haba Tentu dan lain-lain. Kaedah analisis terma juga boleh digunakan untuk membantu mengenal pasti bahan yang tidak diketahui, menjawab soalan tentang struktur kristal, dan membantu dalam penyelidikan dan pembangunan komposit baru.

ANALISIS UJIAN KEGAGALAN POLIMER

MTS membantu menyiasat punca kegagalan supaya tindakan pembetulan dapat dilaksanakan, mengehadkan kerosakan dan mencegah kegagalan produk berulang di masa hadapan. Makmal ujian polimer kami menggunakan kaedah proprietari dan instrumentasi analitikal untuk menjalankan pencirian dan analisis kegagalan polimer termasuk kimia, fizikal, mekanikal, haba dan unsur.

PENCIRIAN BAHAN NANO

MTS berkebolehan mencirikan pelbagai sifat bahan nano seperti saiz zarah, nilai potensi zeta dan morfologinya yang dikaitkan dengan penyelesaian yang berprestasi lebih baik, dengan margin yang lebih tinggi kepada pasaran merentas rangkaian produk termasuk salutan berfungsi, pemangkin, bahan tambahan, dakwat pengalir, terapeutik dan produk antimikrobial.

SERVIS DAN PRODUK

(1)Penyediaan Sampel
- *Internal Mixer*
- *Hot Press*

(2)Ujian Pengenalan Bahan
- *Fourier Transform Infrared (FTIR) with ATR*
- *Electron Spin Resonance (ESR)*

(3)Ujian Terma
- *Thermogravimetric Analysis (TGA)*

(4)Kajian Morfologi Sampel
- *Optical Contact Angle with Topography*
- *BET surface Analyzer*
- *Optical Microscopy*

(5)Ujian Mekanikal
- *Rheology Study*
- *Hardness Test*
- *Dynamic Mechanical Test*
- *Vibrating-Sample Magnetometer*
- *X-Ray Diffraction (XRD)*

(6)Sifat Keterlarutan Cecair
- *Rotational Viscometer*

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PUSAT KHIDMAT BEKALAN RADIOISOTOP (BRI)

Pusat Khidmat Bekalan Radioisotop (BRI) menawarkan 2 jenis kemudahan perkhidmatan:

Makmal Pengeluaran Radioisotop:

1. Menawarkan servis pemprosesan dan pemasangan radioisotop Iridium-192 (Ir-192) menggunakan sel aktif.
2. Ir-192 digunakan bagi mengenalpasti kecacatan paip dalam sektor industri minyak dan gas.

Makmal Khidmat Analisis Farmaseutikal:

1. Analisis LCMS/MS *Triple* ToF
2. Penyaringan Fitokimia
3. Ujian Radikal Bebas
4. Ujian Toksisiti Embrio Ikan (FETT)
5. Ujian Toksisiti Anak Udang (BSLA)
6. Analisis UHPLC
7. Assai Apoptosis
8. Ujian Perembesan Insulin
9. Assai Toksisiti Sel (MTT)
10. Assai Jumlah Fenolik

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Technology Preview & Showcase (TPS) Johor

PUSAT PEMBANGUNAN TEKNOLOGI SISA (WasTeC)

WasTeC adalah Pusat Pengurusan Sisa Radioaktif Kebangsaan yang telah dipertanggungjawabkan oleh kerajaan bagi pengurusan sisa beradioaktif di Malaysia. WasTeC menjalankan khidmat pungutan, penanggalan, pengkondisian, penyimpanan dan pelupusan sisa radioaktif yang diperolehi dari industri pembuatan, hospital, sekolah, institusi pengajian dan makmal-makmal penyelidikan. WasTeC juga menawarkan perkhidmatan dalam bidang pengurusan sisa pepejal perbandaran (MSW).

Khidmat Rundingan dan Lawatan Tapak

Khidmat Pengangkutan Sisa Radioaktif kepada Pelanggan

Khidmat Kutipan Sisa Radioaktif

Khidmat Penanggalan DSRS

Pengukuran Dos Sisa Radioaktif

Pengangkutan DSRS

Penanggalan kepala teleterapi

Senarai khidmat yang ditawarkan di WasTeC adalah:

1. Pelupusan sisa radioaktif jenis pepejal, cecair dan sisa radioaktif jenis punca terkedap terpakai (DSRS)
2. Pelupusan alat penangkap kilat dan alat pengesan asap
3. khidmat pungutan, penanggalan, pengkondisian, pengangkutan, penyimpanan dan pelupusan sisa radioaktif
4. Analisis pencirian sisa pepejal perbandaran mengikut kaedah ASTM (persampelan, analisis proksimat dan penentuan nilai kalori)
5. Analisis tingkah laku pembakaran (combustion characterization) sisa pepejal (termasuk plastik, kertas dan bahan organic)
6. Khidmat perundingan konsep 'Sisa kepada Tenaga' melalui teknologi rawatan terma

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MAKMAL UJIAN BIOLOGI (BIOTEST/ BIODOS)

Makmal Kawalan Mutu Mikrobiologi **(BIOTEST)** menawarkan khidmat ujian bagi memenuhi keperluan pengesahan kualiti ke atas produk untuk kegunaan perubatan seperti produk radiofarmaseutikal dan peranti perubatan.

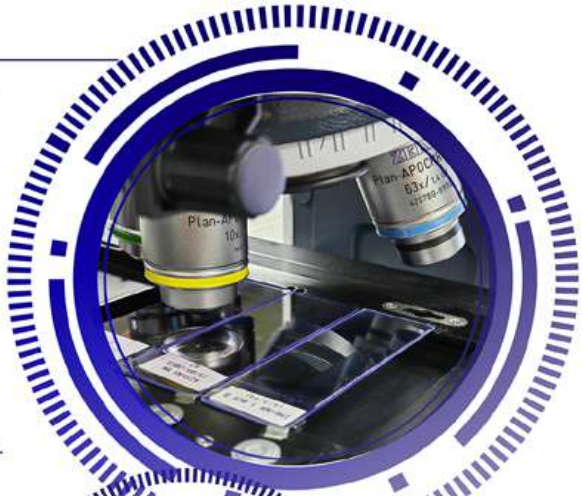
Makmal Biodosimetri **(BIODOS)** menawarkan khidmat ujian aberasi kromosom untuk menganalisa dos dedahan pekerja sinaran di Malaysia.

SENARAI KHIDMAT BIOTEST:

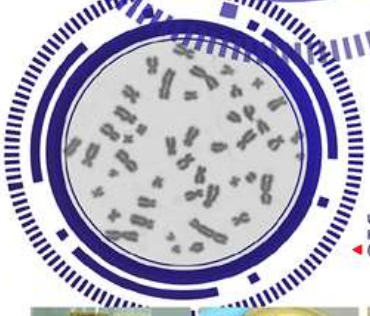
1. Ujian Kesterilan
2. Ujian Biobeban (bakteria atau fungus)
3. Ujian Had Endotoksin Bakteria (Kaedah Pembekuan Gel : Sensitiviti 0.125 IU)
4. Ujian Penggalakan Pertumbuhan
5. Pengeraman dan Pemantauan Sampel Plat Mikrobiologi
6. Pengeraman dan Pemantauan Sampel *Media Fill* dan Kesterilan
7. Validasi Ujian Kesterilan Menggunakan Mikroorganisma
8. Validasi Ujian Had Endotoksin Bakteria (Kaedah Pembekuan Gel : Sensitiviti 0.125 IU)

SENARAI KHIDMAT BIODOS:

1. Ujian Aberasi Kromosom (Teknik Disentrik)
2. Penggunaan Alat Sistem Biodosimetri



▲ Mengimbas sampel dengan perisian *Metafer Metasystem*



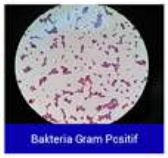
Ujian Aberasi Kromosom (Teknik Disentrik) ◀

Ujian Kesterilan

Ujian Penggalakan Pertumbuhan

Ujian Biobeban (bakteria) kaedah membrane filtration

Ujian Biobeban (fungus) kaedah pour plate



Bakteria Gram Positif

Ujian Had Endotoksin Bakteria

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Technology Preview & Showcase (TPS) Johor

PUSAT KECEMERLANGAN NUKLEAR (CoNE)

Pusat Kecemerlangan Nuklear (CoNE) merupakan sebuah pusat latihan awam kerajaan di bawah Nuklear Malaysia yang bertanggungjawab untuk melaksanakan program latihan dalam bidang teknologi nuklear dan teknologi berkaitan kepada kumpulan profesional, warga industri awam-swasta, belia dan masyarakat. Tujuan meningkatkan kemahiran yang diperlukan, menggalakkan kesedaran keselamatan dan mewujudkan tenaga kerja yang cekap dalam memainkan peranan yang lebih besar dalam agenda pembangunan negara. Program latihan ditawarkan melalui tujuh (7) Sektor Latihan iaitu Keselamatan Sinaran dan Kesihatan, Sinaran Perubatan, Ujian Tanpa Musnah, Keselamatan Persekitaran dan Kesihatan, Sains Nuklear dan Kejuruteraan, Pengurusan Teknologi dan Latihan Antarabangsa.

PENGIKTIRAFAN:

SENARAI KHIDMAT CoNE:

1. Melatih (*facilitate learning*) tenaga kerja dalam bidang berkaitan teknologi nuklear dan teknologi berkaitan melalui Program Latihan Awam, Program Serantau, Program Bersekutu/Kerjasama Latihan, Program Asas Agensi & Konsortia, Sangkutan Penyelidikan dan Program *E-Learning*.
2. Merekabentuk dan membangunkan produk latihan yang memfokuskan kepada keperluan pelanggan dan kehendak pasaran.
3. Menawarkan, mengendali dan menyelaras program latihan, bengkel, seminar, persidangan, simposium dan sebagainya.
4. Menyediakan khidmat profesional dalam aktiviti berkaitan latihan diperingkat tempatan dan luar negara.

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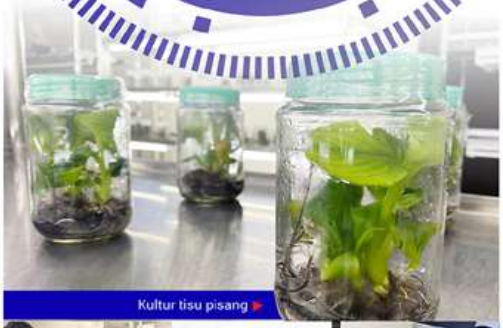
MAKMAL TEKNOLOGI AGRO & BIOSAINS (TAB)

Makmal Teknologi Agro dan Biosains (TAB) adalah satu pusat khidmat di Bahagian Agroteknologi dan Biosains yang menawarkan pelbagai khidmat dalam bidang agroteknologi dan biosains. Dengan kepakaran dan kemudahan yang ada di pusat khidmat ini, pelanggan boleh terus memohon untuk mendapatkan khidmat yang disediakan ataupun hadir untuk perbincangan terlebih dahulu bagi mendapatkan pandangan dan khidmat nasihat daripada pegawai pakar bidang yang terlibat.

Antara khidmat yang diberikan adalah:

1. Analisa pengesanan makanan diiradiasi menggunakan teknik *Photostimulated Luminescence* (PSL) – Kaedah "*screening* PSL".
2. Khidmat Analisis isotop stabil.
3. Khidmat penyinaran menggunakan kebuk gama Biobeam GM8000.
4. Khidmat penyinaran rumah hijau gama (GGH).
5. Khidmat perundingan untuk pengeluaran komersil anak benih kultur tisu tanaman.
6. Kursus dan amali sangkutan (teori dan amali) kultur tisu tanaman (1 bulan).
7. Penyaringan mikrob berfaedah / pengiraan bakteria.
8. Benih kultur pemulaan pisang.
9. Benih kultur tisu pisang.



Kultur tisu pisang

Khidmat perundingan untuk pengeluaran komersil anak benih kultur tisu tanaman

Penyinaran di Gamma Greenhouse (GGH)

Penyaringan mikrob berfaedah/ pengiraan bakteria

Penyinaran sampel menggunakan kebuk gama Biobeam GM8000

Khidmat Analisis isotop stabil

Teknik Photostimulated Luminescence (PSL) – Kaedah "screening PSL"

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Technology Preview & Showcase (TPS) Johor

MAKMAL STANDARD DOSIMETRI SEKUNDER (SSDL)

SSDL ditubuhkan pada tahun 1980 dan bertanggungjawab bagi menyedia, menjaga dan membangunkan standard-standard sinaran mengion di Malaysia untuk keperluan Akta Perlesenan Tenaga Atom 1984 (Akta 304), Peraturan-Peraturan Perlindungan Sinaran (Standard Keselamatan Asas) 1988 (pindaan 2010) yang merangkumi industri, perlindungan dan keselamatan sinaran, perubatan (radioterapi dan brakiterapi), pendidikan dan penyelidikan. SSDL pada tahun 2007 telah dilantik oleh Institut Metrologi Kebangsaan Malaysia (NMIM) sebagai '*designated institute*' untuk pusat rujukan sinaran mengion kebangsaan. SSDL telah diakreditasi MS ISO/IEC 17025 sejak Julai 2004.

Perkhidmatan yang ditawarkan oleh SSDL adalah seperti berikut:

Perkhidmatan Tentukuran:

1. Tentukuran Meter Tinjau dan Dosimeter Aras Perlindungan
2. Tentukuran Kebuk Pengionan Aras Perlindungan dan Aras Terapi
3. Tentukuran Dosimeter Peribadi (Saku & Penggera)

Pembekalan dan Penganalisaan Dosimeter Peribadi dan kawasan:

1. Perkhidmatan TLD
2. Perkhidmatan OSL

Perkhidmatan Dosimetri Aras Tinggi:

1. Perkhidmatan dosimeter Ceric-Cerous
2. Perkhidmatan Dosimeter Fricke
3. Pemetaan dos loji penyinaran gama


Tentukuran Kebuk Pengionan (Aras Terapi)


Tentukuran Meter Tinjau


Tentukuran Kebuk Pengionan (Aras Perlindungan)


Analisa Dosimeter TLD


Analisa Dosimeter OSL


Dosimeter OSL


TLD


Dosimeter Fricke


Dosimeter Cerric Cerrous

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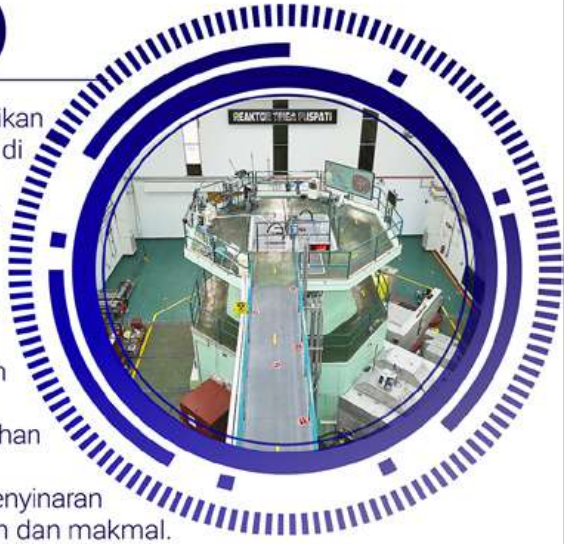
PUSAT TEKNOLOGI REAKTOR (PTR)



Pusat Teknologi Reaktor (PTR) mengendalikan satu-satunya reaktor penyelidikan nuklear di Malaysia, Reaktor TRIGA PUSPATI (RTP) jenis TRIGA Mark II yang telah ditauliahkan pada 28 Jun 1982. Ia mempunyai kuasa nominal 1 MWatt yang direka untuk melaksanakan pelbagai bidang penyelidikan berasaskan sumber neutron, khidmat penyinaran untuk aplikasi nuklear di dalam bidang industri, perubatan, alam sekitar termasuk mengadakan pendidikan dan latihan di dalam teknologi reaktor nuklear. RTP dilengkapi dengan beberapa kemudahanpenyinaran di dalam teras, instrumentasi alur neutron dan makmal. Kemudahan penyinaran sedia ada menawarkan khidmat penyinaran neutron secara tetap dan stabil. RTP dilesenkan mengikut Akta 304 dan dikendalikan oleh Pengendali Reaktor yang bertauliah bagi menjamin keselamatan pada tahap tertinggi.

KEMUDAHAN PENYINARAN DALAM TERAS RTP

1. Jidal Tengah (CT)
2. Rak Berputar (RR)
3. Tiub Kering (DT)
4. Sistem Pemindahan Pneumatik (PTS)

KEMUDAHAN PENYINARAN INSTRUMENTASI ALUR NEUTRON

1. Radiografi Neutron (NUR)
2. Difraktometer Neutron (ND)
3. Penyerakan Neutron Bersudut Kecil (SANS)

KEMUDAHAN MAKMAL

1. Makmal Fizik Neutron
2. Makmal Simulasi Reaktor TRIGA
3. Makmal Simulasi Reaktor Nuklear Berasaskan Komputer


Penyediaan Sampel


Kendalian RTP oleh Pengendali Reaktor Bertauliah


Pengendalian Sampel


Makmal Fizik Neutron


Makmal Simulasi Reaktor TRIGA


Makmal Simulasi Reaktor Nuklear Berasaskan Komputer

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Technology Preview & Showcase (TPS) Johor

LOJI RAYMINTEX

Loji RAYMINTEX merupakan sebuah kemudahan perintis untuk tujuan penyediaan lateks getah asli pra-pemvulkanan dengan sinaran (RVNRL) melalui penggunaan sinaran gama. Ia merupakan sebuah kemudahan semi automatik yang mampu menghasilkan sehingga 6000 tan RVNRL setahun, dengan menggunakan punca sinaran kobalt-60 sehingga 1 MCi. RVNRL ini dapat memenuhi keperluan sektor pembuatan produk celupan lateks dan industri berkaitan secara berkesan sambil menggalakkan promosi dan pemindahan teknologi RVNRL.

Lateks getah asli perlu divulkan sebelum diapplikasi dalam industri. RVNRL yang dihasilkan di Loji RAYMINTEX merupakan lateks tervulkan dengan sinaran gama yang mempunyai sifat fizikal dan mekanikal untuk memenuhi keperluan/ spesifikasi pelbagai produk celupan lateks seperti sarung tangan, belon, sarung jari, puting bayi, pelapik gigi dan lain-lain.

Loji RAYMINTEX telah membangun dan melaksanakan sistem pengurusan kualiti ISO 9001 dan diperakui oleh badan pensijilan LRQA pada tahun 2003.

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Technology Preview & Showcase (TPS) Johor

PUSAT PEMBANGUNAN LOJI & PROTOTAIP/ PUSAT INSTRUMENTASI & AUTOMASI (PDC/PIA)

PDC/PIA menjalankan penyelidikan dan pembangunan kejuruteraan berkaitan teknologi nuklear dan teknologi berkaitan termasuk instrumentasi dan automasi serta memberikan perundingan kejuruteraan dan perkhidmatan sokongan teknikal.

PDC/PIA menawarkan perkhidmatan rekabentuk dan pembuatan dalam membangunkan penggunaan teknologi nuklear. Selain itu, PDC/PIA juga menawarkan perkhidmatan pembangunan prototaip dan sistem automasi serta latihan penyenggaraan instrumentasi nuklear.

PERKHIDMATAN PDC/PIA:

1. Rekabentuk pintu plumbum dan perisai sinaran
2. Rekabentuk bilik penyinaran
3. Pembuatan kaca makmal
4. Rekabentuk prototaip dan komponen
5. Pemesinan bahan logam dan plastik
6. Peleburan plumbum menggunakan relau
7. Sel Aktif Mudah Alih
8. Peleraian peralatan/mesin penyinaran bagi tujuan pelupusan
9. Latihan penyenggaraan instrumentasi nuklear

N.U.R

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BAHAGIAN PENGURUSAN MAKLUMAT (BPM)

Salah satu daripada aktiviti Bahagian Pengurusan Maklumat (BPM) ialah perlaksanaan Program Jangkauan Luar Pendidikan Nuklear (*Nuclear Education Outreach*-NEO).

Bermula 1980an Agensi Nuklear Malaysia (Nuklear Malaysia) mengorak langkah dalam melaksanakan Program Jangkauan Luar Pendidikan Nuklear (*Nuclear Education Outreach*-NEO). Berpaksikan kepada peranan dan tanggungjawab untuk menyalurkan maklumat, memberi pendedahan dan mendidik masyarakat terhadap kepentingan dan sumbangan bidang sains dan teknologi nuklear kepada kemajuan negara.

Untuk kekal relevan dan kompetetif dalam bidang ini, Nuklear Malaysia cakna akan trend semasa dan sentiasa kreatif dan inovatif dalam usaha menyediakan pelbagai pengisian program NEO kepada pelbagai lapisan masyarat. Di samping itu, turut memberi penekanan kepada aspek kemahiran pendidikan STEM terhadap topik berkaitan sains dan teknologi nuklear dalam setiap aktiviti yang dilaksanakan.

Kerjasama Kebangsaan dan Antarabangsa

Antara format yang kebiasaannya digunapakai dalam perlaksanaan program NEO ini pula adalah seperti aktiviti hands-on, lawatan fasiliti, eksperimen dan aktiviti di dalam makmal di Nuklear Malaysia serta sesi perkongsian pengalaman oleh mereka yang terlibat secara langsung dalam dunia penyelidikan sains dan teknologi nuklear.

Keberhasilan yang diharapkan oleh Nuklear Malaysia melalui penekanan kepada program NEO ialah masyarakat yang boleh berfikir secara logik, memahami dan menerima manfaat sains dan teknologi nuklear di samping menyumbang kepada pembangunan sumber tenaga kerja yang kompetitif bagi memacu kemajuan ekonomi negara.

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Minggu Sains Negara (MSN)

01-30 Jun 2024

Minggu Sains Negara (MSN)

Minggu Sains Negara (MSN)

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Technology Preview & Showcase (TPS) Kedah

13-14 Jun 2024

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PUSAT KHIDMAT KUMPULAN TEKNOLOGI BAHAN (MTEG)

MTEG menjalankan aktiviti R&D&I&C dalam bidang seramik, metalurgi, perlindungan kakisan, bahan nano, biomaterial, pelindung radiasi, kerosakan radiasi, bahan elektronik, mineral, sensor, pemeliharaan warisan, pemprosesan mineral, instrumen nuklear serta pemodelan dan simulasi.

MTEG memperoleh kepercayaan yang baik dan pendekatan inovatif dalam melakukan pelbagai pencirian dan ujian terhadap sifat mekanikal, struktur mikro, morfologi, terma, fizikal dan kimia bahan dalam pelbagai keadaan. MTEG bukan sahaja mampu bertindak sebagai penyelesai masalah teknikal pelanggan dalam sains dan kejuruteraan bahan, malah ia juga merupakan pusat perkhidmatan sehenti yang menyediakan perkhidmatan pencirian bahan yang penting untuk kajian bahan, pembangunan dan pengkomersialan produk.

Senarai peralatan yang digunakan di MTEG dalam khidmat pencirian bahan:

1. Pendaflor Sinar-X (XRF)
2. Serakan Sinar-X Sudut Kecil (SAXS)
3. Spektrometer Pembelauan Sinar-X (XRD)
4. Mikroskop Elektron Imbasan Pancaran Medan (FESEM)
5. Spektrometer Sinar-X Serakan Tenaga (EDX)
6. Mikroskop Daya Atom (AFM)
7. Spektrometer RAMAN
8. Spektrofotometer Ultralembayung/ Nampak (UV-Vis)
9. Spektroskopi Spektrum Cahaya (Photoluminescence/PL)
10. Penganalsisa kakisan
11. Penganalisis Terma Serentak (STA)
12. Penganalisis Saiz Zarah (PSA)
13. Universal Testing Machines (UTM)

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KUMPULAN TEKNOLOGI UJIAN TANPA MUSNAH TERMAJU (LENDT)

Kumpulan Teknologi LENDT menawarkan khidmat dan kemudahan Ujian Tanpa Musnah (NDT) Termaju untuk menilai integriti dan kualiti bahan, komponen atau struktur. Antara teknologi yang digunakan ialah *Radiographic Testing - Digital* (RT-D), *Phased Array Ultrasonic Testing* (PAUT) dan *Infrared Thermography Testing* (IRT).

Terdapat 3 makmal utama di LENDT, Agensi Nuklear Malaysia iaitu:

1. ***Radiographic Testing- Digital* (RT-D)**
2. ***Phased Array Ultrasonic Testing* (PAUT)**
3. ***Infrared Thermography Testing* (IRT)**

Kumpulan Teknologi LENDT menyediakan khidmat sokongan teknikal dan kepakaran berkaitan Ujian Tanpa Musnah Termaju kepada sektor industri dalam bidang *Radiographic Testing - Digital* (RT-D) dan *Phased Array Ultrasonic Testing* (PAUT) dan *Infrared Thermography Testing* (IRT). Kumpulan Teknologi LENDT juga menawarkan penilaian keselamatan, khidmat nasihat, kursus, latihan dan perkhidmatan dalam Ujian Tanpa Musnah Termaju.

Kumpulan Teknologi LENDT telah dlantik sebagai pusat kerjasama untuk penyelidikan, latihan dan pembangunan dalam Ujian Tanpa Musnah Termaju oleh International *Atomic Energy Agency* (IAEA).

Perkhidmatan LENDT:

1. Khidmat nasihat melaksanakan ujian radiografi (filem dan digital).
2. Pembangunan prosedur NDT untuk ujian radiografi (filem dan digital) dan PAUT berasaskan keperluan kod, piawaian, atau spesifikasi.
3. Pemeriksaan paip atau objek datar (plat) yang disambung melalui proses sekunder (kimpalan atau pateri).
4. Pengukuran baki ketebalan dinding paip atau lain-lain spesimen.
5. Latihan dan kursus untuk melaksanakan ujian PAUT dan radiografi digital (ISO 9712).

6. Pemeriksaan bangunan (keutuhan dinding, kebocoran bumbung dan lain-lain).
7. Pemeriksaan sistem pemasangan elektrik (MCB, LV cable, transformer).

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MAKMAL RADIOKIMIA DAN ALAM SEKITAR (RAS)

Makmal Radiokimia dan Alam Sekitar (RAS) menyediakan perkhidmatan radioanalisis untuk keperluan agensi kerajaan dan swasta. Makmal RAS mengamalkan QA/QC dan mempunyai prosedur pengurusannya sendiri yang mana makmal ini telah diakreditasi dengan MS ISO/IEC 17025: 2017 sejak Disember 2005 oleh Jabatan Standard Malaysia bagi skop analisis keradioaktifan gama.

Makmal RAS merupakan makmal kebangsaan yang diluluskan dan diiktiraf oleh Kementerian Kesihatan Malaysia (KKM) untuk melakukan analisis pengukuran keradioaktifan dalam sampel makanan untuk tujuan eksport dan air mineral serta air minuman berbungkus sebagai sebahagian daripada syarat perlesenan KKM.

Senarai Khidmat:

1. Pengukuran pemancar gama dalam sampel makanan
2. Pengukuran pemancar gama dalam sampel alam sekitar/industri
3. Pengukuran Am-241 dalam pengesan asap
4. Pengukuran gross alfa/beta dalam pelbagai sampel
5. Pengukuran gross alfa/beta dalam *air borne/ particulate*', penapis dan '*smear test*'
6. Pengukuran Po-210/Pb-210 dalam pelbagai sampel
7. Pengukuran U-234, U-235 dan U-238 dalam pelbagai sampel
8. Pengukuran Th-228, Th-230 dan Th-232 dalam pelbagai sampel
9. Pengukuran Pu-239+240 dalam pelbagai sampel
10. Pengukuran H-3 dalam air/ais
11. Pengukuran Sr-90 dalam pelbagai sampel

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KUMPULAN APLIKASI PENYURIH ALAM SEKITAR (E-TAG)

Pusat khidmat e-TAG (*Environmental Tracer Application Group*) menyediakan khidmat penyelidikan yang merangkumi penggunaan teknologi nuklear serta disokong oleh teknik konvensional berkaitan. Penggunaan teknik/aplikasi penyurih yang disediakan oleh kumpulan ini untuk kajian pengurusan air adalah satu-satunya yang terdapat di Malaysia. Penggunaan teknik penyurih dan juga teknik isotop stabil dalam kajian alam sekitar membantu dalam pengurusan serta pencirian sumber air tanah dan juga permukaan. Penggunaan teknik ini juga telah membantu meningkatkan pengurusan sumber air di banyak negara di seluruh dunia. Penggunaan bersama teknik penyurih dan teknik konvensional seperti Geofizik digunakan dalam kajian penyelidikan seperti eksplorasi tapak, hidrologi, Kajian *'fingerprinting'*, pengukuran aliran dan arah air tanah/permukaan, sedimentologi, pencemaran air tanah dan sebagainya. Bagi khidmat Geofizik, pusat khidmat ini mempunyai pakar dalam bidang geologi bertauliah yang di iktiraf oleh *Board of Geology* Malaysia.

Makmal utama yang menyediakan perkhidmatan adalah WDXRF (*Wavelength Dispersive X-ray Fluorescence*) serta *Liquid Water Isotope Analyser* (LWIA).

Senarai Khidmat Penyelidikan yang ditawarkan:

1. Kajian *'fingerprinting'* menggunakan teknik penyurih
2. Kajian alam sekitar menggunakan teknik Geofizik:
   - *i.* ***Electrical Resistivity Imaging*** – khidmat penyiasatan geologi sub-permukaan, potensi serta pencemaran air tanah, penyiasatan awal penerokaan tanah/ empangan
   - *ii.* ***Seismik*** - kaedah penerokaan geofizik menggunakan prinsip seismologi untuk menganggarkan sifat-sifat bawah permukaan bumi daripada gelombang seismik yang dipantulkan
3. Pengukuran aliran dan arah air tanah/ permukaan (kadar aliran & halaju)
4. Kajian resapan/kebocoran
5. Kajian punca bahan cemar di sekitaran
6. Analisis isotop stabil 2H, 17O & 18O (cecair)
7. Penentuan elemen yang terkandung dalam unsur (cecair @ pepejal)

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LOJI MINTec - SINAGAMA

Loji Penyinaran MINTec-Sinagama menggunakan tenaga pengion dalam bentuk sinaran gamma dari sumber Kobalt-60. Loji penyinaran ini beroperasi dengan kemudahan iradiasi JS10000 (IR-219) yang mampu menyinari pelbagai produk yang memerlukan dos yang berbeza secara serentak.

Merupakan loji penyinaran gamma yang beroperasi pada skala komersial bagi pensterilan atau dekontaminasi peranti perubatan, makanan, rempah ratus, herba dan buah-buahan. Penggunaan sinaran gamma ini akan meningkatkan kualiti mikrobiologi produk-produk berkenaan yang secara langsung akan meningkatkan keselamatan produk serta meningkatkan jangka hayat produk.

MINTec-Sinagama juga menyediakan perkhidmatan pensterilan tisu dan tulang melalui penyinaran gamma untuk tujuan perbankan tisu kepada pihak berkuasa yang berkaitan seperti hospital dan Bank Tisu Negara serta pembasmian serangga dalam komoditi pertanian, termasuk untuk tujuan kuarantin.

Perkhidmatan Penyinaran SINAGAMA:

1. Pensterilan Peranti Perubatan, Bahan Pembungkusan dan Makmal
2. Pensterilan Produk Farmaseutikal
3. Produk Veterinar
4. Makanan, Herba dan Rempah
5. Produk kosmetik
6. Sampel untuk tujuan R&D

Pengiktirafan:

1. ISO 9001
2. ISO 13485
3. Lesen Premis Iradiasi Makanan

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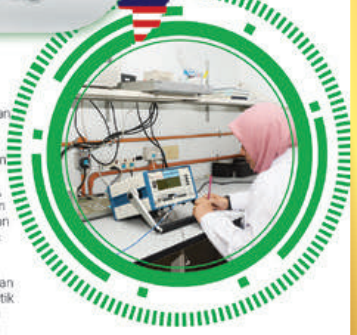
MAKMAL FIZIK PERUBATAN (MPL)

Berpengalaman lebih daripada 20 tahun, Agensi Nuklear Malaysia merupakan salah satu pemegang Lesen Juruperunding Kelas H di bawah Akta Perlesenan Tenaga Atom 1984 (Akta 304) bagi maksud Perubatan dari Kementerian Kesihatan Malaysia (KKM) dimana MPL telah dipertanggungjawabkan memberi perkhidmatan untuk tujuan perundingan bagi aktiviti pengujian dan pengesahan (ujian kawalan mutu) radas penyinaran perubatan serta kemudahan berkaitan, pengujian dan pengesahan penentuan ketebalan plumbum bagi perisaian bilik X-ray perubatan dan bilik-bilik berkaitan serta pengujian kemudahan berkaitan dose calibrator perubatan nuklear di seluruh Malaysia. MPL juga merupakan satu-satunya makmal standard tentukuran radas ujian kawalan mutu (QC *test tools*) radiologi diagnostik di Malaysia dan Asia Tenggara yang mematuhi piawaian MS ISO/IEC 17025 dan diakreditasi oleh Skim Akreditasi Makmal Malaysia (SAMM) semenjak tahun 2013. Selain itu, MPL juga ada menawarkan perkhidmatan ujian ketebalan kesetaraan plumbum sampel perisai perlindungan sinaran, ujian intergriti PPE, ujian serakan sinaran, tentukuran pembilang tiroid. Perkhidmatan yang ditawarkan MPL adalah seperti berikut:



Perkhidmatan ujian kawalan mutu (QC) radas x-ray diagnostik perubatan dan kemudahan berkaitan

1. Pengujian dan pengesahan dibawah skop lesen kelas H yang merangkumi modaliti x-ray seperti x-ray am, Pergigian, Angiografi, densitometer tulang, C-Arm, Fluoroskopi, Mamografi dan Pengimbas CT.
2. Pemeriksaan bilik gelap.
3. Ujian integriti peralatan perlindungan diri (PPE) x-ray perubatan.
4. Ujian serakan radiasi.

Perkhidmatan tentukuran *dose calibrator* perubatan nuklear

1. Pengujian dan pengesahan dose calibrator perubatan nuklear dibawah skop lesen kelas H KKM.
2. Perkhidmatan tentukuran pembilang tiroid.

Perkhidmatan tentukuran peralatan ujian kawalan mutu (QC *test tools*) radiologi diagnostik

1. Tentukuran dosemeters dalam radiologi diagnostik untuk kualiti x-ray RQR, RQA dan RQT yang mematuhi Standard IEC 61267 dan TRS 457 serta telah diiktiraf mengikut piawaian ISO / IEC 17025 oleh SAMM.
2. Tentukuran kualiti mammografi Mo/Mo.
3. Tentukuran meter kVp dan pemasa (*timer*).
4. Tentukuran densitometer dan sensitometer.

Perkhidmatan perlindungan sinaran

1. Ujian ketebalan kesetaraan plumbum (LET) bagi perisaian bilik x-ray perubatan dan bilik-bilik berkaitan dibawah skop lesen kelas H KKM.
2. Ujian ketebalan kesetaraan plumbum sampel perisai perlindungan sinaran dan PPE.
3. Ujian integriti PPE.
4. Pengukuran dos pesakit (diagnostik).
5. Pemonitoran perlindungan sinaran.
6. Perkhidmatan rundingan.

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MAKMAL TEKNOLOGI SINARAN (MTS)

ANALISIS TERMA POLIMER

Makmal Teknologi Sinaran (MTS) merupakan makmal yang menawarkan kaedah analisia yang boleh dipercayai bagi pencirian bahan dan getah kepada pengguna akademik dan industri. Makmal ini dilengkapi dengan peralatan termoden bagi kerja-kerja pencirian bahan termasuk kajian sifat terma, sifat kimia, sifat fizik dan sifat mekanik. Makmal ini juga menawarkan perkhidmatan rundingan bagi penyediaan sampel penyelidikan berasaskan adunan polimer, sintesis produk baharu, penyediaan bahan nano dan demonstrasi kaedah penggunaan sinaran bagi tujuan modifikasi bahan.

Khidmat yang ditawarkan:

1. **Khidmat sewaan alat bagi penyediaan sampel berasaskan polimer**
   - Mesin Pengadun/ Pemampat/ Penyemperit/ Pengacuan/ Tangki Pencampur biopolimer/ Reaktor sintesis resin
2. **Khidmat Pencirian Sifat Kimia Bahan**
   - Spektroskopi Infra-Merah Transformasi Fourier (FTIR)/ Resonan Putaran Elektron (ESR)
3. **Khidmat Pencirian Sifat Terma Bahan**
   - Analisa Termogravimetri (TGA) / Analisa Kalorimetri Pengimbas Perbezaan (DSC)
4. **Khidmat Pencirian Sifat Fizikal dan Mekanikal Bahan**
   - Analisa Reologi/ Kelikatan/ Daya lebur/ Kekerasan Bahan/ Regangan/ Mampatan/ Lenturan/ Hentaman/ Mekanik-Dinamik/ Medan Magnet Bergetar (VSM)/ Pembelauan Sinar-X (XRD)
5. **Khidmat Pencirian Morfologi dan Permukaan Sampel Bahan**
   - Analisa Sudut Sesentuh Optikal/ Keporosan Permukaan/ Mikroskopi Daya Atom (AFM)
6. **Khidmat Pencirian Sifat Keterlarutan Cecair**
   - Analisa Berat Molekul Polimer (GPC-MALLS)/ Daya keupayaan zeta/ Taburan saiz partikel
7. **Khidmat Analisa Kegagalan Bahan (Polimer/Getah)**
8. **Khidmat Rundingan bagi Teknik Penghasilan Polimer dan Teknik Penghasilan Bahan menggunakan Sinaran**

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PUSAT KECEMERLANGAN NUKLEAR (CoNE)

Pusat Kecemerlangan Nuklear (CoNE) merupakan sebuah pusat latihan awam kerajaan di bawah Nuklear Malaysia yang bertanggungjawab untuk melaksanakan program latihan dalam bidang teknologi nuklear dan teknologi berkaitan kepada kumpulan profesional, warga industri awam-swasta, belia dan masyarakat. Tujuan meningkatkan kemahiran yang diperlukan, menggalakkan kesedaran keselamatan dan mewujudkan tenaga kerja yang cekap dalam memainkan peranan yang lebih besar dalam agenda pembangunan negara. Program latihan ditawarkan melalui tujuh (7) Sektor Latihan iaitu Keselamatan Sinaran dan Kesihatan, Sinaran Perubatan, Ujian Tanpa Musnah, Keselamatan Persekitaran dan Kesihatan, Sains Nuklear dan Kejuruteraan, Pengurusan Teknologi dan Latihan Antarabangsa.

SENARAI KHIDMAT CoNE:

1. Melatih (*facilitate learning*) tenaga kerja dalam bidang berkaitan teknologi nuklear dan teknologi berkaitan melalui Program Latihan Awam, Program Serantau, Program Bersekutu/Kerjasama Latihan, Program Asas Agensi & Konsortia, Sangkutan Penyelidikan dan Program *E-Learning*.
2. Merekabentuk dan membangunkan produk latihan yang memfokuskan kepada keperluan pelanggan dan kehendak pasaran.
3. Menawarkan, mengendali dan menyelaras program latihan, bengkel, seminar, persidangan, simposium dan sebagainya.
4. Menyediakan khidmat profesional dalam aktiviti berkaitan latihan diperingkat tempatan dan luar negara.

PENGIKTIRAFAN:

Technology Preview & Showcase (TPS) Kedah

MAKMAL STANDARD DOSIMETRI SEKUNDER (SSDL)

SSDL ditubuhkan pada tahun 1980 dan bertanggungjawab bagi menyedia, menjaga dan membangunkan standard-standard sinaran mengion di Malaysia untuk keperluan Akta Perlesenan Tenaga Atom 1984 (Akta 304), Peraturan-Peraturan Perlindungan Sinaran (Standard Keselamatan Asas) 1988 (pindaan 2010) yang merangkumi industri, perlindungan dan keselamatan sinaran, perubatan (radioterapi dan brakiterapi), pendidikan dan penyelidikan. SSDL pada tahun 2007 telah dilantik oleh Institut Metrologi Kebangsaan Malaysia (NMIM) sebagai '*designated institute*' untuk pusat rujukan sinaran mengion kebangsaan. SSDL telah diakreditasi MS ISO/IEC 17025 sejak Julai 2004.

Perkhidmatan yang ditawarkan oleh SSDL adalah seperti berikut:

Perkhidmatan Tentukuran:

1. Tentukuran Meter Tinjau dan Dosimeter Aras Perlindungan
2. Tentukuran Kebuk Pengionan Aras Perlindungan dan Aras Terapi
3. Tentukuran Dosimeter Peribadi (Saku & Penggera)

Pembekalan dan Penganalisaan Dosimeter Peribadi dan kawasan:

1. Perkhidmatan TLD
2. Perkhidmatan OSL

Perkhidmatan Dosimetri Aras Tinggi:

1. Perkhidmatan dosimeter Ceric-Cerous
2. Perkhidmatan Dosimeter Fricke
3. Pemetaan dos loji penyinaran gama

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Technology Preview & Showcase (TPS) Kedah

MAKMAL APLIKASI KIMIA ANALISIS (ACA)

Seiring dengan Pelan Strategik BAS 2017-2030, iaitu "**Menyediakan Perkhidmatan Analisis Kimia yang Cemerlang, Cekap, serta Berkualiti kepada Pelanggan Dalam dan Luar Agensi Nuklear Malaysia**", makmal ACA dilengkapi dengan kemudahan instrumentasi analisis dan berkeupayaan dalam menyediakan perkhidmatan analisis unsur untuk pelbagai jenis sampel (alam sekitar, produk, makanan dll) kepada sektor awam dan swasta. Makmal ACA juga turut menyediakan kemudahan latihan dan panduan kepada pelajar universiti dalam mengendalikan peralatan analisis. Makmal ini mengaplikasikan kawalan kualiti dan amalan jaminan kualiti yang baik bagi memberikan output berkualiti tinggi dan ianya memenuhi piawaian antarabangsa.

Perkhidmatan analisis sampel yang ditawarkan oleh makmal ACA adalah seperti berikut:

1. **ANALISIS PENGAKTIFAN NEUTRON (APN)**
   Merupakan analisis teknik nuklear dan dikategorikan sebagai ujian tanpa musnah, APN mampu mengesan dan mengukur lebih 30 unsur termasuk logam nadir bumi

2. **ANALISIS SPEKTROMETRI JISIM PLASMA GANDINGAN ARUHAN (ICP-MS)**
   Teknik ICP-MS boleh mengesan dan mengukur pelbagai unsur logam berat dan unsur surih dalam pelbagai jenis sampel pelanggan dalam kepekatan yang rendah (ppb)

3. **ANALISIS SPEKTROMETRI PENYERAPAN ATOM (AAS)**
   Teknik AAS boleh mengesan dan mengukur pelbagai unsur logam berat seperti Al, Ca, Cu, Fe, Mg, Na, Pb dan Zn dalam kepekatan yang tinggi (ppm)

4. **ANALISIS PENGUKUR UNSUR CHNS**
   CHNS mampu menentukan unsur karbon, hidrogen, nitrogen dan sulfur daripada pelbagai jenis sampel seperti tanah, tumbuh-tumbuhan, arang batu dan minyak

5. **ANALISIS ION KROMATOGRAFI (IC)**
   Teknik IC membolehkan penentuan spesies ion (anion dan kation) bukan organik dan organik, dalam kepekatan sekitar 0.50 ppm

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Technology Preview & Showcase (TPS) Kedah

PUSAT TEKNOLOGI REAKTOR (PTR)

Pusat Teknologi Reaktor (PTR) mengendalikan satu-satunya reaktor penyelidikan nuklear di Malaysia, Reaktor TRIGA PUSPATI (RTP) jenis TRIGA Mark II yang telah ditauliahkan pada 28 Jun 1982. Ia mempunyai kuasa nominal 1 MWatt yang direka untuk melaksanakan pelbagai bidang penyelidikan berasaskan sumber neutron, khidmat penyinaran untuk aplikasi nuklear di dalam bidang industri, perubatan, alam sekitar termasuk mengadakan pendidikan dan latihan di dalam teknologi reaktor nuklear. RTP dilengkapi dengan beberapa kemudahanpenyinaran di dalam teras, instrumentasi alur neutron dan makmal.

Kemudahan penyinaran sedia ada menawarkan khidmat penyinaran neutron secara tetap dan stabil. RTP dilesenkan mengikut Akta 304 dan dikendalikan oleh Pengendali Reaktor yang bertauliah bagi menjamin keselamatan pada tahap tertinggi.

KEMUDAHAN PENYINARAN DALAM TERAS RTP

1. Jidal Tengah (CT)
2. Rak Berputar (RR)
3. Tiub Kering (DT)
4. Sistem Pemindahan Pneumatik (PTS)

KEMUDAHAN PENYINARAN INSTRUMENTASI ALUR NEUTRON

1. Radiografi Neutron (NUR)
2. Difraktometer Neutron (ND)
3. Penyerakan Neutron Bersudut Kecil (SANS)

KEMUDAHAN MAKMAL

1. Makmal Fizik Neutron
2. Makmal Simulasi Reaktor TRIGA
3. Makmal Simulasi Reaktor Nuklear Berasaskan Komputer

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N.U.R

Technology Preview & Showcase (TPS) Kedah

LOJI RAYMINTEX

Loji RAYMINTEX merupakan sebuah kemudahan perintis untuk tujuan penyediaan lateks getah asli pra-pemvulkanan dengan sinaran (RVNRL) melalui penggunaan sinaran gama. Ia merupakan sebuah kemudahan semi automatik yang mampu menghasilkan sehingga 6000 tan RVNRL setahun, dengan menggunakan punca sinaran kobalt-60 sehingga 1 MCi. RVNRL ini dapat memenuhi keperluan sektor pembuatan produk celupan lateks dan industri berkaitan secara berkesan sambil menggalakkan promosi dan pemindahan teknologi RVNRL.

Lateks getah asli perlu divulkan sebelum diapplikasi dalam industri. RVNRL yang dihasilkan di Loji RAYMINTEX merupakan lateks tervulkan dengan sinaran gama yang mempunyai sifat fizikal dan mekanikal untuk memenuhi keperluan/ spesifikasi pelbagai produk celupan lateks seperti sarung tangan, belon, sarung jari, puting bayi, pelapik gigi dan lain-lain.

Loji RAYMINTEX telah membangun dan melaksanakan sistem pengurusan kualiti ISO 9001 dan diperakui oleh badan pensijilan LRQA pada tahun 2003.

Technology Preview & Showcase (TPS) Kedah

PUSAT PEMBANGUNAN LOJI & PROTOTAIP/ PUSAT INSTRUMENTASI & AUTOMASI (PDC/PIA)

PDC/PIA menjalankan penyelidikan dan pembangunan kejuruteraan berkaitan teknologi nuklear dan teknologi berkaitan termasuk instrumentasi dan automasi serta memberikan perundingan kejuruteraan dan perkhidmatan sokongan teknikal.

PDC/PIA menawarkan perkhidmatan rekabentuk dan pembuatan dalam membangunkan penggunaan teknologi nuklear. Selain itu, PDC/PIA juga menawarkan perkhidmatan pembangunan prototaip dan sistem automasi serta latihan penyenggaraan instrumentasi nuklear.

PERKHIDMATAN PDC/PIA:

1. Rekabentuk pintu plumbum dan perisai sinaran
2. Rekabentuk bilik penyinaran
3. Pembuatan kaca makmal
4. Rekabentuk prototaip dan komponen
5. Pemesinan bahan logam dan plastik
6. Peleburan plumbum menggunakan relau
7. Sel Aktif Mudah Alih
8. Peleraian peralatan/mesin penyinaran bagi tujuan pelupusan
9. Latihan penyenggaraan instrumentasi nuklear

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Bangi, 43000 Kajang,
Selangor Darul Ehsan, Malaysia

N.U.R

Technology Preview & Showcase (TPS) Kedah

BAHAGIAN PENGURUSAN MAKLUMAT (BPM)

Salah satu daripada aktiviti Bahagian Pengurusan Maklumat (BPM) ialah perlaksanaan Program Jangkauan Luar Pendidikan Nuklear (*Nuclear Education Outreach-NEO*.

Bermula 1980an Agensi Nuklear Malaysia (Nuklear Malaysia) mengorak langkah dalam melaksanakan Program Jangkauan Luar Pendidikan Nuklear (*Nuclear Education Outreach*-NEO). Berpaksikan kepada peranan dan tanggungjawab untuk menyalurkan maklumat, memberi pendedahan dan mendidik masyarakat terhadap kepentingan dan sumbangan bidang sains dan teknologi nuklear kepada kemajuan negara.

Untuk kekal relevan dan kompetetif dalam bidang ini, Nuklear Malaysia cakna akan trend semasa dan sentiasa kreatif dan inovatif dalam usaha menyediakan pelbagai pengisian program NEO kepada pelbagai lapisan masyarat. Di samping itu, turut memberi penekanan kepada aspek kemahiran pendidikan STEM terhadap topik berkaitan sains dan teknologi nuklear dalam setiap aktiviti yang dilaksanakan.

Kerjasama Kebangsaan dan Antarabangsa

Antara format yang kebiasaannya digunapakai dalam perlaksanaan program NEO ini pula adalah seperti aktiviti *hands-on*, lawatan fasiliti, eksperimen dan aktiviti di dalam makmal di Nuklear Malaysia serta sesi perkongsian pengalaman oleh mereka yang terlibat secara langsung dalam dunia penyelidikan sains dan teknologi nuklear.

Keberhasilan yang diharapkan oleh Nuklear Malaysia melalui penekanan kepada program NEO ialah masyarakat yang boleh berfikir secara logik, memahami dan menerima manfaat sains dan teknologi nuklear di samping menyumbang kepada pembangunan sumber tenaga kerja yang kompetitif bagi memacu kemajuan ekonomi negara.

KETUA PENGARAH
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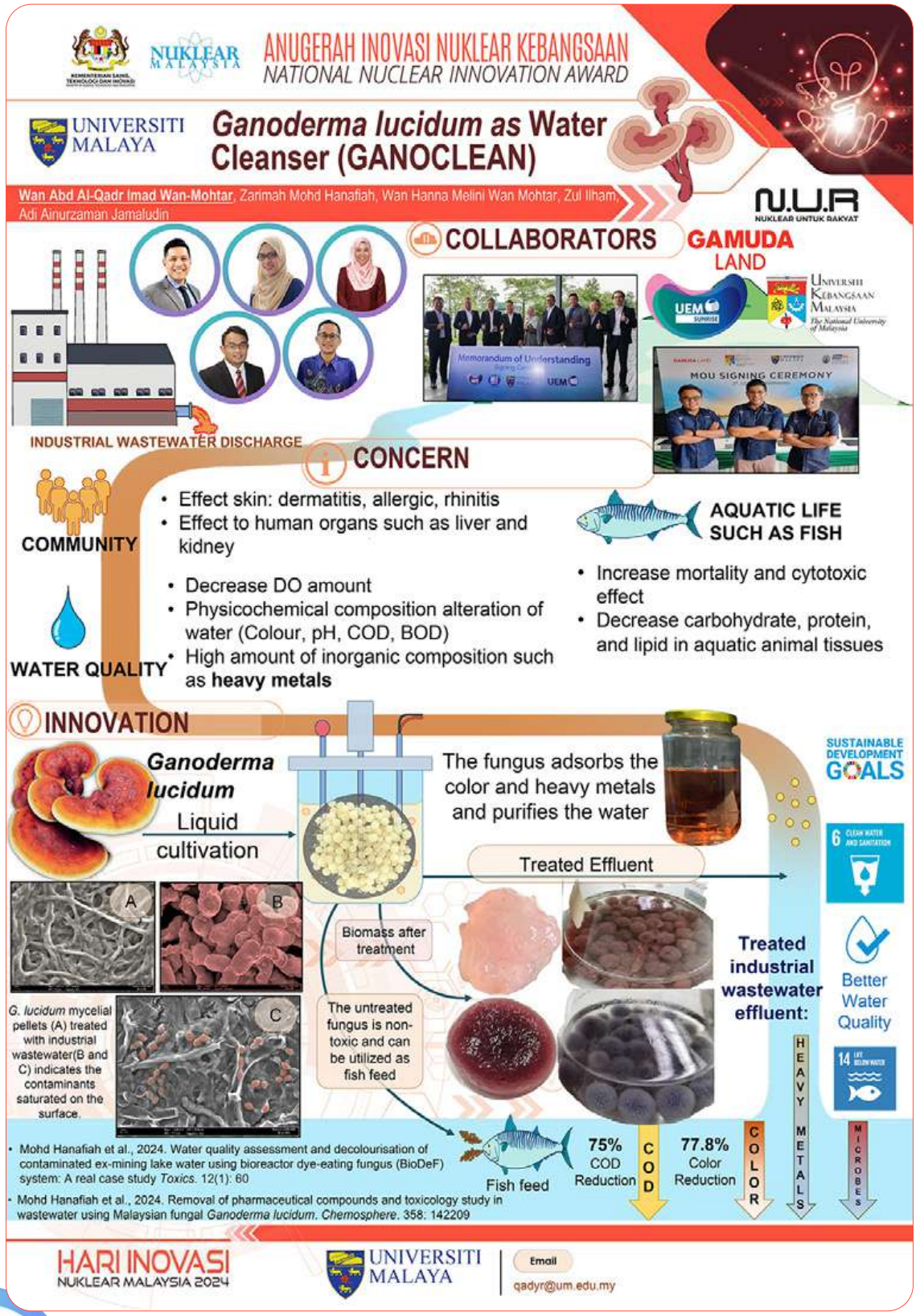
Bangi, 43000 Kajang,
Selangor Darul Ehsan, Malaysia

Halibah binti Adnan
Pengarah BPM

Hari Inovasi Agensi Nuklear Malaysia

26-27 Ogos 2024

Hari Inovasi Agensi Nuklear Malaysia



ANUGERAH INOVASI NUKLEAR KEBANGSAAN
NATIONAL NUCLEAR INNOVATION AWARD

EcoShield Flex: Revolutionary Lead-free Radiation Shielding Rubber Composites

S. Y. Tang, A. W. C. Tan, S. K. Ong, F. A. M. Yusof, B. H. Goh, J. Supramaniam, N. Ismail, D. Y. S. Low, S. W. How

INTRODUCTION

- Lead (Pb), the conventional radiation shielding material against x- and γ-ray, is toxic, rigid and dense
- This project seeks to create a silicone rubber/ natural rubber (SR/NR) composite with tungsten oxide, (WO_3) fillers as a potential non-toxic, flexible and low-density alternative to lead for radiation shielding application

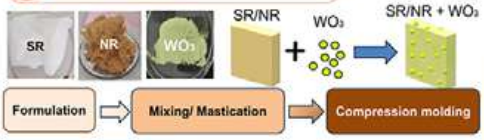
OBJECTIVES

- To synthesize SR/NR (70:30 by weight) composite with WO_3 fillers (0,1,2,4,8 wt%)
- To evaluate the effects WO_3 filler loadings on the x- and γ-ray radiation shielding and mechanical properties of the composites.

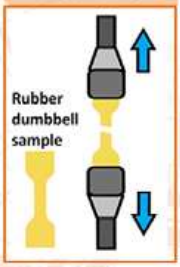
NOVELTY

- A composite material consists of a novel combination of SR, NR and WO_3 for

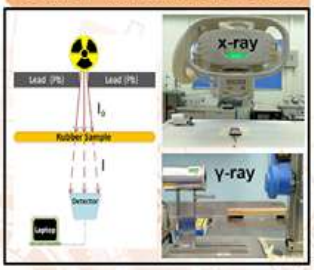
METHODS



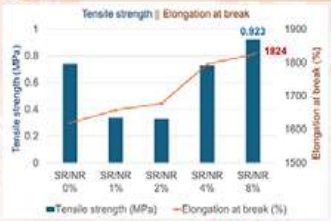
TENSILE TEST



X- AND γ- RAY SHIELDING TESTS

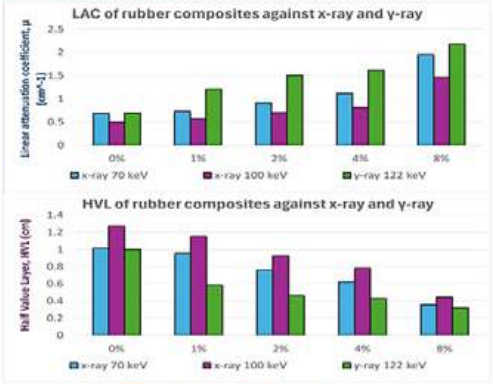


RESULTS & DICUSSIONS



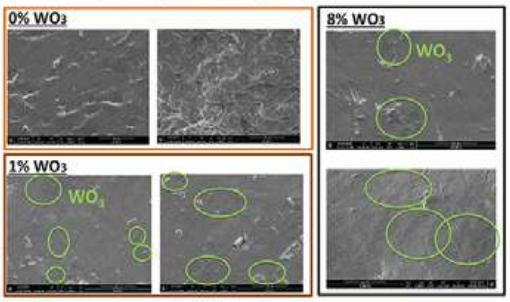
Tensile strength
- Increased with increasing WO_3 wt%.

Elongation at break
- The WO_3 loadings use in this project is insufficient to restrict dislocation of particles hence no significant reduction in flexibility.



Lead Equivalent Thickness, LET (mm)			
	x-ray		γ-ray
WO_3 (wt%)	70 keV	100 keV	122 keV
0	0.004	0.005	0.033
1	0.004	0.005	0.054
2	0.006	0.006	0.070
4	0.007	0.007	0.075
8	**0.012**	**0.013**	**0.101**

- Composite thickness ≈ 1.2mm
- LET of lead based medical PPE are:
  1. 0.25 mm
  2. 0.35 mm
  3. 0.50 mm



POTENTIAL APPLICATIONS

- Use in radiation shielding PPE that are required to be flexible like radiation attenuation gloves

FUTURE WORKS

- Increase the thickness of the composite to improve its LET of the composites to meet the LET requirement of medical PPE.

PREVIOUS PUBLICATIONS

1. J. Supramaniam, D. Y. S. Low, S. K. Wong, B. F. Leo, B. H. Goh, S. Y. Tang. Nano-engineered ZnO/CNF-based Epoxidized Natural Rubber with Enhanced Strength for Self-Healing Glove Fabrication. Chemical Engineering Journal (Q1, IF: 13.3), 437, 135440, 2022.
2. D. Y. S. Low, J. Supramaniam, A. H. Abd. Rahim, S. Y. Tang, B. F. Leo Morphological, Thermal, and Mechanical Properties of Natural Rubber Reinforced with Cellulose Nanofibers from Oil Palm Empty Fruit Bunch. Journal of Rubber Research (Q4, IF: 1.2), 1-10, 2021.
3. S. Y. Tang, P. Sopanon, W. Tanthapanichakoon, A. Soottitantawat Preparation and Properties of Spherical Natural Rubber/Silica Composite Powders via Spray Drying. KONA Powder and Particle Journal (Q2, IF: 4.1), 37, 214-223, 2020.

HARI INOVASI NUKLEAR MALAYSIA 2024

ANUGERAH INOVASI NUKLEAR KEBANGSAAN
NATIONAL NUCLEAR INNOVATION AWARD

iMOS: Intelligent Mobile Apps for Mosquitoes Auto-Spray Dispenser Usage Tracking & Monitoring

Dr. Wan Aezwani Wan Abu Bakar (UNISZA), Assoc. Prof. Ts. Dr. Mustafa Man (UMT), Mr. Lim Chee Hwa (OTN SDN. BHD), Dr. Lee Yean Wang (DR MOS SDN. BHD), Mr. Wan Nur Aizat Wan Azahar (POCKET DATA SDN. BHD)

N.U.R NUKLEAR UNTUK RAKYAT

ABSTRACT

The proposed Intelligent Mosquitoes Home System (iMOS) encompasses of a complete Internet of Things (IoT) based solution. This IoT solution shall leverage the complete eco-system consisting of the devices (i.e.,Sensors), the network connectivity, the cloud computing platform, the data analytics and a comprehensive web-based system. The fundamental component of the IoT in this solution is the optimization of the device from the low-power wide-area network **(LORAWAN)** which is designed to enable battery powered devices to operate with a long read range. The water-based sensors are used to monitor the level of fluid (IGR) dryness in MHS whether Low, Medium or High using the water-based sensors components. LORAWAN technology allows for consistent communication between sensors and signal receivers. Data sent or received is processed and inserted into a database on a public server (Cloud Server) through a real-time mode. Prior to experimentation conducted, water-based sensor is identified to be the benchmark for the iMOS prototype.

OBJECTIVES

- ❑ To automate the manual Aedes Mosquito Home System (AMHS) developed by industry (OTN Sdn. Bhd.)
- ❑ To ease of monitoring the level of Insecticide Growth Regulator (IGR) – the liquid used to kill the Aedes eggs
- ❑ To reduce time, cost and manpower usage in controlling and monitoring of the AMHS.
- ❑ To combat Dengue disease by killing starting from the eggs instead of forging system for adults Aedes mosquitoes

COMMERCIALIZATION

NDA SIGNED (UMT-UNISZA-UNIKL-OTN SDN BHD

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https://youtu.be/sEs7R95adhY
https://youtu.be/m-M-x2N3atA

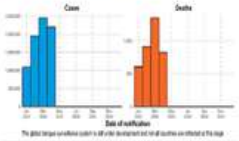
CURRENT PROBLEMS

Fight AEDES, Stop DENGUE!

MALAYSIA STATISTICS UNTIL JULY 2024 BY IDENGUE

- Water based IGR - only 6 weeks due to temperature and humidity
- Vandalism
- Breakdown
- Stolen

DENGUE BY GEOGRAPHICAL LOCATION FROM WHO

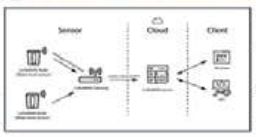


GLOBAL DENGUE CASES AND DEATH UNTIL APRIL 2024 BY WHO

OUR SOLUTION

USED OF WATER LEVEL SENSOR TO DETECT THE LEVEL OF IGR

FRAMEWORK



PUBLICATION

- Bakar, W. A. W. A., Mustafa Man, Bazilah A. Talip, Lim Chee Hwa, and M. I. H. M. Noor. "AMHS: An IOT Embedded for Aedes Mosquito Home System." (2019).
- Bakar, W. A. W. A., M. Man, L. C. Hwa, and L. Y. Wang. "AMR: intelligent auto-dispenser mosquito repellent system." In *IOP Conference Series: Materials Science and Engineering*, vol. 1173, no. 1, p. 012008. IOP Publishing, 2021.
- Man, Mustafa, Wanasekara Bakar, Lim Chee Hwa, Muhammad Irfan Hakim Md Noor, And Mohd Kamir Yusof. "iKmes-iot: Iot Based Mosquito Spray Dispenser System." (2021).
- Man, Mustafa, Wan Aezwani Wan-Abu Bakar, Lim Chee Hwa, Wan Nurul Jawahir Wan Mohd Yusoff, Mustafa Afendi Mat Nor, and Mohd Irfan Hakim Mohd Noor. "Dengue innovation: A sustainability approach for preventing and controlling of dengue diseases outbreaks via IoT technology." In *IOP Conference Series: Materials Science and Engineering*, vol. 769, no. 1, p. 012012. IOP Publishing, 2020.

RECOGNITION

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HARI INOVASI NUKLEAR MALAYSIA 2024

ANUGERAH INOVASI NUKLEAR KEBANGSAAN
NATIONAL NUCLEAR INNOVATION AWARD

Mouse Stopper: A Proficient Solution for Mouse Repellant Using Ultrasonic Approach

Dr. Wan Aezwani Wan Abu Bakar (UNISZA), Assoc. Prof. Ts. Dr. Mustafa Man (UMT),
Dr. Mohd. Kamir Yusof (UNISZA), Mr. Wan Nur Aizat Wan Azahar (PROTECT DATA SDN. BHD.)

N.U.R NUKLEAR UNTUK RAKYAT

ABSTRACT

There is a little rodent, called the wood rat which is notorious for building nests from what they collect from nature or trash from humans. This little one usually visits engine compartments to find a warm and dark shelter colored wires and shiny surfaces of a car engine. Wood rat is described as having ***"such an innocent look, is so easily approached such confidence in one's good intentions"*** because it's a harmless and curious little creature that won't attack you. Research show that starting with the year 1990, car manufacturers started to be forced by governments around the globe to include bio-degradable components to cars to recycle a higher percentage of the car after it is sent to the junkyard. From a technical standpoint you should do a thorough inspection to see what components in the engine bay were affected. Most of the time they chew engine dampening insulation, wire coverings, plastic, carpeting or air conditioning & heating ducts. Thus, based on ***MOUSE STOPPER with ultrasonic vocalizations innovation technology*** has a complete product line of solutions developed specifically to protect your vehicle, equipment from the costly damage caused by mice and other rodents including rats, mice or rodents.

OBJECTIVES

1. Ultrasonic mouse control refers to the use of ultrasonic sound waves to deter or repel mice from a particular area. The idea behind this approach is that the ***high-frequency sound emitted by ultrasonic devices is unpleasant or disruptive to mice***, leading them to avoid the area where these sounds are present.
2. It's important to note that the ***effectiveness of ultrasonic mouse control devices can vary***. Some people report success in using them to deter mice, while others find them less effective. Factors that can influence their success include the type of ultrasonic device used, the frequency of the emitted sound, the location and layout of the treated area, and the severity of the mouse infestation.
3. While ultrasonic mouse control devices ***offer a humane and non-toxic method*** for deterring mice, they may not be the sole solution for severe infestations, and their effectiveness can vary from one situation to another.

METHODOLOGY

IMPACTS

ULTRASONIC VOCALIZATION TECHNOLOGY

COMMERCIALIZATION

RECOGNITION

GOLD MEDAL
KARNIVAL
INOVASI@UMT2023

TEAM MEMBERS

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HARI INOVASI
NUKLEAR MALAYSIA 2024

ANUGERAH INOVASI NUKLEAR KEBANGSAAN
NATIONAL NUCLEAR INNOVATION AWARD

Chemistory Explorer : Discovering the Roots of Chemistry

Ts Hidayah binti Rahmalan, Dr Syahida Mohtar, Dr Nur Atikah Binti Arbain, Wong Yi Xuan, Tan Shi Yun, Ho Jia Qing and Muhammad Ikhwan Bin Che Ross

Innovativeness of Innovation

The innovation "Chemistory Explorer: Discovering the Roots of Chemistry" is a groundbreaking educational platform that merges historical chemistry with a focus on nuclear science, enriching the understanding of their interplay. Its technical features include an interactive timeline showcasing key milestones, virtual laboratories for exploring chemical and nuclear processes, and multimedia integration with videos and archival documents. The novelty lies in its interactive photobooth module, which allows users to envision themselves as historical figures in chemistry, fostering engagement and personal connection. Creatively, an interactive game puzzle enhances learning by challenging users to solve puzzles related to chemical principles and historical events. Overall, Chemistry Explorer innovatively combines education with immersive technologies to inspire curiosity and deeper appreciation for the scientific foundations shaping our world.

Potential for Commercialization

This project has significant commercialization potential due to the growing demand for innovative STEM educational tools. Targeting educational institutions, tutoring centers, museums, and individual learners, this platform offers a unique selling proposition with its immersive learning experience, interactive features, and comprehensive content. Revenue streams include licensing to schools, individual subscriptions, and partnerships with science centers. By promoting STEM careers and educational equity, Chemistory Explorer meets market needs and contributes to social impact.

Contribution to knowledge

Each module had significant contribution to knowledge :

1. User Personalized Module :
Enhances understanding of effective UI/UX design for educational tools by analyzing user interaction data.

2. Virtual Laboratories Module:
Provides practical experience and data on the effectiveness of virtual labs in teaching complex scientific concepts.

3. Multimedia Integration Module:
Identifies effective multimedia content for enhancing learning experiences and catering to different learning styles.

4. Interactive Photobooth Module:
Promotes engagement and motivation by allowing personalized, historical learning experiences.

5. Game Puzzle Module:
Demonstrates the impact of gamification on learning outcomes, engagement, and problem-solving skills.

Status of innovation

"Chemistory Explorer: Discovering the Roots of Chemistry" is currently at Technology Readiness Level (TRL) 3, indicating that the project is in the technology development phase. This stage involves active research and development to validate the core concepts and feasibility of the technology.

Application & Impact

Virtual Laboratories Module

Multimedia Integration Module

Interactive Photobooth Module

Game Puzzle Module

Publication

One paper has been submitted to the Journal of Advanced Computing Technology and Application (JACTA), with title: **Enhancing Self-Learning in Chemistry: A Literature Review and the Role of Chemistory Explorer.**

HARI INOVASI NUKLEAR MALAYSIA 2024

ANUGERAH INOVASI NUKLEAR KEBANGSAAN
NATIONAL NUCLEAR INNOVATION AWARD

COMPOSITE MEMBRANE OF POLYBENZIMIDAZOLE/SULFONATED GRAPHENE OXIDE/ 1-BUTYL-3-METHYLIMIDAZOLIUM TETRAFLUOROBORATE FOR HIGH-TEMPERATURE PROTON EXCHANGE MEMBRANE FUEL CELLS (HT-PEMFC)

N.U.R NUKLEAR UNTUK RAKYAT


Ts. Leong Kok Seng


Prof Madya Dr Shahbudin


Prof Madya Dr Loh Kee Shyuan


Dr Wong Wai Yin

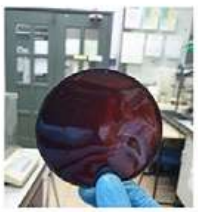

Dr Choo Thye Foo

PRODUCT PROPERTIES

PBI-SGO-[BMIM][BF_4] - (3 wt.%) (CISMA)

Tensile Strength (MPa)	44.38
Young Modulus (MPa)	1914.68
Strain Stress (%)	17.49
Tensile Strength (MPa)*	2.31
Young Modulus (MPa)*	207.51
Strain Stress (%)*	42.06
IEC (mequiv g^{-1})	2.43
Conductivity at 160°C (mS cm^{-1})	36.61
Activation Energy E_a (KJ mol^{-1})	8.99

* DOPED WITH PHOSPHORIC ACID



NOVELTY AND INVENTIVENESS

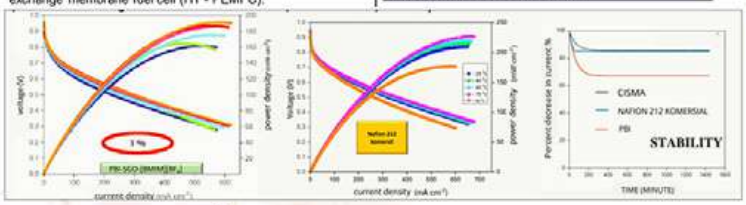
CISMA has the potential to be used in high temperature proton exchange membrane fuel cell (HT - PEMFC).

GRANT

GRANT TRANS-TECH 4TVET (TVET TECHNOLOGY TRANSFER IR 4.0) - RM 50000

STATUS OF PRODUCT

TRL 3 - EXPERIMENTAL PROOF OF CONCEPT



PUBLICATION

RECOGNITION AND AWARDS

Usefulness/ Benefit to Society

1. To promote and support the development of the fuel cell industry in Malaysia by providing technology resources obtained from research programs, development and demonstration projects.
2. Conducting research programs, development, and demonstration projects to produce indigenous fuel cell technology.

NETWORKING

COPYRIGHT

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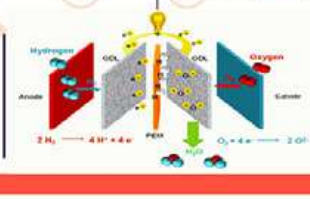
INDUSTRY PARTNER AND COMMERCIALIZATION POTENTIAL

TENAGA NASIONAL PETRONAS



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No telefon : 014-6408450
Address : Politeknik Tun Syed Nasir Syed Ismail

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Attention:
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Institute Fuel Cell UKM
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Hari Inovasi Agensi Nuklear Malaysia

ANUGERAH INOVASI NUKLEAR KEBANGSAAN
NATIONAL NUCLEAR INNOVATION AWARD

H_2POWER EDUKIT

Nuclear Technology Driven Hydrogen and Fuel Cell Edukit

Nur Ubaidah Saidin, Choo Thye Foo, Wong Wai Yin, Nurazila Mat Zali, and Norhazirah Azhar

N.U.R
NUKLEAR UNTUK RAKYAT

MOTIVATION

Malaysia faces a significant challenge in achieving a sustainable energy future, hindered by the insufficient understanding of cutting-edge energy technology among the public. While solar and wind power are gaining recognition, the complexity of hydrogen technology utilizing nuclear techniques in material synthesis remain largely obscure. The lack of understanding in this area is especially apparent among Malaysian students, who are the future pioneers and leaders in STEAM disciplines. To bridge this gap and build a workforce that is skilled in STEAM and capable of tackling the energy issues faced by the country, it is crucial to improve public knowledge and understanding. Through the development of educational kits that streamline complex energy ideas, we may motivate a fresh cohort of individuals skilled in resolving problems and accelerate Malaysia's shift towards a sustainable energy economy.

H_2POWER EDUKIT

The H_2Power Edukit presents a compact educational system for exploring clean energy through hydrogen technology. It features a solar-powered water electrolyzer equipped with a green radiolysis-synthesized electrocatalyst, enhancing hydrogen production efficiency. Subsequently, the generated hydrogen is safely stored and utilized in a miniature fuel cell, also employing a green radiolysis electrocatalyst, to produce electricity. Designed for safe learning, the kit fosters understanding of hydrogen fuel technology and ignites curiosity about sustainable energy solutions. Furthermore, it bridges the gap between complex science and public comprehension, potentially leading to a more informed citizenry engaged in discussions about clean energy advancements and environmental sustainability.

IMPACT

- Empowers the public to understand hydrogen technologies.
- Encourage investment and innovation in hydrogen fuel infrastructure, potentially creating new jobs in clean energy sectors.
- Widespread adoption of this technology could significantly reduce reliance on fossil fuels, leading to cleaner and healthier planet.

STATUS

TRL 4: SMALL SCALE PROTOTYPE

4 QUALITY EDUCATION | 7 AFFORDABLE AND CLEAN ENERGY | 9 INDUSTRY, INNOVATION AND INFRASTRUCTURE | 11 SUSTAINABLE CITIES AND COMMUNITIES | 13 CLIMATE ACTION

OUTCOMES

THE INNOVATION

1

Education kits with simple assembly guide for students/public to improve the understanding on hydrogen technology.

2

Attractive module developed for school students.

3

Application module designed for higher educational level/ industry/ public, with quizzes to test their understanding, which can easily be access through mobile/ tablet/ desktop.

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ANUGERAH INOVASI NUKLEAR KEBANGSAAN
NATIONAL NUCLEAR INNOVATION AWARD

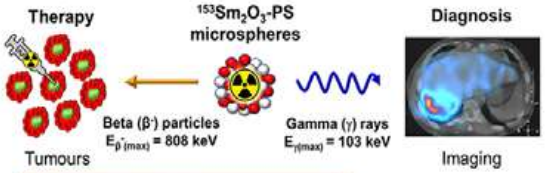
Pre-clinical Study: Radioembolization Samarium-153 Therapy (REST) for Liver Cancer

Dr. Wong Yin How (Taylor's University), Dr. Tan Hun Yee (MOH), Prof. Dr. Yeong Chai Hong (Taylor's University), Dr. Azahari Kasbollah (MNA), Prof. Madya Dr. Mohammad Nazri Md Shah (UMMC), and Prof. Dr. Basri Johan Jeet Abdullah (UMMC)

N.U.R NUKLEAR UNTUK RAKYAT

INTRODUCTION

Liver cancer is the 6th most common diagnosed cancer and the 3rd leading cause of cancer death worldwide yearly. Hepatic radioembolization is a combination of embolization and internal radiation therapy to treat intermediate and advanced stage liver cancer. Neutron-activated Samarium-153 oxide loaded polystyrene microspheres has been developed as a potential theranostic agent for hepatic radioembolization. In this study, the therapeutic efficacy and diagnostic imaging capabilities of the formulation was assessed using liver cancer Sprague-Dawley rat model.



METHODS

IMPORTANCE

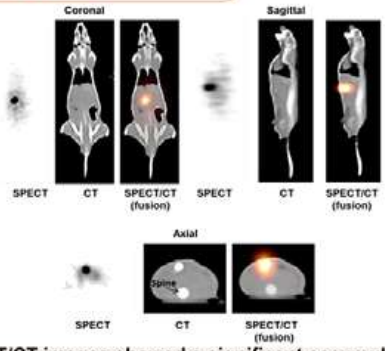
- Targeted and effective treatment for unresectable/ metastatic tumour
- Excellent diagnostic imaging capabilities
- Personalized treatment, minimal side effects and improved outcomes

TEAM MEMBERS

Dr. Wong Yin How
Head of Project
Faculty Health & Medical Sciences
Taylor's University, Malaysia
E-mail: yinhow.wong@taylors.edu.my

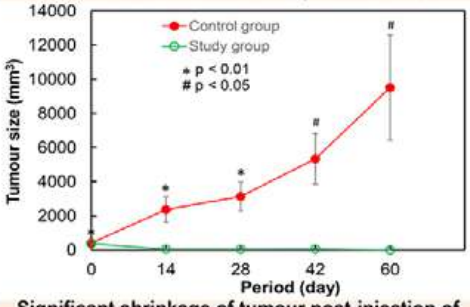
OUTCOME

DIAGNOSTIC IMAGING

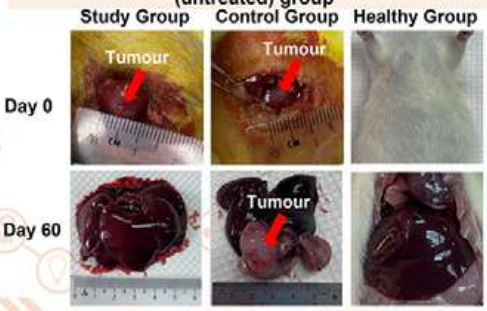


SPECT/CT images showed a significant accumulation of Samarium-153 radioactivity in the tumour

THERAPEUTIC EFFICACY



Significant shrinkage of tumour post-injection of Samarium-153 microspheres as compared to control (untreated) group



AWARDS

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Hari Inovasi Agensi Nuklear Malaysia

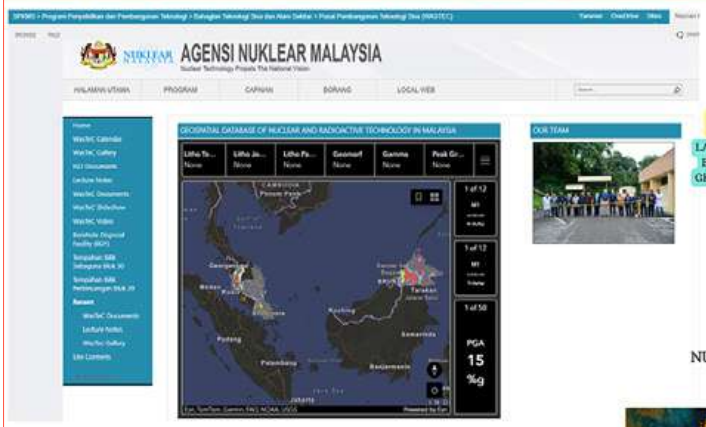
NUKLEAR MALAYSIA

ANUGERAH INOVASI NUKLEAR KEBANGSAAN
NATIONAL NUCLEAR INNOVATION AWARD

GEOSPATIAL DATABASE OF NUCLEAR AND RADIOACTIVE TECHNOLOGY IN MALAYSIA

Nazran Harun, Azmi Ibrahim, Rafizi Salihuddin, Mohd Zaidi Ibrahim, Muhammad Fathi Sujan, Nurul Syazwani Yahaya, Ahmad Hasnulhadi Che Kamaruddin & Mohd Zahiruddin Jaafar

N.U.R NUKLEAR UNTUK RAKYAT



BAB — PADDY, MUSHROOM, GAHARU
BAS — SITING, ISOTOPE HYDROLOGY, SEDIMENTS
BKS — AREA MONITORING, PERSONEL MONITORING
BKJ — LAYOUT PLAN, BOREHOLES, GEOTECHNICS
BSM — STUDENTS, RPO
BPA — CTBTO
BST — AREA MONITORING

GEODATA CONTRIBUTORS

NUKLEAR MALAYSIA'S GEODATABASE
- gdb
- extension
- scheme
- shapefile
- table
- join & relations

PUSAT GEOSPATIAL NEGARA — esri

GEOPORTAL ONLINE DATA VISUALIZATION
- Web Layer
- ArcGIS Online
- Connect Geodatabase
- Dashboard

NUKLEAR MALAYSIA WEBPORTAL

STAKEHOLDERS

NOVELTY

THE GEOSPATIAL DATABASE OF NUCLEAR AND RADIOACTIVE TECHNOLOGY IN MALAYSIA IS THE FIRST GEOSPATIAL DATABASE IN MALAYSIA SPECIFICALLY DESIGNED TO PROVIDE COMPREHENSIVE INFORMATION ON NUCLEAR AND RADIOACTIVE TECHNOLOGY WHICH CAN BE ACCESSED THROUGH A WEB APPLICATION.

APPLICATIONS BENEFITS

- THE CREATIVITY AND INNOVATIVENESS OF THIS PLATFORM LIE IN ITS DIGITAL ACCESSIBILITY, MAKING COMPLEX INFORMATION READILY AVAILABLE AND TRANSPARENT.
- ENHANCES UNDERSTANDING OF NUCLEAR AND RADIOACTIVE TECHNOLOGY DISTRIBUTION, REDUCING RESEARCH GAP AND ENSURES DYNAMIC PLATFORM FOR SHARING GEOSPATIAL DATA

APPLICATIONS POTENTIALS

- THE GEOSPATIAL DATABASE SERVES AS A DYNAMIC PLATFORM FOR SHARING GEOSPATIAL DATA FOR THE STAKEHOLDERS IN LINE WITH DTNN 2030 STRATEGIC THRUST 1 AND 2.
- COLLABORATION NETWORK BETWEEN GOVERNMENT AGENCIES IN DATA SHARING USING WEB-GIS APPLICATIONS.

IMPACT TO THE ECONOMY

- OPTIMIZING TIME TO OBTAIN INFORMATION RELATED TO NUCLEAR AND RADIOACTIVITY.
- BY UTILIZING EXISTING ARCGIS PLATFORMS, IT REDUCES THE RELIANCE ON PAPER, LEADING TO FINANCIAL SAVINGS AND PROMOTING SUSTAINABLE PRACTICES.
- DID NOT USE FUNDS FOR SOFTWARE DEVELOPMENT.

IMPACT TO THE SOCIETY

- PROVIDES AN EFFICIENT SYSTEM FOR DELIVERING CRITICAL INFORMATION TO STAKEHOLDERS, ENSURING TIMELY AND ACCURATE DATA DISSEMINATION.
- IMPROVES THE ABILITY OF HUMAN RESOURCES TO MANAGE BIG DATA.

IMPACT TO THE ENVIRONMENTAL

- PROMOTES THE USE OF DIGITAL SOLUTIONS
- REDUCING THE ENVIRONMENTAL FOOTPRINT ASSOCIATED WITH PAPER-BASED RECORDS AND TRADITIONAL DATA STORAGE METHODS.

TARGET BENEFICIARIES/ TARGET MARKET

- PROMOTING THE VISUAL PRESENCE OF MALAYSIA'S NUCLEAR AND RADIOACTIVE TECHNOLOGY DATA TO STAKEHOLDERS AT THE NATIONAL AND GLOBAL LEVEL.
- THE STAKEHOLDERS INCLUDE:
  - FEDERAL, STATE, LOCAL GOVERNMENT
  - RESEARCHER
  - ACADEMICIANS
  - INDUSTRY
  - NON-GOVERNMENTAL ORGANIZATIONS
  - LOCAL COMMUNITY
  - PUBLICS

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Scan Me

NUKLEAR MALAYSIA

ANUGERAH INOVASI NUKLEAR KEBANGSAAN
NATIONAL NUCLEAR INNOVATION AWARD

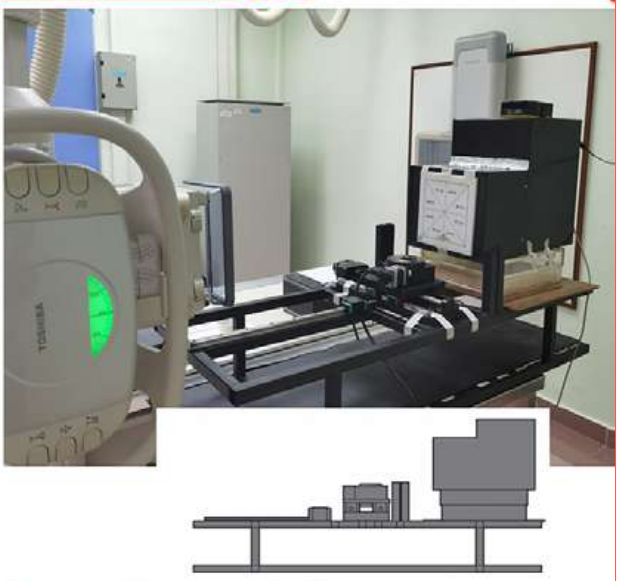
MiniMedImager (*Mini Medical Imager*)

KHAIRIAH BINTI YAZID@KHALID,MUSTAFA ABDULRAHMAN AHMED NOMAN,SURYAPRAKAZSH A/L SHUPPARA MANIAM , AZUHAR BIN RIPIN, AZRAF BIN AZMAN, RAFHAYUDI BIN JAMRO, JULIE ANDRIANNY BINTI MURSHIDI, WAN HAZLINDA BINTI ISMAIL

N.U.R
NUKLEAR UNTUK RAKYAT

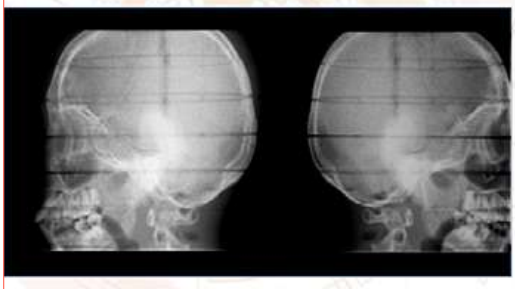
INTRODUCTION

The cost of flat panel detectors makes X-ray medical imaging mostly available in well-funded hospitals, which is challenging for patients in remote areas. The MiniMedImager is an innovative benchtop X-ray imager that addresses this issue. It features a flexible and interchangeable X-ray detector, which is more affordable than traditional options. This imager produces clear images of hard tissues like bone, teeth and jaws while aiming to offer low-cost digital imaging for rural facilities. It's lightweight and easy to install with any medical X-ray system, making it highly portable. Additionally, it includes a rotation stage for precise imaging and can perform both standard 2D X-rays and advanced tomography.



INNOVATION

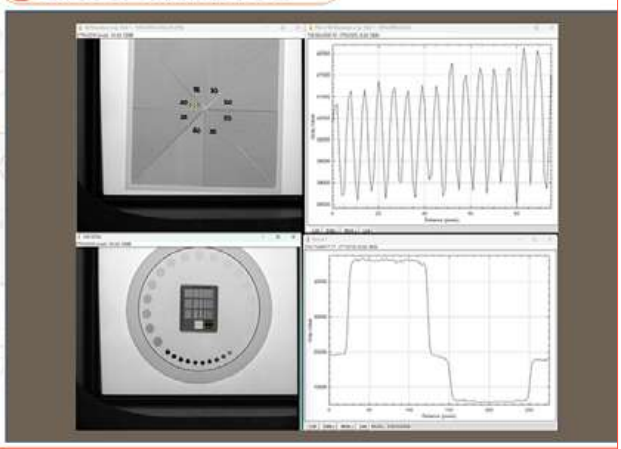
- Flexible and Interchangeable Components
- High-Quality Imaging
- Low Initial Cost
- Lightweight and Portable
- Easy Installation
- Rotation Stage
- Dual Imaging Capabilities
- Real-Time Monitoring
- Low cost maintenance



APPLICATION

- Rural Healthcare Facilities
- Emergency Medical Services
- Dental Clinics
- Veterinary Clinics
- Field Hospitals
- Research Settings

IMAGE ANALYSIS



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ANUGERAH INOVASI NUKLEAR KEBANGSAAN
NATIONAL NUCLEAR INNOVATION AWARD

Innovative Palm Oil Graphene Composite for Superior Corrosion-Resistant Coatings

Mohd Sofian Alias, NorinsanKamil Othman, Mohd SuzreenMd Jamil, Rida Anak Tajau, Mohd Hamzah Harun, Mahathir Mohamed, Siti RadiahKamaruddin, Siti FatahiyahMohamad , MaznahMahmud, ZaifolSamsu, UbaidahSaidin, Nurul Huda Modri, Khairul Azhar Abdul Halim, NaurahMat Isa, Farah FadzehahHilmi, SharillaBinti Muhammad Faisal , RosleyChe Ismail , Abdul MutzzMohd Sani & AzharinaAida Zamri.

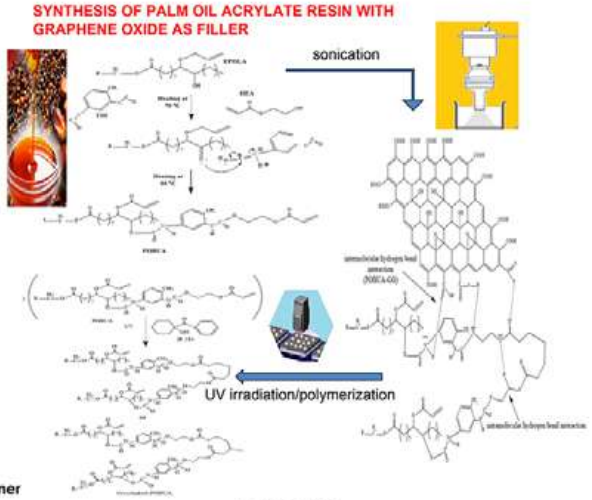
N.U.R
NUKLEAR UNTUK RAKYAT

HIGHLIGHT

- Polyurethane acrylate (POBUA) derived from palm oil polyol was combined with graphene oxide particles to create a corrosion-resistant coating
- Acrylate functional groups in the POBUA polymer chain formed a cross-linked protective layer upon UV exposure, contributing to corrosion resistance
- The metal surface coated with POBUA alone has an annual corrosion rate of 0.3 mmpy, while the addition of graphene particles reduces this rate to 1.1 x 10^{-6} mmpy.
- Palm oil's long-chain polymer structure helps stabilize graphene particles within the coating.
- The graphene lattice structure within POBUA blocks corrosive agents like Cl^-, OH^-, and O_2, delaying corrosion.
- The POBUA coating demonstrated hydrophobic properties with a contact angle of 111°, further preventing water from interacting with the surface and enhancing corrosion resistance.

METHOD/ PROCESS

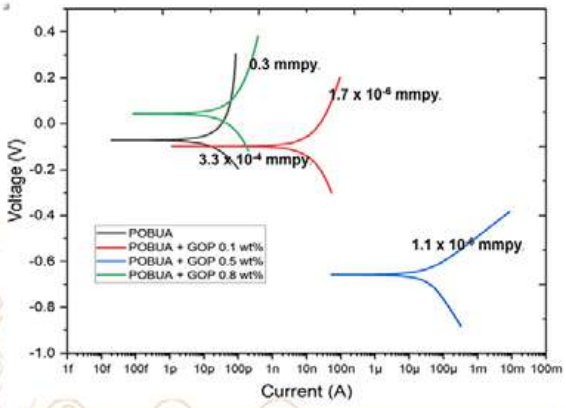
SYNTHESIS OF PALM OIL ACRYLATE RESIN WITH GRAPHENE OXIDE AS FILLER



PROBLEM STATEMENT

- High VOC emissions from petrochemical-based coating products
- The use of fillers that act as sacrificial anodes, such as Zn, in polymer coatings can cause defects in the coating.
- Shortage of downstream palm oil products in Malaysia

FINDING

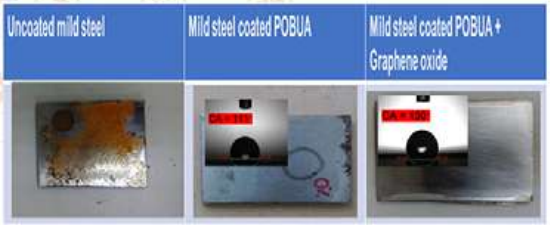


ADVANTAGES

- Fast curing and low VOC
- Graphene oxide avoid coating delamination due to anod sacrification process
- Crosslink network and hydrophobic properties of POBUA prevent water penetration on mild steel

NOVELTY

The use of Palm Oil-derived Polyurethane Acrylate (POBUA) synergistically incorporated with graphene oxide has led to a significant reduction in corrosion rate, demonstrating the effectiveness of this innovative material combination in enhancing corrosion resistance by using UV irradiation technique.



HARI INOVASI
NUKLEAR MALAYSIA 2024

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NUKLEAR MALAYSIA

ANUGERAH INOVASI NUKLEAR KEBANGSAAN
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Innovative PE Irradiation Tubes for High Performance PTS and RR Systems in TRIGA Research Reactor

Khairil Nor Kamal bin Umar, Dr. Mohammed Iqbal bin Hj. Shueb, Nursyafiqah binti Al-Mahi, Asyraf Arif Bin Abu Bakar, Ahmad Hambali Bin Ismail, Mohd Faizal b. Abd Rahman

N.U.R NUKLEAR UNTUK RAKYAT

INNOVATION

The innovation involves the development of two types of irradiation tubes designed for the Pneumatic Transfer System (PTS) and the Rotary Rack (RR) at Nuklear Malaysia's PUSPATI TRIGA Research Reactor.

TECHNICAL FEATURES:

PTS: Utilizes a pneumatically operated "rabbit" transfer system entering the reactor core at position G-20 for producing short-lived radioisotopes for neutron activation analysis (NAA).

RR: Used for activation analysis and isotope production.

FUNCTION:

• Acts as a container for vials filled with samples for NAA inside the reactor.

• Polyethylene (PE) polyethylene material allows gamma and neutron particles to penetrate the tube walls, ensuring all radiation reaches the samples.

NOVELTY:

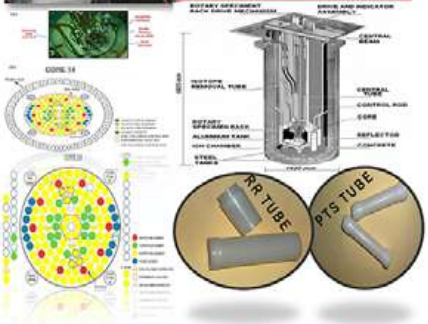
• First use of locally produced polyethylene (PE) irradiation tubes in **Malaysia**, replacing expensive imports.

CREATIVITY AND INNOVATIVENESS:

• Selection of suitable PE material that does not block radiation, ensuring accurate analysis.

• Developed using local resources and expertise

- TRIGA MARK Research Reactor
- Only nuclear research reactor in Malaysia, operational since 1982
- Reached first criticality on 28 June 1982
- *TRIGA:* Training, Research, Isotope Production, General Atomic
- Facilities: Neutron Activation Analysis (NAA), Delayed Neutron Activation Analysis (DNA), radioisotope production, Neutron Radiography, Small Angle Neutron Scattering (SANS)



BENEFITS AND IMPACT:

ECONOMIC:

Cost-Effective: 'In-House' produced tubes cost 1/10 of imported tubes, saving government expenditure significantly.

In-House Production: Reduces dependency on imports, ensures continuous supply, and supports local industry.

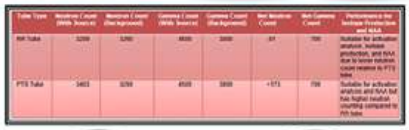
SOCIETAL:

Skill Development: Enhances the expertise of Nuclear Malaysia's staff in materials selection and production techniques.

Local Industry Growth: Demonstrates 'In-House' capability in high-precision mold engineering.

ENVIRONMENTAL:

Sustainable Supply: 'In-House' production ensures a consistent supply, minimizing the risk of operational disruptions in NAA activities.



Gamma Shielding Test

Neutron Shielding Test

CONTRIBUTION TO NEW KNOWLEDGE

- **MATERIALS SELECTION:** Enhanced understanding of selecting appropriate PE grades for irradiation containers.
- **PRODUCTION CAPABILITY:** Leveraged 'In-House' production facilities, developing operational expertise.
- **NUCLEAR TECHNOLOGY APPLICATION:** Advanced knowledge in verifying gamma and neutron penetration values for polyethylene tubes.

STATUS OF INNOVATION

- **IN-HOUSE PRODUCTION:** Utilizing the injection molding machine model BATTENFELD HM800/350 at Block 53, Radiation Processing Technology Division.

Cost-Efficient, In-House Irradiation Tubes via Injection Molding Processing

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Radiation Processing Technology Division

ANUGERAH INOVASI NUKLEAR KEBANGSAAN
NATIONAL NUCLEAR INNOVATION AWARD

MusaBioplast - Engineered Plastic

UV Protection in Biodegradable Packaging

Farah Fadzehah Hilmi, Muhammad Aidell Amir, Noora'tiqah Mohamad Fauzi, Nurul Huda Mudri, Khairul Azhar Abdul Halim, Nik Mahathir Nik Anuar, Naurah Mat Isa

N.U.R NUKLEAR UNTUK RAKYAT

INTRODUCTION

- Our innovation focuses on developing a novel bioplastic by **crosslinking polyvinyl alcohol (PVA) with banana peel waste** by electron beam radiation. Banana peel waste was incorporated to enhanced biodegradability of resulting bioplastic.
- This approach not only improves the mechanical strength but also utilizes an abundant organic resource, reducing environmental impact. Additionally, the produced bioplastic can effectively **block UV radiation**, providing further functional benefits.
- By applying electron beam radiation, this innovation bridges sustainable materials science with advanced nuclear technology, offering a precise, energy-efficient method for creating biodegradable plastics that contribute to a greener, more sustainable future.

Scientific name: Musa acuminata

PROBLEM STATEMENT

Revolutionizing Bioplastics

Advancing Sustainable Materials

NOVELTY

Innovative Use of Electron Beam Radiation

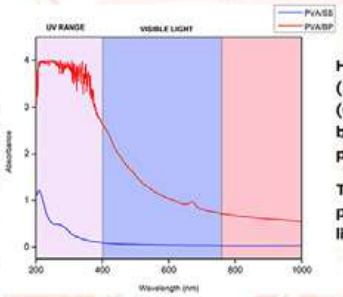
Enhanced Biodegradability

Sustainable Materials Advancement

BENEFITS, IMPACTS AND CONTRIBUTION

1. Economic Benefits
2. Environmental Impact
3. Societal Impact
4. Impact to Nuclear Science
5. Advancement in sustainable materials

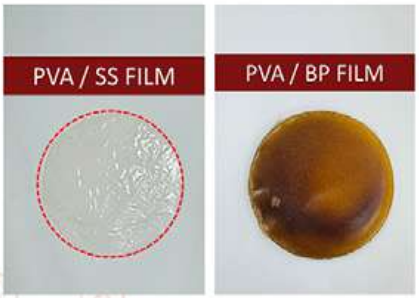
PRODUCT AND ANALYSIS



High absorbance values in UV range area (190 nm to 400 nm) and Visible light (0.97 at 671 nm) indicate strong light-blocking capability for light-sensitive products

This type of packaging suitable to preserving quality during the shelf life of light sensitive products

THE FILM



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ANUGERAH INOVASI NUKLEAR KEBANGSAAN
NATIONAL NUCLEAR INNOVATION AWARD

New Kenaf Variety (ML5) Developed by Acute Gamma Irradiation

Mustapha Akil, Dr. Zaiton Ahmad, Affrida Abu Hassan, Shakinah Salleh, Dr. Muniroh Md. Saad, Norazlina Noordin, Norhafiz Talib, Ahmad Zaki Hussain, Mohamed Hasyraf Mat Nawi, Mohammad Nazri Romli

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Project Summary

Introduction: Kenaf (*Hibiscus cannabinus* L.) which belongs to the Malvaceae family is a herbaceous annual plant and one of the **important sources of raw materials** for the traditional production of rope, canvas, and carpet. Currently, kenaf-based products are getting higher demand from local and international markets. It has generated revenue of around RM350 million in the local market.

Challenge: Lack of varieties well-suited to the country's climate, with most areas still cultivating the V36 variety. There is a **critical need for new locally-owned varieties with high biomass yield**.

Solution: A project was initiated with the National Kenaf and Tobacco Board (NKTB) using **nuclear technology**. The primary criterion for selecting new kenaf mutants was **high fiber yield**.

Achievement: The **ML5 kenaf mutant**, developed in collaboration with the National Kenaf and Tobacco Board (NKTB), represents a groundbreaking advancement in agricultural biotechnology. Originating from the V36 variety and enhanced through acute gamma irradiation at 300 Gy, ML5 exhibits a remarkable **40% increase in fiber yield** compared to its parent. Notably, ML5 produces 4.2 tons of fiber per hectare, significantly more than V36's 3 tons. With distinct features like **palmate leaves** and a **light-yellow throat area in flowers**, ML5 not only outperforms in yield but also adds aesthetic value to the landscape.

Benefits & Impact

ECONOMIC

The high-yielding ML5 enhances productivity and profitability, creating new market opportunities and strengthening the global fiber industry's competitiveness.

ENVIRONMENTAL

Kenaf's low input requirements and ability to thrive on marginal soils make ML5 a sustainable choice, promoting soil health, reducing chemical use, and contributing to carbon sequestration.

SOCIAL

This innovation fosters job creation in farming and processing, thereby uplifting rural communities and reducing poverty.

AGRO-TOURISM

ML5's unique visual appeal like palmate leaves and a light-yellow throat area in flowers can add aesthetic value to the landscape and boost agro-tourism.

Mutant ML5
Variations in leaf shape, flower color, tall plant, and high fiber

Contribution to Nuclear Science & Technology

The development of ML5 through mutation breeding showcases the application of nuclear technology in agriculture. Using acute gamma irradiation, researchers have gained valuable insights into how plant genomes can be enhanced to produce high-yielding varieties, marking a significant step forward for the kenaf industry.

Status & Recognition

Anugerah Inovasi Kenaf Kategori Agensi Penyelidikan, Hari Agrokomoditi Negara 2023

Publications

- Al-Mamun, M., Rafii, M. Y., Misran, A. B., Berahim, Z., Ahmad, Z., Khan, M. M. H., & Oladosu, Y. (2023). Heterosis and Combining Ability Estimate on Yield and Yield-Related Traits in a Half Diallel Crosses of Kenaf (Hibiscus Cannabinus L.) in Malaysia. Journal of Natural Fibers, 20(1). https://doi.org/10.1080/15440478.2023.2192541
- Al-Mamun, M., Rafii, M. Y., Misran, A. B., Berahim, Z., Ahmad, Z., Khan, M. M. H., ... Arolu, F. (2022). Kenaf (Hibiscus Cannabinus L.): A Promising Fiber Crop with Potential for Genetic Improvement Utilizing Both Conventional and Molecular Approaches. Journal of Natural Fibers, 20(1). https://doi.org/10.1080/15440478.2022.2145410
- Al-Mamun, M., Rafii, M. Y., Oladosu, Y., Misran, A. B., Berahim, Z., Ahmad, Z., ... Arolu, F. (2022). Genotypic Variability, Correlation and Path Analysis among Yield Components in Kenaf Mutants under Tropical Conditions. Journal of Natural Fibers, 19(16), 12632–12646. https://doi.org/10.1080/15440478.2022.2073499
- Al-Mamun, M., Rafii, M. Y., Oladosu, Y., Misran, A. B., Berahim, Z., Ahmad, Z., ... Khan, M. M. H. (2021). Characterization and Genetic Diversity of Photoperiodic among Mutant Kenaf (Hibiscus Cannabinus L.) Using EST-SSR Markers. Journal of Natural Fibers, 19(15), 10093–10707. https://doi.org/10.1080/15440478.2021.2002762
- Zaiton Ahmad, Faiz Ahmad, & Mustapha Akil (2019). Recent Progress in Mutation Breeding of Kenaf (Hibiscus cannabinus L.) in Malaysia. In Fairuz Faisal (Ed.). Proceedings of the Research and Development Seminar Nuklear Malaysia 2018 Nuclear Technology Towards Sustainable Development. (p. 275). Malaysia: Malaysian Nuclear Agency.

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NUKLEAR MALAYSIA 2024

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Hari Inovasi Agensi Nuklear Malaysia

NUKLEAR MALAYSIA

ANUGERAH INOVASI NUKLEAR KEBANGSAAN
NATIONAL NUCLEAR INNOVATION AWARD

RodeXtri-ner
Rodent restrainers for whole-body and abdominal X-ray irradiation

N.U.R NUKLEAR UNTUK RAKYAT

Fazliana Mohd Saaya, Anwar Abdul Rahman, Asmaliza Hashim, Khairul Anuar Mohd Salleh, Noorhazleena Azaman, Norriza Mohd Isa, Asmahani Ibrahim, Muhammad Ridzuan bin Rosdi, Ahmad Bazlie Abdul Kadir, Nur Shahriza Zainuddin, Arshad Yassin, Zainah Adam, Abang Abdul Rahim bin Ossen, Daryl J. Arapoc, Rosniza Razali, Nurmaziah Mohammad Shafie, Muhammad Ibrahim bin Aminuddin, Mohd Azam Safawi bin Omar,Harfidzul Faidzal bin Haris, Veshalini Kasiraja.

INTRODUCTION

The concept for developing this restrainer originated in 2018 when we encountered difficulties in irradiating mice without a specialized device to keep them still during X-ray exposure. The need arose from the requirement to irradiate multiple mice simultaneously, necessitating a restrainer to ensure they received a specific dose together. For whole-body exposure, it was essential that the mice were not anesthetized during the procedure. When focusing on specific parts of the mice, proper shielding was crucial to prevent radiation from affecting other organs. To address this, a restrainer with lead shielding was designed for abdominal irradiation. This design helps target specific areas while protecting the rest of the body. The prototype was fully completed in end of 2023, marking a significant milestone in the project's progress. We began testing the prototype in February 2024, aiming to refine and optimize its usage.

BENEFIT & POTENTIAL USERS

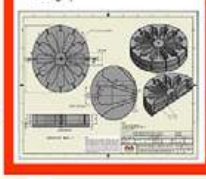
Researchers from nuclear agencies, space departments, medical research institutions, and academia could benefit from these prototypes. Irradiated mice and rats can be utilized in various fields, such as:

Nuclear Field	Medical and science
• Radiation safety and protection • Radiation countermeasures • Radiation dosimetry • Radiation biology • Environmental impact • Genomic instability • Nuclear Medicine • Space exploration • Nuclear Waste Management	• Cancer research • Immunology • Genetics • Aging research • Hematology • Neuroscience • Space Biology • Toxicology • Developmental biology

APPLICATION

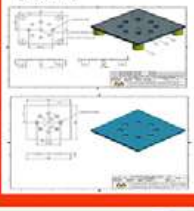
"RodeXtri-ner" is a set of three prototypes for rodent restrainers, designed specifically for research to facilitate whole-body and abdominal X-ray irradiation of mice and rats. These devices improve the efficiency of irradiating rodents by keeping them stationary and properly positioned throughout the procedure, ensuring that the dose administered is both accurate and uniform.

Function: use for whole-body irradiation of mice
Specification of Prototype:
- Small pie shape restrainer
- Material : Acrylic (superior clarity and light transmission)
- 11 usable sections + 1 loading section
- Dimension: 27 cm x 5.2 cm
- Has tail slot for intravenous dosing + act as air ventilation
- Compact and attractive design (mouse-shaped design)



Function: use for whole-body irradiation of rat
Specification of Prototype:
- Large pie shaped restrainer
- Material: Acrylic
- Consist of base and a lit attached with screw
- 5 usable sections + 1 loading section
- Dimension: 60 cm x 6 cm
- Has tail slot for intravenous dosing + act as air ventilation
- Compact and attractive design (rat-shaped design)

Function: use for abdominal rat
Specification of Prototype:
- Square shaped mice restrainer with 8 holes
- Layer 1 : Acrylic
- Layer 2: 6 mm thick lead
- Layer 3: PVC plate
- 4 PVC stands
- Dimension: 30 cm x 30 cm
- Rat should have be anesthesize before irradiation procedure



NOVELTY

1. The only irradiation restrainer for rodents that accommodates both whole-body and abdominal irradiation in Malaysia.
2. Designed and tested by a multidisciplinary team of researchers, laboratory assistants, and technicians.
   Biomedical Science, Nuclear Science, Toxicology, Laboratory animal Science, Engineering, Medical physics, Radiation Safety and Industrial Technology
3. Successfully met all criteria in the series of irradiation tests.

- Amendment and improvement of prototype drawing
- Field size diameter study,
- Lead thickness measurement,
- Dose mapping,for mice, rat and abdominal restrainer,
- Irradiation of rodent for 1 Gy dose for mice, rat and abdominal part of mice

ECONOMIC, SOCIAL AND ENVIRONMENTAL IMPACTS

Economic

Previously, researchers in Malaysia conducting irradiation-related experiments had to perform their work at overseas research institutes for in vivo radioprotectant study because of limitation in animal radiation facility and expertise. The introduction of this equipment will greatly benefit Malaysian researchers by allowing them to conduct experiments locally, thus saving on costs and retaining valuable currency within the country. Additionally, Nuclear Malaysia can generate income by offering new services such as the irradiation of rodents, providing training, and sharing expertise in radiation biology with other organizations

Social

To raise public awareness in Malaysia and enhance understanding of radioprotection studies and the application of nuclear technology in daily life and industrial settings. This can be achieved by assisting researchers and students in research institutes and universities in Malaysia

Environmental Impacts

RodeXtri-ner is made up of non-toxic material, with durability, recyclability, and energy-efficient properties

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ANUGERAH INOVASI NUKLEAR KEBANGSAAN
NATIONAL NUCLEAR INNOVATION AWARD

ELECTRONIC PERSONAL DOSE RECORD (e-PDR)

Muhammad Safwan Ahmad Fadzil, Yu Kai Yee, Mazlyfarina Mohamad, Abdul Khaliq Mohd Saparudin, Siti Hajar Zuber, Nurul Husna Nor Mohammad, Norjana Abdul Rahman, Ahmad Bazlie Abdul Kadir

PROBLEM STATEMENT

Routine personal dose monitoring is crucial to regulate the dose limits as it can identify novel risks resulting from intolerable levels of radiation exposure. The development of a new dose management system was prompted by the **challenges of distributing, storing, and analyzing** occupational radiation exposure.

PRODUCT DESCRIPTION

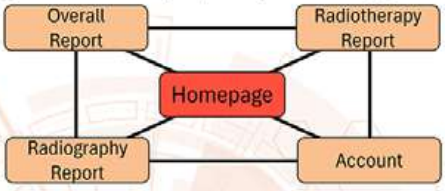
e-PDR is an innovative solution designed to monitor radiation exposure among radiological technologist trainees during clinical attachments in the hospital.

System Design

Web development tools and storage management.

Webbed Navigation Structure

Non-linear and highly interconnected system of web pages that allow multiple pathways between pages.



Web architecture diagram of e-PDR system.

Functional & Non-Functional System Requirement

User Module
Able to visualize and download their personal dose report according to their clinical practices or date after login to their own dashboard.

Administrator Module
More authority on the proposed system including add, read, update and delete features for the trainee's dose report management.

- Security
- Scalability
- Usability
- Performance

Technology Readiness Level (TRL): 5
Partial-scale prototype validation in relevant environment.

e-PDR system home page.

Alert features in the dose report.

- Welcoming message and navigation buttons.
- Graphical presentation for dose records.
- Dose distribution pattern across clinical attachments.
- Specific pinpoint data to speed up the analyzing procedure.
- Alert functionality:
  Alarm limit (Yellow)
  Trigger limit (Red)

SCAN ME

BENEFITS AND IMPACT

- Provides secure and user-friendly interface for analyzing radiation exposure records.
- Enhances transparency and accountability in radiation dose management.
- Reduces workload for administrators and lead to efficient operations.
- Supports eco-friendly practices within educational and healthcare settings.
- Promote engagement and compliance among users and administrators.

SUSTAINABLE DEVELOPMENT GOALS

IP REGISTRATION

File number: UKM.IKB.800-4/1/6063
Status: Under committee review

TEAM MEMBERS

HARI INOVASI
NUKLEAR MALAYSIA 2024

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ANUGERAH INOVASI NUKLEAR KEBANGSAAN
NATIONAL NUCLEAR INNOVATION AWARD

GAMMAGLOW DUCK: READY-TO-COOK SMOKED DUCK MEAT PRESERVED VIA GAMMA TECHNOLOGY

"Pure Flavour, Perfectly Preserved"

Ts. Mohamad Shahrimi Hashim[a], A.P Dr. Salma Mohamad Yusop[a], A.P Dr. Irman Abdul Rahman[b] and Mr. Mohamad Saiful Nizam Jahaluddin[c]

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[c] 48 Salai Smoke House, No. 48 Kampung Ibol Terachi, Tanjung Ipoh 71500, Negeri Sembilan

OVERVIEW & OBJECTIVE

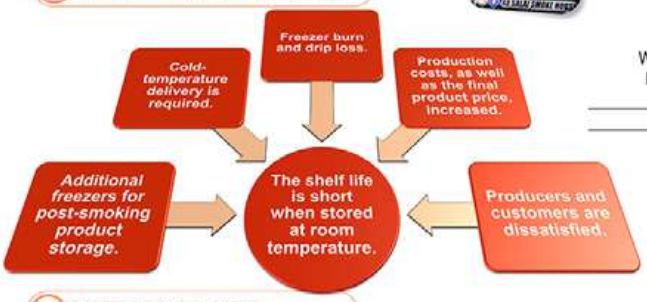
A ready-to-cook, vacuum-packed, gamma-irradiated smoked duck that is ideal for preparing traditional Negeri Sembilan cuisine. This product offers high-quality smoked duck and addresses common challenges faced by food processing SMEs and microentrepreneurs in the smoked duck industry.

Objective: Develop a smoked duck product that can maintain its quality and flavour when stored at an average room temperature of 27°C.

Social impact: Food processing companies, especially SMEs and microentrepreneurs working on poultry product.

Industrial collaborator: 48 Salai Smoke House, Negeri Sembilan

PROBLEM STATEMENT



RESEARCH RESULTS

Parameters	Irradiation dose (kGy)	
	0 (Control)	10
Shelf-life study		
Shelf-life (day)	1	>30
Microbiological analysis		
Total viable count (log CFU/g)	4.30 ± 0.00[a]	1.62 ± 1.50[b]
Total yeast and mould (log CFU/g)	3.57 ± 0.00[a]	<2[b]
Total coliform (log CFU/g)	1.30 ± 0.00[a]	<1[b]
Staphylococcus aureus (log CFU/g)	<1[a]	<1[a]
Bacillus cereus (log CFU/g)	2.30 ± 0.00[a]	<1[b]
Salmonella spp. (in 25g)	ND	ND
Listeria monocytogenes (in 25g)	Present	ND
Chemical analysis		
pH	5.93 ± 0.03[a]	5.82 ± 0.11[a]
Total acidity (%)	0.43 ± 0.01[a]	0.45 ± 0.01[a]
Water activity (aW)	0.99 ± 0.02[a]	0.99 ± 0.14[a]
Water holding capacity (%)	89.77 ± 0.89[a]	86.65 ± 3.86[a]
Peroxide value (mEq/kg)	81.66 ± 0.81[b]	85.83 ± 0.45[a]
TBARS (mg-MDA/kg)	0.29 ± 0.01[b]	0.34 ± 0.01[a]
Physical analysis		
Colour L*	56.55 ± 0.12[a]	54.77 ± 5.15[a]
Colour a*	13.80 ± 0.46[b]	17.72 ± 1.74[a]
Colour b*	10.65 ± 0.35[a]	9.01 ± 1.79[a]
Hardness (kg)	6.97 ± 5.47[a]	9.23 ± 2.70[a]
Adhesiveness (g.sec)	-17.89 ± 5.97[a]	-13.48 ± 10.93[a]
Springiness	0.53 ± 0.03[a]	0.58 ± 0.15[a]
Cohesiveness	0.42 ± 0.12[a]	0.52 ± 0.11[a]
Gumminess (kg)	5.63 ± 2.88[a]	6.12 ± 3.03[a]
Chewiness (kg)	2.96 ± 1.42[a]	3.81 ± 2.56[a]

METHODOLOGY

SDG IMPACTS

IP

IP File number: UKM.IKB.800-4/1/6053 (Status: Under committee review).

RESEARCH CONCLUSION

Gamma irradiation is proven an effective method for extending the shelf life and reducing the microbial load of smoked duck meat, while having minimal impact on its physicochemical properties.

WOS PUBLICATION

Hashim, M. S., Yusop, S. M., & Rahman, I. A. (2024). The impact of gamma irradiation on the quality of meat and poultry: A review on its immediate and storage effects. Applied Food Research, 4(2), 100444. https://doi.org/10.1016/j.afres.2024.100444 (Impact Factor: 4.5, Q1).

ACKNOWLEDGEMENT

Special thanks to the Faculty of Science and Technology, Universiti Kebangsaan Malaysia, for research facilities and support, as well as the Ministry of Higher Education (MoHE) and Universiti Teknologi MARA for Mohamad Shahrimi Hashim's PhD scholarship under memorandum 500-BPD(BKK.14/3/2/3) (282967).

COMMERCIALISATION

Food processing companies especially SMEs and microentrepreneurs.

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ANUGERAH INOVASI NUKLEAR KEBANGSAAN
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DeCO2x - THE CATALYST CONVERTS CO_2 INTO E-METHANE USING GREEN ENERGY

Ts Dr Ahmad Zamani Ab Halim, Prof Dr Mohd Hasbi Ab Rahim, Prof Dr Gaanty Pragas A/L Maniam
ahmadzamani@umpsa.edu.my

N.U.R NUKLEAR UNTUK RAKYAT

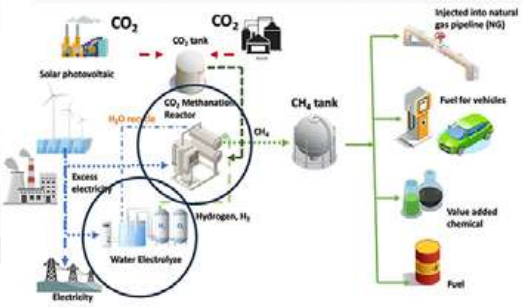
PROBLEM STATEMENT

The increasing levels of atmospheric CO_2 due to human activities are a major contributor to climate change and global warming.

SUSTAINABLE DEVELOPMENT GOALS

SOLUTION

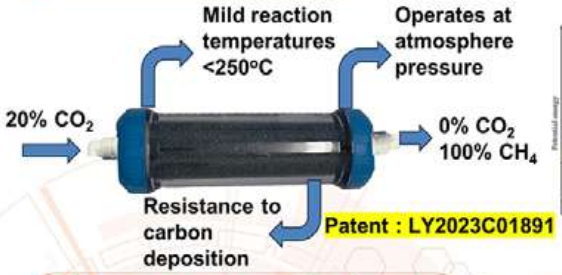
TECHNOLOGY POWER TO GAS



Need improvement

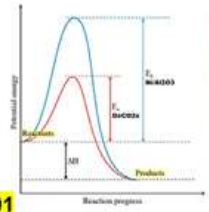
1. Hydrogen production by water electrolysis (high cost) and high consumption of hydrogen
2. Catalyst – High activation energy, required high temperature > 350°C and high pressure

DeCO2x



Patent : LY2023C01891

RESULTS



CATALYSTS	Activation energy (Ea, kJ/ mol)
Ni/Al_2O_3	80
$3\%Ru/\gamma\text{-}Al_2O_3$	60
DeCO2x	28.4

RELATED PUBLICATION

1. Optimization of CO_2 methanation reaction over $M^*/Mn/Cu–Al_2O_3$ (M^*: Pd, Rh and Ru) catalysts. Journal of Industrial and Engineering Chemistry. Q1

2. Modeling and optimization of carbon dioxide methanation via in situ hydrogen generated from aluminum foil and alkaline water by Box– Behnken design. Journal of the Taiwan Institute of Chemical Engineers. Q1

ACHIEVEMENTS

- ✓ Commercial agreement and NDA with international company (Germany)
- ✓ 3 Letter of award
- ✓ Gold medal CITREX UMPSA 2023
- ✓ 2nd place Automotive Excellence Award CITREX UMPSA 2023
- ✓ UMP Funding -RDU170360 RM30,500.00

STATUS OF INNOVATION

TRL 6-7

Scan me

GLOBAL MARKET SIZE

USD 82 Million Year 2028

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NUKLEAR MALAYSIA

ANUGERAH INOVASI NUKLEAR KEBANGSAAN
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EARLY MATURITY AND CLIMATE RESILIENT ADVANCED RICE MUTANT LINES

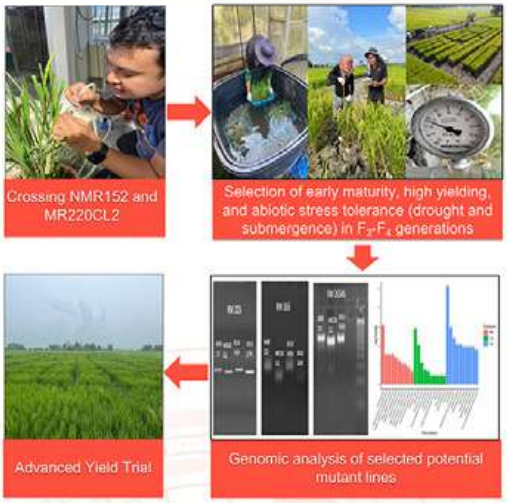
Faiz Ahmad, Sobri Hussein, Muhammad Nabil Haqiem Hisham, Siti Norvahida Hisham, Siti Nurdiyana Yusof, Nor'Aishah Hasan, James Mackester Simoli, Muhammad Ruzaini Abdul Wahab,, Muhamad Adib Najmi Ja'afar, Mohd Sharkawi Ahmad, Wan Dalila Wan Chik, Mohammad Malek Faizal Azizi, Asma Aris, Wan Norhanis Ahmad Yarani, Sarah Hani Mohd Salleh, Salman Mohd Latiff, Noor Liyana Sukiran , Atiqur Rahman Bhuiyan, Ros Anita Ahmad Ramli, Affrida Abu Hassan, Yoshihiro Hase, Anna Pick Kiong Ling, Azhar Mohamad, Abdul Rahim Harun, Noraziyah Abd Aziz Shamsudin.

N.U.R NUKLEAR UNTUK RAKYAT

DESCRIPTION OF INNOVATION

This innovation aims to develop early maturity and climate resilient rice lines using the mutant cultivar (NMR152) as a recipient and the early maturity mega rice variety (MR220CL2) as a donor. In Malaysia, lacking early maturity and climate-resilient rice is a major issue for national rice production. Mutant cultivar NMR152 is the first mutant rice cultivar released as a national certified seed and was officiated by former Prime Minister Dato' Sri Ismail Sabri bin Yaakob in 2021. Unfortunately, this mutant cultivar is considered intermediate in maturity (105-108 days after transplanting). Thus, crossing it with an early maturity variety (less than 100 days after transplanting) is highly recommended. Through several screenings in early generation (F_2 & F_3) under submergence stress, about ten early maturity selected lines were further screened for yield evaluation under drought conditions in Sanglang, Kedah, for two seasons (F_3 & F_4). Only four advanced lines (191-1, 82-2, 68-1, 125-2) showed high yield, early maturity, and good agro-morphological traits. These lines were further evaluated for national yield trials.

PRODUCT DEVELOPMENT



COMMERCIALIZATION

The visit by the Deputy Minister of Science, Technology, and Innovation (MOSTI), the Minister of Agriculture and Food Security (MAFS), and the special visit by His Royal Highness the Crown Prince of Kedah.

MOA between Nuclear Malaysia and Pertama Padi (Malaysia) Sdn Bhd on commercialization and development of new rice variety.

Early maturity & climate resilient advanced rice mutant lines.

PUBLICATION

- Faiz Ahmad, Nor'Aishah Hasan, Siti Norvahida Hisham, Siti Nurdiyana Yusof, Affrida Abu Hassan, Sobri Hussein, Abdul Rahim Harun, Noraziyah Abd Aziz Shamsudin (2023). Data on genome resequencing of the rice cultivar MR219 and its abiotic stress tolerant mutant lines, NMR152 and NMR151. Data in Brief, 46 (2023) 108815.
- Ahmad, Siti Norvahida Hisham, Siti Nurdiyana Yusof, Mohd Sharkawi Ahmad, Nor'Aishah Hasan, Affrida Abu Hassan, Noor Liyana Sukiran, Atiqur Rahman Bhuiyan, Sobri Hussein, Abdul Rahim Harun, Noraziyah Abd Aziz Shamsudin (2023). Heterosis analysis of F1 progenies derived from IS21 x MR220CL2 and IS21 x UKMRC16 crossing combinations. IOP Conference Series: Earth and Environmental Science.

IMPACT OF INNOVATION

- Tackle food security issues in Malaysia.
- Increase the rice self-sufficiency (SSR) ratio in Malaysia.
- Help rice farmers increase their income (majority in B40 group).
- Early-maturity varieties will use fewer pesticides (produce fewer environmental pollutants and reduce soil contaminants).

CONTRIBUTION TO NEW KNOWLEDGE

- Contributes to the molecular insight into drought and submergence traits of the mutant cultivar NMR152.
- Performs biochemical and transcriptomic profiling analysis of drought-tolerant related genes.
- Develops a whole genome sequencing database for the NMR152 mutant cultivar.

ACKNOWLEDGEMENT

- FRGS Grant (FRGS/1/2019/WAB01/MOSTI/02/1)-Elucidating of Drought Resistant Rice Mutant Lines through Genotypic and Phenotypic Analysis.
- IAEA RAS 5088-Enhancing Crop Productivity and Quality through Mutation by Speed Breeding.
- IAEA RAS 5094-Promoting Sustainable Agriculture and Food Productivity in the Association of Southeast Asian Nations Region.
- FNCA-Mutation Breeding of Major Crops and Application of New Technologies Towards a Sustainable Agriculture.
- SRF-APP – Development and Commercialization of Climate-Resilient Rice Varieties to Increase National Yield Production.

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ANUGERAH INOVASI NUKLEAR KEBANGSAAN
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Ecowatch : Intelligent Water Pollution Detection and Monitoring System

Muhammad Danish Saiful Rizal, Nur Fatihah Amani Mohd Azmi, Muhammad Fikri Noor Shahidan, Muhammad Iqmal Mohammad Safie, Fakhitah Ridzuan, Noorshella Che Nawi

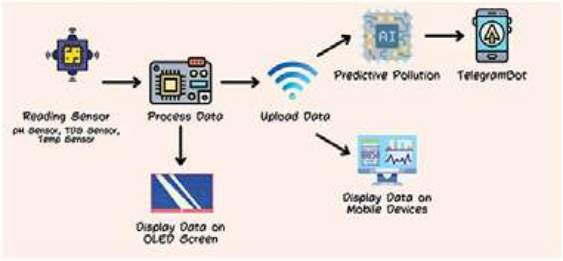
N.U.R NUKLEAR UNTUK RAKYAT

PROBLEM STATEMENT

Water issues, including water pollution or shortages, can disrupt a company's daily operations, potentially halting production processes that rely on clean water.

Current water quality monitoring often relies on manual sampling and lab testing, which can be
- Time-consuming
- Costly
- Limited in Scope

TECHNOLOGY



IMPACT & VALUES

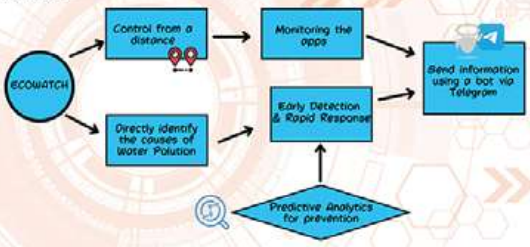
Predictive Analysis can provide early prevention and protection to the water sources from pollution. This is beneficial as it reduces healthcare costs, productivity, and supports industries reliant on clean water.

RESEARCH & DATA

Alam Sekitar Sdn Bhd focus on monitoring drinking water distribution network and an online lake water quality

However, they just focus on monitoring - manually or automatically

Traditionally, when pollution happened, they'll get notified, and they will bring the sample to lab to analyze



Improved efficiency in water treatment through optimized resource allocation and automatic detection.

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Hari Inovasi Agensi Nuklear Malaysia

NUKLEAR MALAYSIA

ANUGERAH INOVASI NUKLEAR KEBANGSAAN
NATIONAL NUCLEAR INNOVATION AWARD

FLEXI-RAD JOINT COMPOUND: RADIATION SEALANT

"Locally Sourced, Globally Shielded"

Dr. Azuhar Ripin, Mohd Khalid Matori, Wan Hazlinda Ismail, Ts. Dr. Husaini Salleh, Ir.Ts. Dr. Mohamad Azman Mohd Isa, Nurul Asyikin Razali, Azmin Nur Aina Azmi, Pairu Ibrahim

N.U.R NUKLEAR UNTUK RAKYAT

PROBLEM

- Limited flexibility in design may restrict the architectural layout of X-ray rooms.
- Conventional radiation shielding materials, like lead, can degrade and need regular maintenance, which can be challenging and disrupt the X-ray facility's operation.
- Traditional radiation shielding materials, like lead, pose challenges due to their weight and bulkiness.

OUR PROPOSED SOLUTION

In a diagnostic radiology facility, the utilization of Flexi-Rad Joint compounds is crucial for safeguarding the room against radiation leakage and serving as the primary shielding barrier

KEY INNOVATION

- Researchers exploited locally available mineral resources.
- High-density fillers incorporated to enhance the shielding effectiveness.
- Flexible formulations for joint applications, improving coverage and adaptability.
- Optimized for maximum radiation attenuation and workability.
- Ensure better sealing of joints and prevent radiation leakage.
- Durability and resistance to environmental factors were improved for long-term effectiveness.
- Compounds were customized to shield specific types of radiation, increasing their efficiency.
- Researchers used readily available materials to create cost-effective radiation shielding solutions for joint compounds.

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ANUGERAH INOVASI NUKLEAR KEBANGSAAN
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Ra-226 RAPID SCREENING USING SMALL VOLUME WATER

Yii Mei-Wo, Nooradilah Abdullah, Salahuddin Muhamad

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Environment and Natural Resources

PROJECT SUMMARY

Present of Ra-226 in water (especially drinking water) is of concern due to its radiotoxicology. This approach introduced a faster way to measure water sample using nuclear instrumentation of Liquid Scintillation Counter without waiting for secular equilibrium. This enable measurement to be performed and corrected using mathematical model without spending time for secular equilibrium as done traditionally. Therefore, allow more water samples to be tested and can help authorities carry out effective monitoring programme to identify and regulate high Ra-226 water resources for public safety, better water management and environment protection.

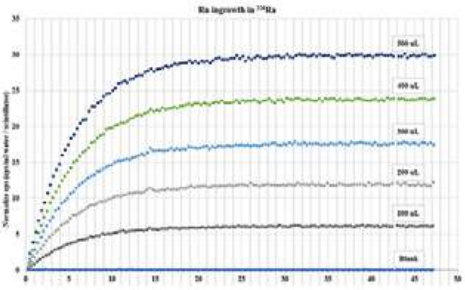
EXPERIMENTAL

ADVANTAGES VS DISADVANTAGES

	Parameters	Rapid screening method	Gamma Spectrometry method	Alpha Spectrometry method
Advantages	Process Duration	10 – 14 days	> 1 month	2 – 3 weeks (but may need to repeat the whole process if radionuclides not well separated and low recovery; Recovery need to be measure with Gamma Spectrometry)
	Sample volume	10 mL	> 2 – 20 L	100 mL – 20 L
	Preparation	Simple & Direct	Evaporation to smaller volume (eg. 2 L to 500 mL)	Pre-concentrate / precipitation followed by chemical separation and purification
	Waste generated	10 ml scintillator + vial	Counting container	Lots of chemical waste (acids, resin, precipitate, etc)
	Measurement	100 – 200 samples can be prepared simultaneously and queue for automated counting	Not easily adopt to automated counting (each time one sample)	Alpha discs have to be counted individually, limited by the number of chambers on Alpha System
	Operation Cost	Low (simple chemical)	Intermediate (evaporate – hot plate, long duration)	High (evaporate – hot plate, chemical & resin)
Disadvantages	Sample types	May not be suitable for high salinity / TDS / colour (due to quenching effect)	Not suitable for high salinity/TDS but not affect by colour	Pre-preparation steps can remove high salinity / TDS and colour
	Detection limit	0.5 – 0.8 Bq/L	0.3 – 1.0 Bq/L	< 0.1 Bq/L
	Radionuclides measured	Only Ra-226	Ra-226, Ra-228	Ra-226, Ra-223, Ra-224

TDS – Total Dissolved Solid

METHOD RELIABILITY



Tested with various concentration of spiked Ra-226 had proven consistency of this method.

NOVELTY

New approach to measure Ra-226 in water using immiscible cocktail and small sample size without secular equilibrium.

TRL: 5

Technology already developed by us & currently fine tune using various types of water samples.

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NUKLEAR MALAYSIA

ANUGERAH INOVASI NUKLEAR KEBANGSAAN
NATIONAL NUCLEAR INNOVATION AWARD

Radiation Crosslinked Halogen-Free Flame Retardant PVC Compound for Low Voltage Cable with Enhanced Fire Safety Performance

Nor Azwin Shukri, Norshafarina Ismail, Noora'tiqah Mohamad Fauzi, Muhammad Hazim Muhammad Sayuti, Sarala a/p Selambakkannu, Pairu Ibrahim, Chan Chang Choy, Zulkafli Ghazali, A'liya Abdul Laziz, Norazrina Mat Jali, Kugana a/p Ellangovan, Nur Latheifa Sofea Saufi Hamizal, Mohammad Najmi Ab Razak

N.U.R
NUKLEAR UNTUK RAKYAT

Crosslinking allows wires and cables to be utilized at temperatures above their intrinsic softening point for an extended period and also protects the insulations from severe deformation for high currents and temperatures

PVC CABLE INSULATION

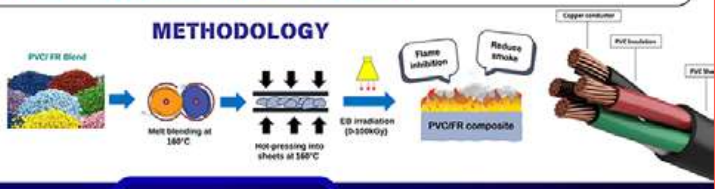
- PVC is most commonly used for conductor insulation ~ 65% used in the wire and cable industry
- PVC insulated cables are lightweight, flexible, and also resistant to moisture, chemicals, and abrasions
- PVC has the lowest environmental footprint due to its ~58% chlorine content, so only ~42% is based on petroleum as compared to almost 100% petroleum content in polyolefin

WONDERFUL EBEAM CABLE
TECHNOLOGY READINESS LEVEL: 7 (Demonstration of prototype)

PROBLEM STATEMENT

- PVC by itself is a robust material and thermally not stable. Short circuit in PVC insulation cable cause overheating which can lead to ignition of fire
- According to fire statistics released by the Fire and Rescue Department (BOMBA), 34,902 cases of fire were recorded in 2022 with the majority of fire emergencies occurring in residential buildings, followed by public locations such as hospitals, religious institutions, schools and universities
- Based on their forensic data, the most frequently reported causes of the fire were electrical short circuits, electrical overloading and resistance heating

METHODOLOGY



THERMAL INSULATION MATERIAL MARKET

Expected to worth USD 96bil by 2028

POTENTIAL APPLICATIONS

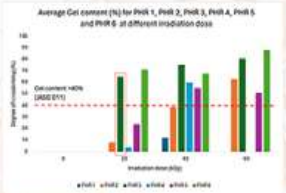
NOVELTY

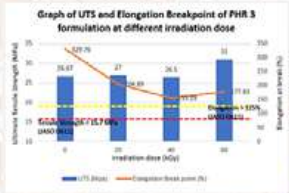
Advanced EB Crosslinked Low-smoke Halogen-free Flame-retardant Compound with enhanced properties and fire safety performance

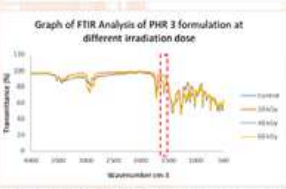
RESEARCH BENCHMARK

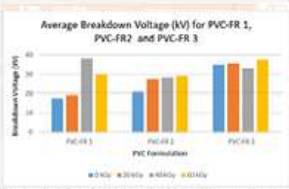
Desirable degree of crosslinking: >40%	Tensile strength: >9 Mpa Elongation at break: > 125%	Limiting oxygen index >25%

RESEARCH FINDINGS









MECHANISM OF FLAME RETARDANT

THE FIRE TRIANGLE

FR acts at one or several key phases of the burning process:

- ❑ Remove H+ and OH- radicals
- ❑ Prevent breakdown of materials to flammable gas
- ❑ Produce a 'char' layer on the material surface
- ❑ Emit nitrogen and other non-flamable gas
- ❑ Release water – cooling effect and dilution of flame

POTENTIAL FOR COMMERCIALIZATION

Insulation Material	Cross Section Area (mm2)	Material Weight (kg/km)	Copper Price (RM/Mt)	Cost (RM/km)
PVC	20	178	26,460.00	4,709.88
XL-PVC	15	133.5	26,460.00	3,532.41

33% OF MATERIAL COST SAVING!!

Acknowledgement: Thank you for the technical support provided by Universiti Pertahanan Nasional Malaysia (UPNM), Universiti Teknologi Malaysia (UTM), and Wonderful Ebeam Cable Sdn Bhd

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ANUGERAH INOVASI NUKLEAR KEBANGSAAN
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The active ethanol fraction from the herb *Aquilaria malaccensis* for antioxidant soap production

Mohd Kamal Nik Hasan, Ihsan Safwan Kamarazaman, Daryl Jesus Arapoc, Zaridah Mohamad Zaki, Azman Mohamed, Muhammad Alif Haikal Asman

N.U.R NUKLEAR UNTUK RAKYAT

INTRODUCTION

Aquilaria malaccensis (AM) is a species of plant in the Thymelaeaceae family. It is found in Bangladesh, Bhutan, India, Indonesia, Laos, Malaysia, Myanmar, Philippines, Singapore, and Thailand. AM is the main source of agarwood, a resinous heartwood used for perfume and incense. When oil is extracted from AM, a water extract is produced as a by-product.

The active ethanol fraction of AM was extracted from the AM water extract. The content of phenolic compounds in the active ethanol fraction of AM is high and this compound has a very high antioxidant activity and make it suitable for cosmetic products for human use.

Methodology

Aquilaria malaccensis

↓

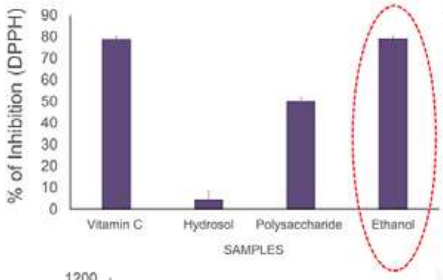
Hydro distillation process

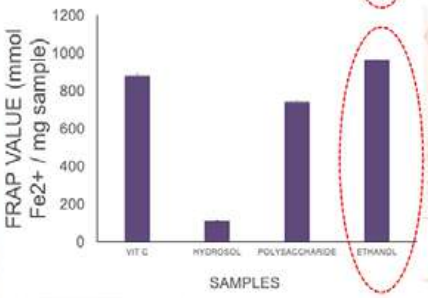
↓

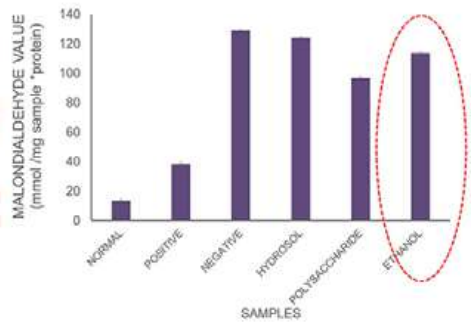
Byproduct AM water extract → Evaporation process → Add ethanol → Antioxidant test → DPPH, MDA, FRAP → Antioxidant soap production

Resinous oil

RESULTS







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ANUGERAH INOVASI NUKLEAR KEBANGSAAN
NATIONAL NUCLEAR INNOVATION AWARD

ECO-FRIENDLY SHELTER FROM IRRADIATED RECYCLED HDPE/BAMBOO FIBER COMPOSITE

Pairu Ibrahim, Dr. Nor Azwin Shukri, Muhamad Nurfalah Karoji, Ts Dr. Maidiana Othman, Dr. Norazrina Mat Jali, Nur Lathefa Sofea Saufi Hamizal,Kugana A/P Ellangovan, Muhammad Razlan Ariff Marzuki

N.U.R NUKLEAR UNTUK RAKYAT

INTRODUCTION

- High-Density Polyethylene (HDPE) waste has surged alarmingly, with 91% of it being discarded, posing significant environmental challenges.
- This project aims to address this environmental challenge by developing eco-friendly shelters from irradiated recycled HDPE/bamboo fiber composites.
- This innovative approach not only contributes to sustainable infrastructure but also aligns with the United Nations' 11th Sustainable Development Goal, promoting sustainable cities and communities.

PROBLEM STATEMENT

- The challenge to determine the ideal ratio of bamboo fibers mixed with recycled HDPE to create a strong and environmentally friendly composite material for disaster relief shelters.
- Limited research of composite on the impact of weathering exposure as it is essential to evaluate the ability to withstand natural disasters and serve as temporary shelters.

METHODOLOGY

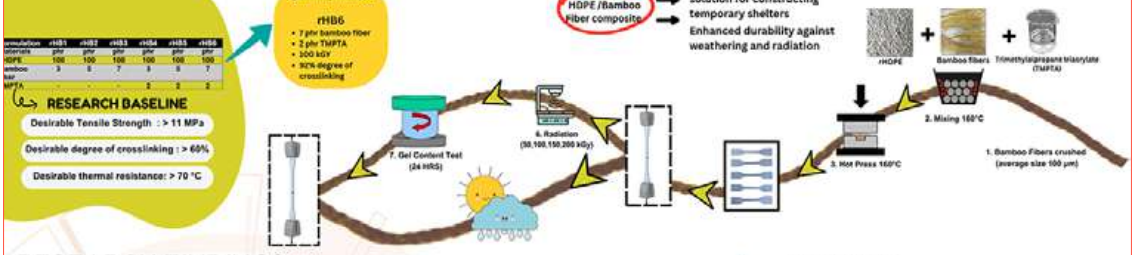
Recycled HDPE → Easily found; Acts as a matrix; Low cost

Bamboo fibers → Extracted from bamboo culm; Enhance strength and moisture absorption

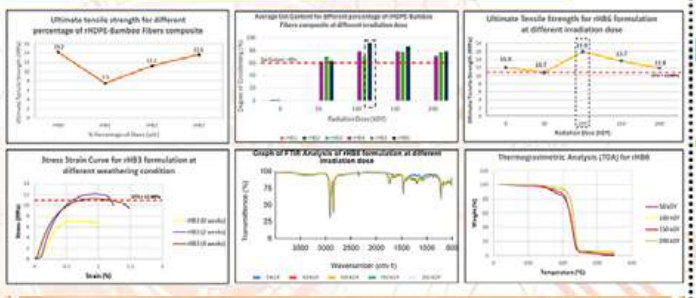
Recycled HDPE /Bamboo Fiber composite → Provides an innovative solution for constructing temporary shelters; Enhanced durability against weathering and radiation

Optimum parameter: rHB6
- 7 phr bamboo fiber
- 2 phr TMPTA
- 100 kGy
- 92% degree of crosslinking

RESEARCH BASELINE
- Desirable Tensile Strength : > 11 MPa
- Desirable degree of crosslinking : > 60%
- Desirable thermal resistance: > 70 °C



RESEARCH FINDINGS



NOVELTY

The novelty in this research lies in the use of the electron beam irradiation process that improved the bonding between recycled HDPE and bamboo fibers, leading to a biocomposite with enhanced mechanical properties.

POTENTIAL COMMERCIALIZATION

GLOBAL TEMPORARY SHELTER MARKET

Expected Growth Rate Through 2028: 5.1%

Expected Market Size By 2028: $57.5 Bn

PRICE COMPARISON

$420 USD excluding transport
Ref:https://emergency.unhcr.org

$300 USD excluding transport
Ref: https://skilford.wordpress.com (Portable emergency shelter design)

POTENTIAL APPLICATION:

- Disaster Relief
- Temporary Structure
- Rural development
- Green tourism

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NUKLEAR MALAYSIA

ANUGERAH INOVASI NUKLEAR KEBANGSAAN
NATIONAL NUCLEAR INNOVATION AWARD

MICROBIOLOGICAL TEST INFORMATION SYSTEM (MBIOTEST)

Dr. Mohamad Safuan Sulaiman, Rahimah Abdul Rahim, Noraisyah Mohd Yusof, Ts. Dzul Aiman Aslan, Nurfatini Abdul Ghani, Nursuliza Samsudin, Ahmad Adib Afham Abdul Rahman, Ahmad Adhwa Asyraf Hashim & Muhamad Syazwan Zulkifli

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DESCRIPTION OF INNOVATION

The MBioTest system is an innovative, centralized, internet-based platform developed for microbiological testing laboratory. It ensures high accessibility for multiple users at anytime and anywhere. Designed for high availability, it uses virtual technology and a backup system to guarantee uptime. The system features multi-tier redundancy, separating system codes, databases, web services, and backups for continuity. Prioritizing security, it incorporates secure user access, the latest operating systems, and hardware to mitigate cyber-attack risks. User-friendliness is enhanced with a barcode/QR code system for sample tracking. MBioTest upgrades VBMikrotestV01, addressing its limitations with modern solutions. Tailored to contemporary standards, it offers a robust, scalable, and efficient platform, developed using agile methodology for microbiological testing laboratory.

OBJECTIVE

1. To develop a new system - Replace the outdated VBMikrotestV01 system
2. To meet microbiological test laboratory and modern user requirements - Align with current technological needs, microbiological test laboratory standard and user expectations.
3. To strengthen security - Implement robust data protection and system security measures to ensure high data integrity of the microbiological test laboratory.
4. To enhance user-friendliness - Provide efficient user interface, including features for generating certificates and tracking sample status.

BENEFIT & IMPACT

Economic

- Centralization and Automation: Reduces costs and enhances efficiency.
- Faster Turnaround Times: Leads to increased productivity.
- Scalability: Achieves growth without significant additional investment.
- High Availability and Maintainability: Ensures minimal downtime.

Social

- User-Friendly Design: Reduces training time and increases job satisfaction.
- Transparency and Accountability: Detailed reports foster these qualities.

Environmental

- Digital Platform: Reduces paper use and decreases deforestation.
- Efficient Servers: Minimizes energy consumption.
- Sustainable Practices: Optimizes data management and lab processes, reducing the environmental footprint.

SYSTEM DEVELOPMENT

UNIQUENESS

A robust, scalable, secure, reliable and user-friendly system solution tailored to modern requirements and technological advancements in the area of microbiological test laboratory

CONTRIBUTION TO NEW KNOWLEDGE

Cumulative Microbiological Test Laboratory Data Management:

1. Digitalize Manual Data and fulfilling Laboratory Requirements & Standards.
2. Facilitates Nuclear Technology Development in Medical Industrial & Environmental sector through a New System that Provide Dashboard to Support Decision Making.

Innovation with Digital Technology:

1. Enhancing Microbiological Testing Processes through advancement of ICT
2. Creates an innovative and efficient system.

PUBLICATION

1. Mohamad Safuan B. Sulaiman; Rahimah Bt. Abdul Rahim; Noraisyah Bt. Mohd Yusof; Nur Fatini binti Abd Ghani; Nursuliza Bt. Samsudin; Ahmad Adib Afham Bin Abdul Rahman; Mohd Dzul Aiman Bin Aslan; Ahmad Adhwa Asyraf Bin Hashim; Muhamad Syazwan bin Zulkifli; Siti Nurbahyah Bt. Hamdan." Design and Implementation of User Acceptance Test (UAT) for MBioTest System", R&D Seminar 2024 Nuclear Malaysia.
2. Mohamad Safuan Sulaiman, Nurfatini Abd Ghani, Nursuliza Samsudin, Rahimah Abdul Rahim, Noraisyah Mohd Yusof, Mohd Dzul Aiman Aslan, Ahmad Adhwa Asyraf Bin Hashim, Muhamad Syazwan Bin Zulkifli, "Development of MBioTest Database Architecture for Microbiology Laboratory Test", R&D Seminar 2022 Nuclear Malaysia.
3. Mohamad Safuan Sulaiman, Rahimah Abdul Rahim, Noraisyah Mohd Yusof, Nurfatini Abd Ghani, Nursuliza Samsudin, Mohd Dzul Aiman Aslan, Othman Mahmud and Norasmidah Jazam (2021). Development of Microbiological Test Information System (MBioTest). Nuclear Technical Convention, 26-28 Okt 2021.

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ANUGERAH INOVASI NUKLEAR KEBANGSAAN
NATIONAL NUCLEAR INNOVATION AWARD

RADIATION SHIELDING PROPERTIES OF SPENT COFFEE GROUNDS AGAINST NEUTRONS

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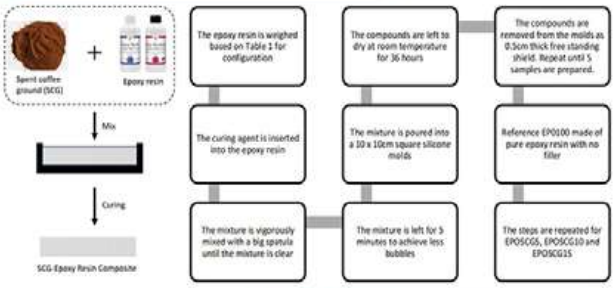
[b]Bahagian Teknologi Industri, uklear Malaysia

N.U.R NUKLEAR UNTUK RAKYAT

INTRODUCTION

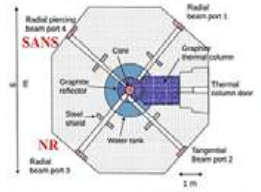
- Spent coffee ground (SCG) and epoxy resin composites are fabricated with different thicknesses and compositions.
- As the thickness of composites increases, the neutron dose rate decreases.
- An increase in SCG content enhances the performance as neutron shielding.
- Agglomeration, which causes uneven distribution of SCG in the composite samples, leading to inconsistent results.

SAMPLE FABRICATION

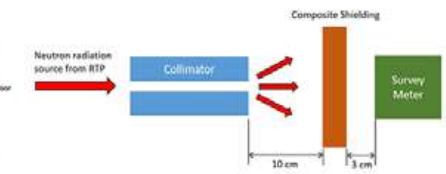


EXPERIMENT SETUP

- SANS (beam port 4) of Reactor Triga Puspati

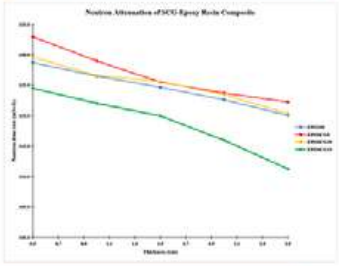


Cutting view of RTP (Zin et al., 2020)



Setup

RESULT



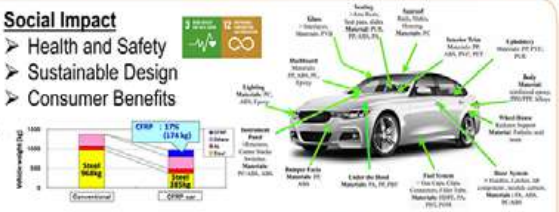
NOVELTY AND IMPACT TO SOCIAL, ECONOMY AND ENVIRONMENT

Novelty

- Durability and Remoldability
- Shield against Neutron Radiation
- Customizable Shielding Properties

Social Impact

- Health and Safety
- Sustainable Design
- Consumer Benefits

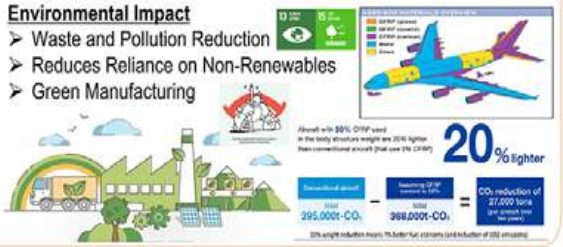


Economic Impact

- Cost Reduction
- Market Expansion
- Waste Management

Environmental Impact

- Waste and Pollution Reduction
- Reduces Reliance on Non-Renewables
- Green Manufacturing



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ANUGERAH INOVASI NUKLEAR KEBANGSAAN
NATIONAL NUCLEAR INNOVATION AWARD

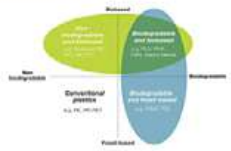
BIODEGRADABLE PLASTIC FROM RAMBUTAN SEED

Eleen Dayana Mohamed Isa, Roshafima Rasit Ali, Thanusha Subaramaniam
Malaysia-Japan International Institute of Technology (MJIIT), UTM KL

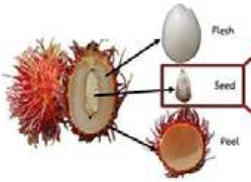
N.U.R NUKLEAR UNTUK RAKYAT

RESEARCH BACKGROUND

Global Plastic Usage



Type of biodegradable plastics



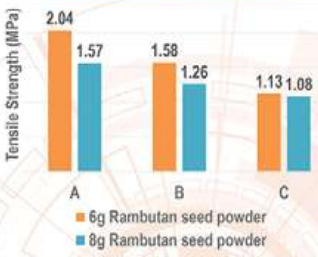
Moisture content : 9.6±3.52 wt%
Crude protein : 7.6±0.14 wt%
Crude fiber : 2.4±0.32 wt%
Lipid: 38.0±4.36 wt%
Carbohydrate : 28.7±0.43 wt%
Ash content : 1.22-2.26 wt%

FORMULATION

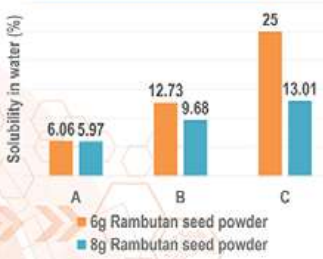
SET	SAMPLE	RAMBUTAN SEED POWDER	GLYCEROL	GELATIN	CITRIC ACID
1	A	6 g	1 mL	5 g	1 g
	B		2 mL		
	C		3 mL		
2	A	8 g	1 mL		
	B		2 mL		
	C		3 mL		

FINDINGS

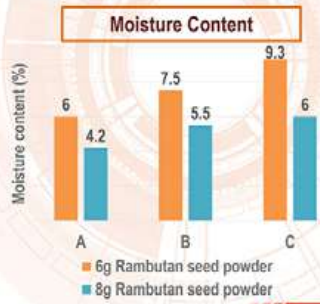
Tensile Strength



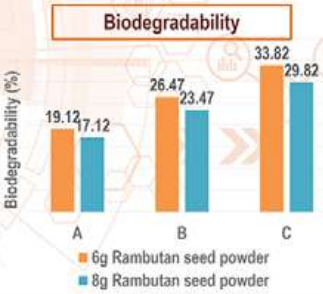
Water Solubility



Moisture Content



Biodegradability



CONCLUSION

- **Sample A from Set 2** is the **most suitable for packaging** due to its superior mechanical properties, lower water solubility, and lower moisture content.
- These characteristics make it durable and resistant to moisture, ensuring the packaging remains intact and effective in various conditions, enhancing its practicality and reliability for commercial use.

CONTACT DETAILS

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Hari Inovasi Agensi Nuklear Malaysia

NUKLEAR MALAYSIA

ANUGERAH INOVASI NUKLEAR KEBANGSAAN
NATIONAL NUCLEAR INNOVATION AWARD

RAMOS : RISK ASSESSMENT MATRIX OF OCCUPATIONAL STRESS APPs

Dr. Norwahida Yaakub, Dr. Ayuni Nabilah Alias, Dr. Hajar Mariah Hashim, Prof. Madya Dr Mohd Rafee Baharuddin, Ts Dr Mohamad Azhar Mohd Noor, Nur Fazhilah Abdul Razak

N.U.R NUKLEAR UNTUK RAKYAT

BACKGROUND

Psychosocial risks have a significant impact on the physical and mental health of employees due to insufficient knowledge and guidance on identifying assessing occupational stress in the workplace.

A guided risk assessment tool is vital to predict, prevent the issue and improve the health and wellbeing of their employees.

RAMOS Apps is developed to support OSHMP2025 Strategy 6 through OSH risk management through digital technology. It is important to digitalize the matrix, so it will be easy to assess, record, improved data sharing, realistic decision making.

METHODOLOGY

RAMOS Apps

NOVELTY

- **FIRST fully automated tool** developed to guide and quantify the level of occupational stress risk and CMF analysis based on STRESSOR elements in line with Guideline DOSH and Standard ISO.
- Ability to self-guided and identify the gaps of occupational stress risk factor. It will encourage and guide industries

APPLICATION

- Suitable to be used to empower risk management focusing on occupational stress risk factors in all sectors.
- The developed product is more practically evaluated and systematic monitoring which indirectly achieve a solution from the occurrence of serious / complaint issues
- Compliance with objective OSHA 1994 will promote an occupational environment for persons at work which is adapted to their physiological and psychological needs.

INNOVATION

- Product development, validation by OSH expert and testing with worker in industry. It can be accessed via phone and laptop.
- Psychosocial Impact - offers insights into available accurate and reliable integrated data with dual languages.

PUBLICATION & COPYRIGHT

PUBLICATION

- Determinants of Occupational Stress In Container Port Industry–An Application Of Structural Equation Modelling Approach. Journal of Positive School Psychology (2022)
- Developing a Risk Control Modifying Matrix in Assessing Occupational Stress in Port Terminal. International Journal of Recent Technology and Engineering (2019)

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RAMOS Tool : LY2023C01899

ENVIRONMENTAL IMPACT

- Eco-friendly system tool and does not create waste
- Save time and resources (guided, paperless and digitalized).

COMMERCIALISATION

- Target potential market = 1000 device
  Estimate commercial value = RM 1500 x 1000 = **RM 150,000**
- The target user focused to employers, OSH/Industrial Practitioner & DOSH Officer.

AWARDS

- Gold Medal CITREX 2024
- Silver Medal ITEX 2023

FUNDER

Risk Assessment for Occupational Stress (RDU220370) funded By UMPSA

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UNIVERSITI MALAYSIA PAHANG AL-SULTAN ABDULLAH

ANUGERAH INOVASI NUKLEAR KEBANGSAAN
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DIGITAL REACTIVITY METER FOR RESEARCH, TRAINING AND SAFE OPERATION OF NUCLEAR REACTOR (DReaM-Rx)

Ts. Dr. Mohd Sabri Minhat, Dr. Julia Abdul Karim, Zareen Khan Abdul Jalil Khan, Mohd Khairulezwan Abdul Manan, Nurfarhana Ayuni Joha, Khairul Anwar Bapujee, Muhammad Zulhelmi Mahadi, Mohamad Amirudin Mohamad Rosli, Shahril Mohd Shah

N.U.R
NUKLEAR UNTUK RAKYAT

INTRODUCTION

Nuclear reactors are complex systems that require precise monitoring and control to ensure safe and efficient operation. Among the critical parameters to be monitored, reactor reactivity plays a central role. Reactivity is a measure of the reactor's deviation from criticality, and accurate real-time measurement of reactivity is crucial for maintaining reactor stability, optimizing performance, and ensuring safety.

Figure 1: Reactor Operating Console for Nuclear Plant

PROBLEM STATEMENT

The traditional methods of reactivity measurement in nuclear reactors, while effective to an extent, suffer from several limitations. **Manual calculations** are labor-intensive and subject to inaccuracies, especially under dynamic operating conditions. **Analog instruments**, though reliable, lack the precision and real-time processing capabilities needed for modern reactor operations. There is a pressing need for a system that can provide accurate, real-time reactivity data with minimal human intervention.

Figure 2: Nuclear Research and Power Reactor

OBJECTIVES

- ✓ **To Develop a Digital Reactivity Meter**: Utilize Inverse Point Kinetic Equations (IPK) for precise, real-time reactivity measurements.
- ✓ **To Create a User-Friendly Interface**: Design an intuitive Graphical User Interface (GUI) to simplify reactivity measurement and enhance safety.
- ✓ **To Automate Analysis and Visualization**: Implement LabVIEW for automated data processing and visualization.
- ✓ **To Ensure Flexibility**: Develop a modular system adaptable to various reactor types and research needs.

BENEFITS & IMPACT

Economical

1) **Cost Efficiency**: Reduces manual checks and lowering operational costs.
2) **Enhanced Productivity**: Improves measurement accuracy and boosting reactor performance.
3) **Market Competitiveness**: Positions nuclear facilities as innovation leaders and attracting investment.

Social

1) **Safety Enhancement**: Increases reactor safety, reducing accident risks and protecting people.
2) **Training and Education**: Serves as a valuable tool for training operators, researchers, and students.
3) **Public Confidence**: Boosts confidence in nuclear reactor (nuclear energy and research) as safe and reliable.

Environmental

1) **Sustainable Energy**: Supports clean energy generation and reducing emissions.
2) **Resource Efficiency**: Enhances fuel efficiency, reducing waste and environmental impact.
3) **Environmental Protection**: Prevents contamination, safeguarding ecosystems and health.

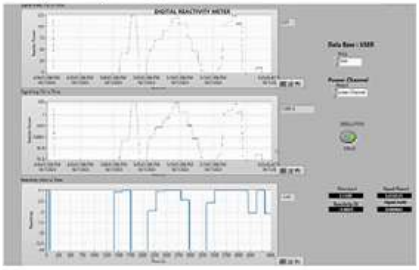

Figure 3: GUI of Digital Reactivity Meter (DReaM-Rx)

CONCLUSION

The **DReaM-Rx** system represents a significant advancement in nuclear reactor monitoring technology, providing real-time, precise, and automated reactivity analysis. It improves measurement accuracy, operational efficiency, safety standards, supporting sustainable energy goals and training capabilities.

ACKNOWLEDGEMENTS

The authors would like to thank all individuals who have contributed to this innovation project, especially the Reactor Technology Center and the top management of the Malaysian Nuclear Agency for their support.

HARI INOVASI
NUKLEAR MALAYSIA 2024

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ANUGERAH INOVASI NUKLEAR KEBANGSAAN
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Enhancing Nuclear Safety and Security with the k0 Method: New Standards for Thorium, Uranium, and Plutonium Analysis Using Gamma Spectrometry and IAEA Data

KHOO KOK SIONG, MUHAMMAD ARIF HAKIMI BIN SAIRU BAHRI, AMIRUL AKMAL FAROOQ BIN AMINUDDIN, MUHAMMAD AMIR BIN MOHD ABD NASIR

N.U.R NUKLEAR UNTUK RAKYAT

Introduction:

- Nuclear safety and security are crucial due to the hazards of nuclear materials. The k0-NuMat software improves the accuracy of nuclear material analysis with advanced computational methods. This innovation sets new standards by using advanced techniques and comprehensive data integration.
- $$P_{a} = \frac{\left(\frac{N_p}{wSDCt_c}\right)_a}{A_{sp,std}} \frac{1}{k_{0,std}(a)} \left(\frac{f + Q_{0,std}(\alpha)}{f + Q_{0,a}(\alpha)}\right) \frac{\varepsilon_{p,std}}{\varepsilon_{p,a}}$$

Objectives:

- To develop new analytical standards for thorium, uranium, and plutonium.
- To enhance accuracy of nuclear material concentration measurements.
- To address data gaps in nuclear material radioisotopes.

Potential for Commercialization:

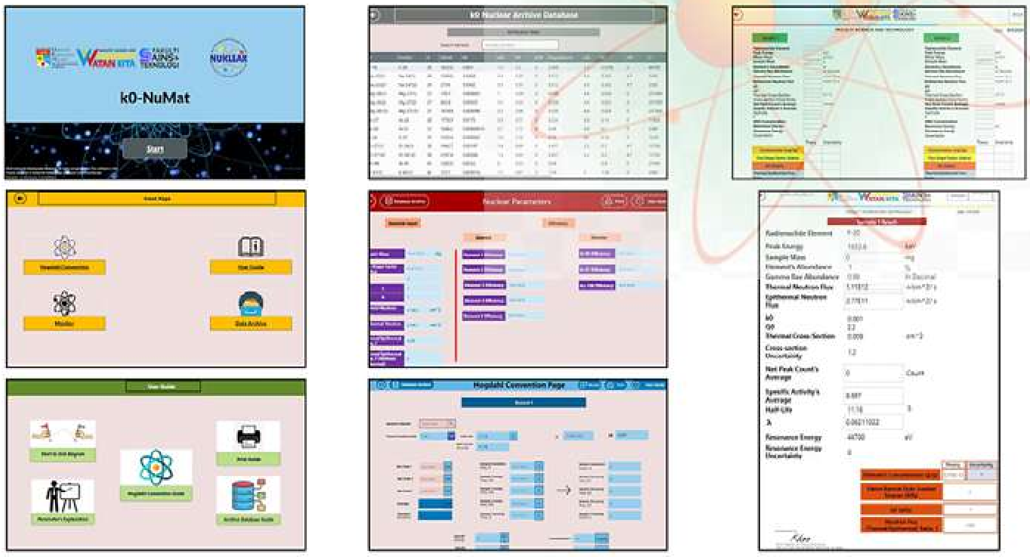
The k0-NuMat software is scalable and adaptable, making it suitable for diverse applications. Its user-friendly design ensures broad adoption by professionals, enhancing its commercial viability.

Originality of Innovation:

The k0-NuMat software is a major advancement in nuclear material analysis. It integrates a k0 nuclear database with Google Sheets for real-time updates and easy access. Using Hogdahl's Convention, it improves neutron flux measurement accuracy and enables analysis of Th, U, and Pu radioisotopes, providing new and previously unavailable data.

Application and Impact of Research Findings and Innovation:

The k0-NuMat software accurately measures nuclear material concentrations, essential for safety and compliance. It enhances nuclear safety protocols, reducing incident risks. Its potential to set new international standards could greatly improve global nuclear safety practices, promoting a safer environment.



Contribution to Nuclear Technology:

The k0-NuMat software offers new data on nuclear material radioisotopes, closing important knowledge gaps. It improves k0-INAA and gamma spectrometry techniques, advancing nuclear technology. Additionally, it is a valuable educational tool for researchers and students, promoting further study in nuclear sciences.

Status of Innovation:

The k0-NuMat software is fully developed, tested, and validated with sample data for reliability and accuracy. Continuous updates and improvements are planned to keep it relevant and effective in advancing nuclear material analysis.

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Universiti Kebangsaan Malaysia The National University of Malaysia

NUKLEAR MALAYSIA

ANUGERAH INOVASI NUKLEAR KEBANGSAAN
NATIONAL NUCLEAR INNOVATION AWARD

B-CUTLER 462; A NOVEL BIOCOMPOSITE FROM AGRICULTURE WASTE FOR BIODEGRADABLE CUTLERY

Nor Hakimin Abdullah, Dr. Nik Alnur Auli Nik Yusuf, Dr Muhammad Iqbal Ahmad, Ts. Dr. Muhammad Luqman Nordin, Ts. Dr. Azmul Fadhli, Dr Mohammad Khairul Azhar Bin Abdul Razab

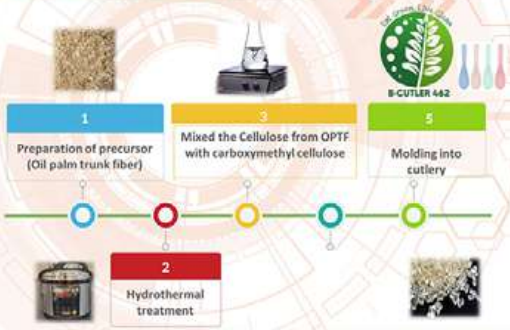
N.U.R NUKLEAR UNTUK RAKYAT

INTRODUCTION

It is known that Malaysia is one of the biggest producers of palm oil products, and according to a report by the Malaysian Palm Oil Council (MPOC), the production of crude palm oil in 2020 was 19.14 million tonnes. Malaysian Palm Oil Certification Council (MPOCC) has introduced the Malaysia Sustainable Palm Oil (MSPO) certification to ensure the sustainability of the palm oil industry in Malaysia. To support our local oil palm industry, we took the initiative by implementing the waste-to-wealth concept, which is in line with Sustainable Development Goals (SDG), where we turn the palm oil trunk waste into a new useful product, which is the plant-based cutlery/utensil. Our plant-based cutlery/utensil could fill the void among consumers to look for clean-label, non-animal, and plant-based products.

PROBLEM STATEMENT

METHODOLOGY



IMPACT

Environment
Waste to wealth

Society
Reduce the environmental impact

Industry
A novel biodegradable cutlery

CONTRIBUTION TO NUCLEAR/ RADIATION APPLICATION

The microcrystalline cellulose in this project was characterized:

- X-ray Diffraction (XRD)
- Field Emission Scanning Electron Microscopy (FESEM)
- The characterization results were presented at the **international conference** and published in the **scientific journals**

ACHIEVEMENTS

PUBLICATIONS

1.Preparation & Characterization of Microcrystalline Cellulose from Agriculture Waste. IOP Conf. Ser.:, Earth Environ. Sci., 596, 012035 (Scopus)

2.Effect of Cellulose Nanofibers (CNF) as Reinforcement in Polyvinyl Alcohol/CNF Biocomposite. J. Phys.: Conf. Ser. 2129 012057 (Scopus)

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PI2021004084 LY2021C01448

AWARDS (3 Gold Medals & 2 Special Award)

CONCLUSION

We successfully implemented the waste-to-wealth concept to turn palm oil trunk waste into plant-based cutlery/utensils. Our plant-based cutlery/utensil could fill the void among consumers to look for clean-label, non-animal, and plant-based products

ACKNOWLEDGEMENT

KPT Universiti Malaysia Kelantan (R/FRGS/A1300/00462A/003/2019/00713)

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ANUGERAH INOVASI NUKLEAR KEBANGSAAN
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ViPro- VIBRATING INSOLE PROTOTYPE

IP No: AR2024W04725

Dr. Ayuni Nabilah Alias (UPM)*, Prof. Madya Dr. Karmegam Karuppiah (UPM), Dr. Norwahida Yakub@Yaakub (UMPSA), Fazilah Abdul Razak (UMPSA), Dr. Nurulain Mustafa Udin (UiTM)

N.U.R NUKLEAR UNTUK RAKYAT

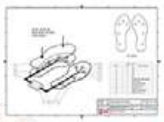
ABSTRACT

Vibrating Insole Prototype or also known as ViPro is a device specifically designed to be placed inside footwear. It uses **vibrations to provide a massage-like effect to the feet**, aiming to improve comfort and reduce fatigue. This prototype includes components such as **vibration tactors and a power source of control box**. This design ensure the device's efficiency and workers' comfort during various activities such as walking, standing and sitting. By integrating mechanical stimulation with noise reduction, this insole addresses both **comfort and practicality**, making it a unique solution in workplace environments. Its innovative approach ensures that workers receive the benefits of vibration effects without disturbing their work activities. In alignment with Malaysia's National Nuclear Policy 2030, which **emphasizes safety and security**, this ViPro is designed with worker's safety and health in mind.

DESIGN AND SPECIFICATIONS

- **Five vibrating electromechanical tactors** with were embedded in the insoles' middle layer to transmit vibrations to the feet plantar surface.
- Five significant areas chosen based on the **high-pressure distribution of feet** (the plantar side of Medial Forefoot, Central Forefoot, Lateral Forefoot, Lateral Midfoot, and Lateral Heel (Alias et al., 2021).

NO	CRITERIA	REQUIREMENTS
1	Performance	The vibrating insole prototype is real-time system controlled by control box in order to not disturb any movement during normal working condition (sitting, standing, walking) and activities during teaching session.
2	Environment	Anti-bacterial and waterproof insole material.
3	Product life span	It can withstand up to three years with regular maintenance.
4	Materials	Light, comfortable and relatively hard (Shore A50), should not absorb the vibration and adapt well to vibration tactors.
5	Ergonomics	Bottom layer consisted of non-slip high performance.
6	Weight	Light weight material with 18mm thickness.
7	Aesthetics	Non-invasive product with minimal handling.
8	Installation	Easily operated with control box and easily charged using a power bank. The prototype is wearable and mobile without disturbing any movement and activities.



APPLICABILITY

- Workers:
  - ❑ Comfort – provide relief from foot discomfort and fatigue
  - ❑ Improved circulation – helps in enhancing blood flow in the feet
  - ❑ Ease of use – can be used with most types of footwear
  - ❑ Portability- easily portable due to its compact size
  - ❑ Non-invasive – provides a non-medicinal solution for foot pain relief

INNOVATION

TRL 7-9

- ✓ Technology system prototype demonstration in an operational environment
- ✓ Actual technology system completed and qualified through test and demonstration
- ✓ Actual technology system qualified through successful mission operations

COMMERCIALISATION

- Potential to cater wide range of markets due its versatility and numerous benefits (industry, retails, healthcare, office workers and individuals such as elderly and athlete)

SDG IMPACT

3 GOOD HEALTH AND WELL-BEING | 7 AFFORDABLE AND CLEAN ENERGY | 9 INDUSTRY, INNOVATION AND INFRASTRUCTURE | ECO FRIENDLY

COLLABORATION AND FUNDED

RECOGNITION

Special Award-The Best Intervention Award (Quantitative Assessment of Vibrating Insole Prototype that Induced Transient Comfort among Female School Teachers), Human Factors and Ergonomics Malaysia Conference (HFEMC), 2023

PUBLICATION

- **Ayuni Nabilah Alias**, Karmegam Karuppiah, Vivien How, Velu Perumal (2021). Feet Plantar Pressure Distribution among Female School Teachers. Nat. Volatiles & Essent. Oils, NVEO 8(4):4080-4087. (Scopus)
- **Ayuni Nabilah Alias**, Karmegam Karuppiah, Vivien How, Velu Perumal (2020). The Perception on School Footwear Comfort among Primary School Teachers in Terengganu. International Journal of Pharmaceutical Research, 12(3). (Scopus)
- **Ayuni Nabilah Alias**, Karmegam Karuppiah, Vivien How, Velu Perumal (2020). Does Prolonged Standing at Work among Teachers Associated with Musculoskeletal Disorders (MSDs). Malaysia Journal of Medicine and Health Sciences, 16(2):281-289. (Scopus)
- **Ayuni Nabilah Alias**, Karmegam Karuppiah, Vivien How, Velu Perumal (2020) Prevalence of Musculoskeletal Disorders (MSDs) among primary school female school teachers in Terengganu, Malaysia. International Journal of Industrial Ergonomics, 77:102957. (Q2-WOS)

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Seminar R&D Agensi Nuklear Malaysia

27-29 Ogos 2024

Seminar R&D Agensi Nuklear Malaysia

SCREENING ACID TOLANRANCE ACTIVITIES OF *ACINETOBACTER CALCOACETICUS* AS BIOFERTILISER

Phua Choo Kwai Hoe and Mariani Deraman

N.U.R NUKLEAR UNTUK RAKYAT

Abstract

Acid sulphate soils are generally unproductive and reduce farm productivity. The sulfuric acid lowers pH, which makes several soil nutrients less available to plants. Screening tests of biofertilizer microbes (*Acinetobacter calcoaceticus*) for nitrogen fixation activity and population were conducted under various acidity conditions (pH 3.0 to 6.0) using nitrogen screening agar plates and nutrient agar plates. Results of the acid tolerance test showed positive nitrogen fixation screening results for pH 4.0 to 6.0 and pH 7.5 (control) after 3 months of incubation. After three months of incubation under various acidity conditions, populations on agar plates were 10^8 cfu/ml for pH 4.0 to 5.5. Populations at pH 3.5 and 6.0 were lower (10^6 cfu/ml), indicating that *A. calcoaceticus* tolerated these acidity conditions well. Further investigations of these acid tolerance activities on acid soils will be carried out.

Introduction

Food safety and security are critical global issues, with agriculture playing a vital role in ensuring a stable and healthy ecosystem. Biofertilisers, which consist of living microorganisms that enhance plant growth by increasing nutrient availability, are being promoted as a sustainable alternative to chemical fertilizers (Vessey, 2003; FNCA, 2018). These microorganisms contribute to nutrient processes like nitrogen fixation and phosphate solubilisation (Youssef and Eissa, 2014; Kaur and Kaur, 2018). *Acinetobacter* sp., particularly *A. calcoaceticus*, is noted for its plant growth promoting properties, including nutrient solubilisation and hormone production (Suzuki et al., 2014; Bhawsar and Patil, 2015; Moreno-Ramírez et al., 2015; Phua et al., 2019). Given that most agricultural plants thrive in near-neutral pH conditions, soil acidification that leading to toxicities and affecting plant growth are poses a challenge (Msimbira and Smith, 2020). Therefore, isolation acid-tolerant biofertiliser microbes like *A. calcoaceticus* is crucial for sustainable agriculture.

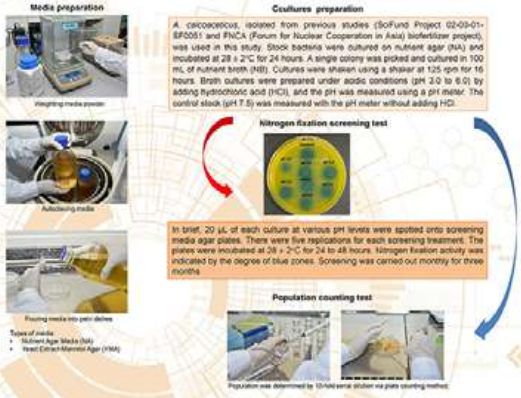
Problem statement

Acidification of the soil is currently a major limitation for sustainable agricultural production.

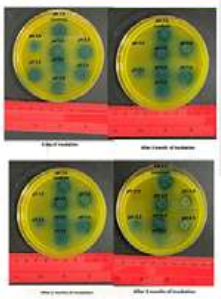
Objectives

The objective of this study is to screen the acid tolerance activities of *A. calcoaceticus* as biofertiliser microbes.

Materials and Methods



Results and Discussion



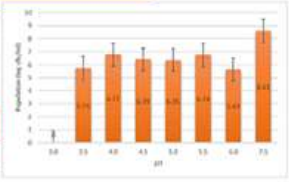


Figure 2. Population of *A. calcoaceticus* (cfu/ml) after 3 months of incubation at various acidic conditions

Figure 1. Screening of acid tolerance test on Nitrogen fixation media for 3 months.

Results of the acid tolerance test showed positive nitrogen fixation screening results for pH 4.0 to 6.0 and pH 7.5 (control) after 3 months of incubation. After three months of incubation under various acidity conditions, populations on agar plates were 10^8 cfu/ml for pH 4.0 to 5.5. Populations at pH 3.5 and 6.0 were lower (10^6 cfu/ml), indicating that *A. calcoaceticus* tolerated these acidity conditions well. Similar results were reported for *Acinetobacter* sp., which grew in the pH range of 4.0 to 7.0 and tolerated up to pH 3.5 (Athuly et al., 2015). Several mechanisms enable microbes to tolerate extreme pH changes, such as the production of extracellular polysaccharides (Gopalakrishnan et al., 2015), the production of glutathione, a tripeptide (Muglia et al., 2007; Wang et al., 2018), the accumulation of high levels of potassium and phosphorus to tolerate low pH (Watkin et al., 2003), and the production of a thin biofilm composed of polysaccharides and proteins. *Acinetobacter* sp. has been reported to produce biofilms and biosurfactants (Jung and Park, 2015), which could be one of the mechanisms contributing to its acid tolerance. This study was an in vitro study; thus, further investigations of these acid tolerance activities in acidic soils could confirm their acid tolerance in natural scenarios.

Conclusion

A. calcoaceticus tolerated pH levels from 4.0 to 6.0 after three months of incubation. Positive results were observed in the nitrogen fixation screening test and population count. In conclusion, *A. calcoaceticus* can function under acidic conditions for a planting season in acidic soils. Further investigation into its performance in acidic soils is recommended.

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EVALUATION OF NEW PROCESS CONFIGURATION FOR PINEAPPLE GAMMA IRRADIATION AS A PHYTOSANITARY TREATMENT

Ahmad Zainuri Mohd Dzomir, Ahsanulkhaliqin Abd Wahab, Syuhada Ramli, Mohd Rizal Chulan, Cosmos George, Zarina Mohd Nor, Wan Muhammad Ikram Wan Ibrahim, Ruzalina Baharin, Hasan Sham, Zulkifli Juhari and Nurul Fatihah Zamri

N.U.R NUKLEAR UNTUK RAKYAT

INTRODUCTION

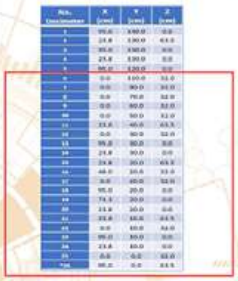
Facility must perform preliminary tests on the agreed process configuration of certain consignments or articles to ensure that it meets all requirements. Process configurations are distinct methods for treating articles with irradiation. Each configuration is defined by a combination of article type and size, packaging materials, stacking pattern, bulk density, density distribution, and other factors that affect the absorption of radiation and measurement of absorbed dose during treatment. All work done during this preliminary testing must follow facility's standard operating procedures and applicable ASTM standards. All dosimetry systems used must have applicable dose ranges as specified in ISO/ASTM 51261:2013 Practice for Calibration of Routine Dosimetry Systems for Radiation Processing (ASTM, 2013). When the preliminary testing is complete and the facility is satisfied that the new configuration will meet the requirements of all concerned parties, the results of the preliminary facility testing then submitted to regulatory authorities such as APHIS for review.

Thus, the objectives of this study are to 1) calibrate optichromic FWT-70-40M, and 2) design the process configurations for pineapple and validate that the delivery of the minimum dose (D_{min}) is ensured. This target is accomplished through (i) dose mapping the configuration and (ii) creating a straightforward mathematical model for estimating doses during routine treatments, as outlined in APHIS's guidelines for approving new process configurations for irradiation treatments and the new process configuration worksheet (APHIS, 2010).

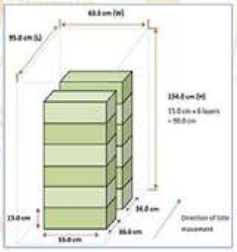
MATERIALS AND METHODS

Calibration of optichromic FWT-70-40M. The type of dosimeters used were optichromic, FWT-70-40 dosimeters, specifically from a new batch Lot#1177 by Far West Technology Inc., US (FWT, U.S.) were used. Optichromic dosimeters are clear small optical wave guides with dose measurement range from 0.01 to 10 kGy which gradually change to deep blue as the absorbed dose increases.

Dosimetry. Dosimeter were placed at 19 out of 25 specific locations throughout the load to provide a clear indication of the areas receiving the highest and lowest dose (no.6 to no. 25). An additional dosimeter was placed at a reference location to monitor dose during routine treatments, resulting in a total of 20 out of 25 dosimeter being positioned in their respective zones. These coordinates were selected based on previous operation qualification exercise (Cosmos et al. 2023).



Irradiation. The pineapple cv Royal Rompine MD2 selected in the study were supplied by Malaysian Department of Agriculture (DOA). They were provided pre-packaged in carton boxes measuring 36.0 cm x 55.0 cm x 15.0 cm, with an average carton unit weight of 8.62 ± 0.5 kg. loading pattern in the tote was determined to be 12 carton per tote, arranged in a 2 x 1 x 6 configuration (W x L x H) in triplicates. Irradiation was performed at Sinagama, with cycle time, C_t of 4 minutes was set as the working master timer.



RESULT AND DISCUSSION

Figure 1. Calibration curve of FWT-70-40M batch #1177 at 656nm

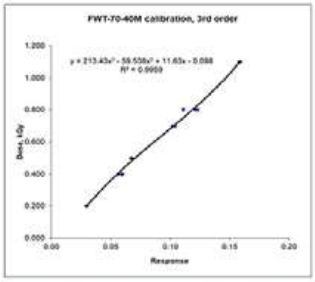


Table 1. Minimum and maximum equivalence zone of pineapple dose mapping

Zone/ Coordinate	Dose Tote 1	Tote 2	Tote 3	Mean (Gy)	Standard Deviation (n=3)	Coefficient variation (%)	Note
15	824.0	820.5	831.5	825.3	5.62	0.7	Max
25	612.0	581.5	573.0	588.8	20.5	3.5	Min
26	791.0	790.0	793.0	791.3	1.50	0.2	Ref

Mean D_{rm} position no. 26 = 791.3 Gy

Mean D_{min} = 588.8 Gy

Mean D_{max} = 825.3 Gy

$$a = \frac{D_{min}}{D_{rm}} = \frac{588.8}{791.3} = 0.74$$

$$b = \frac{D_{max}}{D_{rm}} = \frac{825.3}{791.3} = 1.04$$

CONCLUSION

This study demonstrated that the facility is capable of processing pineapples at specified configuration to achieve the minimum dose (D_{min}) above 400 Gy. The data indicates that the range of actual absorbed dose for pineapple cv Royal Rompine (MD2) with packing density of 0.11g/cm^3 packing density has been validated between 588.8 to 825.3 Gy. Using the dose value of 791.3 Gy at the reference zone, the correction factor are 1.04 for the maximum dose and 0.74 for the minimum.

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INVESTIGATION OF 3 MEV ELECTRON BEAM DOSE DEPTH DISTRIBUTION USING RADIOCHROMIC FILM (FWT-60) FOR DOSIMETRY IN FOOD IRRADIATION

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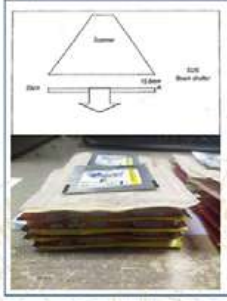
INTRODUCTION

Gamma rays, emitted from isotopes like Cobalt-60 or Cesium-137, have high penetration capabilities due to their high energy and lack of mass. This allows them to penetrate deeply into food products, making gamma radiation suitable for treating bulk or densely packed items. The deep penetration ensures that even the innermost parts of the food receive the necessary dose for effective microbial decontamination and/or pest control. Electron beams (EB), in contrast, consist of high-energy electrons generated by an electron accelerator. Unlike gamma rays, EB has relatively shallow penetration because electrons have mass and charge, which causes them to interact more readily with the food's surface and near-surface layers. The penetration depth of EB typically ranges from a few millimeters to a few centimeters, depending on the energy level of the electrons. This makes EB ideal for treating thin or surface-contaminated food products.

Thus, the aim of this study is to investigate 3 MeV electron beam dose depth distribution in food irradiation using radiochromic film, FWT-60 under single and double-side irradiation with known penetration depth, Rp as 1.45 g/cm² (IAEA, 2023).

MATERIALS AND METHODS



Commercial food paste samples used as phantoms were with following specifications; 40g weight, 0.75 cm height, 10.7 cm length and 7.8 cm width. Phantoms were constituted by a stack of 1 to 5 samples interleaved with 2 to 6 pieces of aluminum pouches contained radiochromic film. The samples were irradiated in single and double side treatment at 5 kGy by electron beam irradiator EPS3000 (Nissin High Voltage, Japan) which generates continuous electron beam with the maximum energy 3 MeV, current 5 mA and trolley speed 11.20 m/min.

After irradiation, the dosimetry films were withdrawn and rested about an hour due to post-irradiation polymerization. Dosimetry films were analyzed using Genesys 20 visible spectrophotometer (Thermo Scientific, US).

Absorbances were converted to dose readings using AerODE software (Aerial, France). To avoid any false color development, films are covered from exposed to light from pendaflour lamp as soon as they were taken out from pouches for the purposes of reading.

RESULT AND DISCUSSION

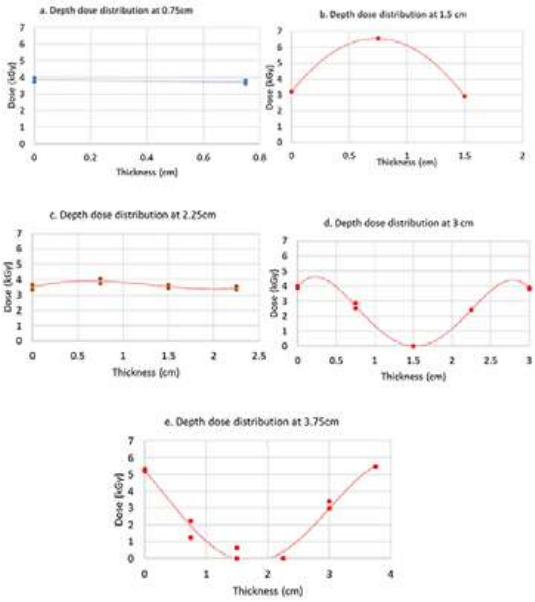


Figure 1. Depth dose distribution of electron beam within different thickness of food samples (a, 0.75 cm; b, 1.5 cm; c, 2.25 cm; d, 3 cm and e, 3.75 cm) towards single side (blue) and double sides irradiation (red) with dose uniformity ratio (DUR) of 1, 2.2, 1.1, ∞ and ∞ .

CONCLUSION

Single-side treatment could deliver an even dose if not more than one food paste was stacked together. The optimal thickness for double-side treatment was achieved with three stacked food pastes at total thickness of 2.25cm. This investigation of the depth dose profile using radiochromic film is very helpful for monitoring DUR of foodstuff processing with electron beam.

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IAEA. 2023. Expert End of Mission Report RAS5087-RER1021-EVT2101729 Validation and verification of dosimetry system at 3 MeV electron beam (EB) machine for sanitary (1-10 kGy) and phytosanitary (< 1 kGy) purpose.

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MORPHOLOGICAL AND MOLECULAR IDENTIFICATIONS OF FUNGI ISOLATED FROM RICE ADVANCED MUTANT LINES

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ABSTRACT

The identification of fungi associated with advanced rice mutant lines is crucial to understand their potential impacts on rice health and productivity. This study aimed to characterize fungi isolated from advanced rice mutant lines using both morphological and molecular approaches. Samples were collected from various lines of infected rice plants, including seed and leaves. Microscopic characteristics such as conidia, septate, chlamydospore, phialide and hyphae were observed under compound microscope. Macroscopic characteristics were observed based on fungal colonies, pigmentation, colony features and colour of mycelia. Isolate were extracted using PrimeWay Genomic DNA extraction kit. The DNA was amplified and sequenced using the universal primers ITS1 and ITS4. The sequences were assembled and the contigs were analyzed with the databases in the National Centre for Biotechnology Information (NCBI) by using Basic Local Alignment Search Tool (BLAST). Phylogenetic tree was constructed to elucidate the phylogenetic relationships among the isolated fungi where the ITS sequences were aligned using the ClustalW algorithm. The phylogenetic tree was constructed using the Maximum Likelihood method with 1000 bootstrap replications to assess the reliability of the branching. The tree was visualized and edited using Molecular Evolutionary Genetics Analysis (MEGA 11.0) software. Based on the results there is a diverse array of fungal species, with a predominance of the genera *Nigrospora*, *Talaromyces*, *Fusarium*, and *Curvularia*. Molecular identification of filamentous fungi is an important tool for the development of strategies aiming at the reduction of productivity loss, batch failure and quality deviations. The presence of these fungi suggests potential implications for the health and yield of rice cultivation, necessitating further investigation into their pathogenicity and interactions with crops.

INTRODUCTION

Rice, a major food crop that feeds more than half of the world's population. Diseases such as rice blast, leaf spot and wilt are constant threats to the rice caused by fungal infection. Understanding the fungal diversity associated with advanced rice mutant lines is essential for maintaining plant health, optimizing agricultural practices, potentially identifying beneficial fungal associations and screening of resistant mutant variety.

OBJECTIVES

1. To isolate various fungi from infected rice advanced mutant lines.
2. To identify the morphological characteristics of isolated fungi from rice advanced mutant lines.
3. To characterize the isolated fungi from rice advanced mutant lines using ITS sequence analysis.

METHODS

RESULTS & DISCUSSION

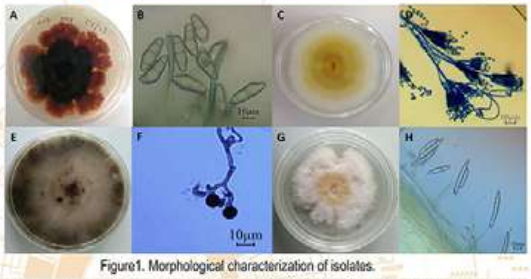

Figure1. Morphological characterization of isolates.

Ascomycetes **reproduce asexually by the production of conidiophores** that release haploid conidia (Figure 1: B, D, F, H). These fungi are rich in soil and mostly colonized through root system and initiates infection (Mendes et al. 2023). Each genus poses distinct mode of action depending on the growth rate.

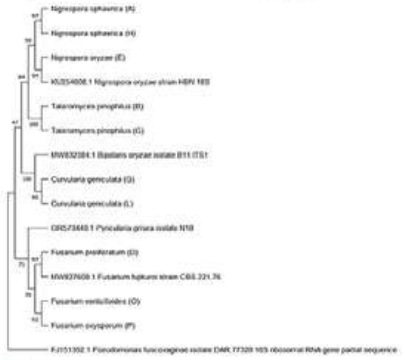

Figure 2. Phylogenetic tree analysis of the ten isolates.

Talaromyces is a common endophytes inhabiting rhizosphere. The genus is frequently applied as biocontrol against pathogenic fungi and bacteria. Figure 2 shows the evolutionary relationship between phyla of Ascomycota. *F. proliferatum* is a teleomorph of *Giberella fujikuroi* (Jiao et al 2024).

CONCLUSION

Three predominance fungal genera namely ***Curvularia geniculata***, ***Nigrospora sphaerica*** and ***Fusarium oxysporum*** were isolated from infected rice advanced mutant lines. These are important fungal infections invading rice cultivation areas. Further research on the host-pathogen interactions and the development of sustainable control measures would be beneficial for ensuring the success of advanced rice mutant lines in agricultural production.

ACKNOWLEDGEMENT

Researchers and staff of Agrotechnology and Bioscience Division, Malaysian Nuclear Agency. Students of University Putra Malaysia (UPM) and Universiti Teknologi Mara (UiTM)

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Hydrogen Stable Isotope Analysis for Distinguishing Mangos from Two States

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INTRODUCTION

- **Harumanis Mango:** Cultivated only in Perlis, Malaysia, known for its exceptional flavor and cultural value.
- **Geographical Indication (GI):** Official recognition highlighting the unique origin and quality of Harumanis mango.
- **Issue:** Mislabeling and fraud harm consumer trust and local farmers' income.
- **Importance of Hydrogen-2 (Deuterium):** Deuterium (δ^2H) isotopes are essential for tracing agro-products. They reveal geographical origins and environmental influences, ensuring product authenticity and origin verification.

METHODOLOGY

1. **Sample Collection:**
   i. 96 Harumanis Perlis mangoes from various orchards in Perlis.
   ii. 48 Clone MA 128 mangoes from Malacca.
2. **Sample Processing and Analysis:**

Juice Extraction

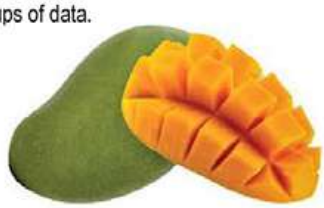
Centrifugation

Transfer Mango Juice into IsoFLOW Vial

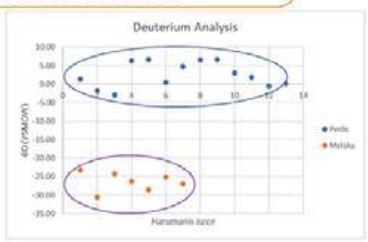
IsoFLOW IRMS Analysis

METHODOLOGY

3. **Cluster Analysis Using Excel:**
   i. The data were plotted by using Excel.
   ii. Then, ellipses were drawn to visualize the groups of data.



RESULTS AND DISCUSSION



1. **Two distinct clusters are observed:**
   - Perlis Cluster: δD values range from approximately -5.00‰ to 7.50‰.
   - Melaka Cluster: δD values range from approximately -30.00‰ to -23.00‰.
2. **Perlis:** Higher temperatures and evapotranspiration enrich deuterium (δD) in mangoes, resulting in enrichment in δD values.
3. **Malacca:** Moderate climate and humidity reduce deuterium enrichment, leading to depletion of the δD values.

CONCLUSION

Hydrogen stable isotope analysis distinguishes Harumanis mangoes from Perlis and Malacca, confirming their geographical origin and authenticity.

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PHOTOSTIMULATED LUMINESCENCE (PSL) TECHNIQUE FOR DETECTING IRRADIATED DRIED FOODS

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N.U.R NUKLEAR UNTUK RAKYAT

ABSTRACT

Photostimulated luminescence (PSL) is one of the physical method for the identification of Irradiated dried foods. Two types of samples were analyzed: dried mushrooms and dried shrimp. The samples were irradiated with a gamma source at dose levels of 1, 3, and 5 kGy. The PSL intensity of both non-irradiated and irradiated samples dried food was measured, along with the fading characteristics of the irradiated samples. The results show that PSL intensities of non-irradiated and irradiated samples from each type of dried food are relatively well-distributed. The result showed that, irradiated dried food can be distinguished after storage periods of 1 month, 6 months and 12 months. The findings of this study provide a useful database for the applicability of the PSL technique in detecting irradiated Malaysian dried food.

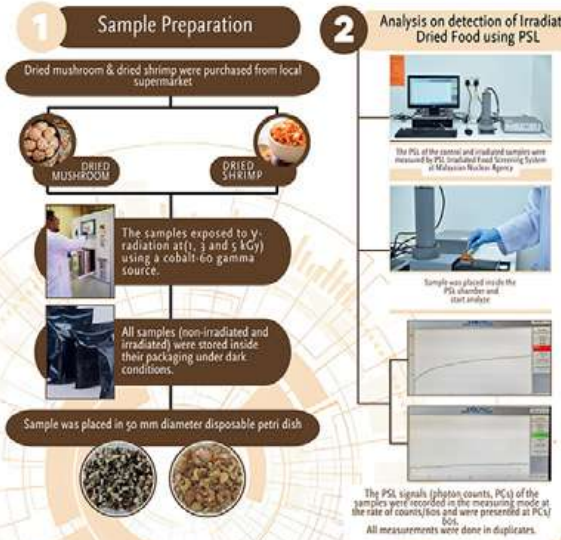
Keywords: Food Irradiation, Detection, Dried Food, Photostimulated Luminescence (PSL)

INTRODUCTION

Food irradiation has been proven as one of the alternative techniques to the existing methods for improving hygienic quality, increasing shelf-life, and enhancing the functional properties of different food items. To enhance microbiological safety and stability, food items are exposed to controlled amounts of ionizing radiation, such as gamma rays, X-rays, and accelerated electrons. Research on detection methods for irradiated food has focused on physical, biological, and chemical aspects of foods exposed to ionizing radiation over the past few decades (Delincée, 2002). The PSL detection method is particularly useful for the rapid screening of various irradiated foods, including herbs and seasonings (Sanderson et al., 1996). The development of analytical methods for correct identification of irradiated samples from non-irradiated samples has thus become important for upholding regulatory controls, checking compliance against labeling requirements, facilitating international trade, and reinforcing consumer confidence.

The objective of this study was to further investigate the applicability of this PSL technique can be to identify two different types of dried food. The aim was to establish baseline data on PSL measurement for dried food and to examine key characteristics such as dose response and signal stability during storage (1 month, 6 months and 12 months).

MATERIALS & METHODS



RESULTS & DISCUSSIONS

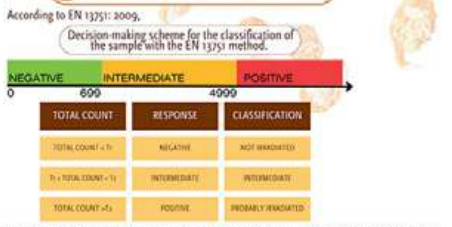


Figure 1 shows the Effect of irradiation dose on the signal intensity of dried mushroom and dried shrimps after fading one year.

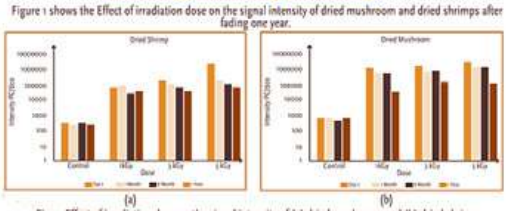


Fig. 1. Effect of irradiation dose on the signal intensity of (a) dried mushroom and (b) dried shrimp

The results indicated that PSL signals for all samples slightly decreased after 6 months of storage. PSL signals remained higher than the initial counts after one year of storage in dark condition, indicating their stability as reported by Jae-Jun et al. (2011). The photon counts during the storage in the dark after irradiation treatment were consistent with those reported earlier by Goulas, et al., 2008.

The other hand, the PCs of store in dried food at dose 3 and 5 kGy, for 6 to 12 months storage were decrease. Respectively, which were upper threshold values 5000 counts/60s indicated the samples irradiated (EN 13751: 2009). According to Yi (2000), if the PSL responses of the irradiated food are significantly greater than those of unirradiated ones or if the fading of the PSL response is low during the long-term storage, the PSL measurement suitable for the detection of food irradiation.

CONCLUSION

The photostimulated luminescence (PSL) detection method has proven effective for identifying irradiation treatment in dried food. The PSL signal intensity remained high even after 12 months of storage for irradiated dried mushrooms and dried shrimp, indicating the method suitability for detecting dried food ingredients with long shelf life. All irradiated samples were successfully distinguished from the non-irradiated control samples analyzed in this study. These results provide a valuable database on the applicability of the PSL technique for detecting irradiated dried food. The availability of this method for detecting irradiated food in Malaysia will be beneficial to the Ministry of Health for enforcing labeling (RADURA) regulations.

ACKNOWLEDGEMENT

The authors wish to express their gratitude to the Malaysian Nuclear Agency (MOSTI) for their support in this project.

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KEMENTERIAN SAINS, TEKNOLOGI DAN INOVASI

NUKLEAR MALAYSIA

DETECTION OF *Pantoea ananatis* CAUSING BACTERIAL LEAF BLIGHT (BLB) OF RICE IN KEDAH AND SELANGOR USING SPECIES-SPECIFIC PCR ASSAYS

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ABSTRACT

Pantoea ananatis is a Gram-negative bacterium in the Enterobacteriaceae family. This bacterium is known to cause bacterial leaf blight (BLB) disease in rice plants, resulting in significant economic losses in rice production worldwide. The identification of *Pantoea* species primarily relies on the sequencing of housekeeping genes due to their close phenotypic relationship. To facilitate the rapid and precise detection of 20 *P. ananatis* strains in PCR assays, attempts have been made to develop species-specific primers. In the present study, we conducted a thorough assessment of the primers that were specifically designed to accurately target identified *P. ananatis* species through the sequencing of housekeeping genes. Subsequently, PCR assays were performed using these species-specific primers. The results obtained demonstrated the remarkable specificity of the *P. ananatis*-specific primer pair towards its intended *Pantoea* target species. The primers successfully distinguished these strains specifically as *P. ananatis*. The findings of this study are expected to greatly enhance the effectiveness and accuracy of *P. ananatis* identification, thereby enabling prompt and reliable identification.

Keywords: *Pantoea ananatis*, bacterial leaf blight, species-specific primers

INTRODUCTION

Bacterial leaf blight (BLB) is a highly damaging rice disease globally, leading to substantial reductions in crop yields.

Rice infected by BLB

The symptoms start as yellow lesions on the leaves that turn brown and necrotic.

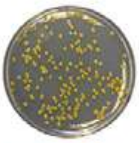
In severe infections, the whole leaf may turn brown, dry, and straw-like.

The bacteria entered the plant through openings like stomata and wounds, causing the disease to spread.

The bacteria enter the xylem, spreading through the plant and disrupting water and nutrient flow (Hassan *et al.*, 2020).

Emergence of New Causative Agent

BLB is mainly caused by the bacterium *Xanthomonas oryzae pv. oryzae*. Nonetheless, ***Pantoea ananatis*** was also discovered to **induce BLB in rice in 2019**, marking a significant discovery since this bacteria is typically not linked to BLB in rice, but is more commonly found in other crops (Azizi *et al.*, 2019).



The urgency for a rapid and precise detection of BLB

is high due to the potential of causing up to a **70% decrease** in yield (Din *et al.*, 2023).

Hence, utilizing a specific primer as a detection marker for *Pantoea ananatis* is extremely important as it guarantees an accurate and timely detection, facilitates efficient plant management, and contributes to the development of BLB-resistant rice varieties.

OBJECTIVES

To detect and characterise *Pantoea ananatis* causing Bacterial Leaf Blight (BLB) using species-specific primers.

CONCLUSION

In summary, the study successfully detected 20 strains of *Pantoea ananatis*, responsible for Bacterial Blight disease in Selangor and Kedah, utilizing a species-specific PCR assay. The primers PANAN_gyrb_F and PANAN_gyrb_R proved effective in identifying these strains, highlighting the assay's accuracy and specificity for this pathogen.

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METHODS & MATERIALS

RESULTS & DISCUSSION

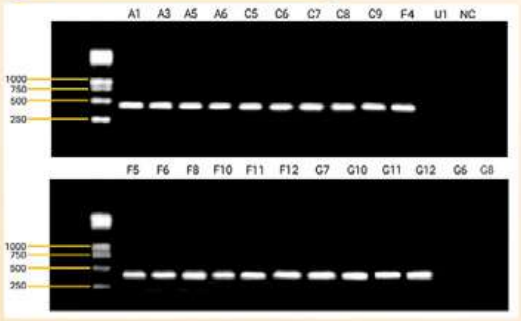

Figure 1. Gel electrophoresis of twenty strains *Pantoea ananatis* using specific-species primer PANAN_gyrb_F and PANAN_gyrb_R and 4 samples as negative control. A1-G12: *P. ananatis*; G6: *M. testaceum*; U1: *P. stewartii*; G8: *P. wallisii* and NC: negative control. Amplicon size (bp) for *P. ananatis* gene in 423 base pair.

Table 1. Blastn identification of 20 strains of *Pantoea ananatis* isolates

Line	Isolate code	Closest relative	Percentage Identity (%)	Source*
KJ-2	A1	*Pantoea ananatis*	98.87	OL742772
KJ-2	A3	*Pantoea ananatis*	99.45	OL742772
KJ-2	A5	*Pantoea ananatis*	97.78	OL742733
KJ-2	A6	*Pantoea ananatis*	98.34	MZ007836
KJ-2	C5	*Pantoea ananatis*	99.84	OL742772
KJ-2	C6	*Pantoea ananatis*	98.59	OL742772
KJ-2	C7	*Pantoea ananatis*	97.69	OL742772
KJ-2	C8	*Pantoea ananatis*	98.09	OL742772
KJ-2	C9	*Pantoea ananatis*	97.96	OL742796
ML 10	F4	*Pantoea ananatis*	94.32	MZ001508
ML 10	F5	*Pantoea ananatis*	98.78	OL742733
ML 10	F6	*Pantoea ananatis*	95.56	MZ007857
NMR 151	F8	*Pantoea ananatis*	94.81	OR761634
CL2	F10	*Pantoea ananatis*	99.87	OL742733
CL2	F11	*Pantoea ananatis*	99.66	OL742735
CL2	F12	*Pantoea ananatis*	99.49	OL742735
NMR 192	G7	*Pantoea ananatis*	98.53	OL742735
MR 297	G10	*Pantoea ananatis*	94.74	MZ007857
MR 297	G11	*Pantoea ananatis*	99.27	OL742735
MR 297	G12	*Pantoea ananatis*	99.56	MZ007857

*Accession number of the closest relative sequence found by Blast search

We developed primers that specifically detect *P. ananatis*, showing no cross-reactivity with other species. This precise identification is crucial for managing plant diseases cause by this bacterium. These primers can be used in various diagnostic applications, aiding in effective disease management and improving agricultural productivity.

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DISTINCTIVENESS, UNIFORMITY AND STABILITY (DUS) ASSESSTMENT OF KENAF MUTANT LINES GENERATED THROUGH MUTATION BREEDING

Affrida Abu Hassan, Zaiton Ahmad, Mustapha Akil, Shakinah Salleh, Muniroh Md Saad, Mohamed Hasyraf Mat Nawi and Norhafiz Talib

N.U.R NUKLEAR UNTUK RAKYAT

ABSTRACT

Kenaf is a fibre plant commonly used as a raw material for various industries such as paper, furniture, construction and automotive. In early 2000, it was introduced in Malaysia as part of government effort to replace tobacco nationwide. Due to its emerging use, there is a need to develop new kenaf variety with improved agronomic traits. In collaboration with the National Kenaf and Tobacco Board (NKTB), development of new variety was carried out using gamma irradiation to induce genetic mutation in Kenaf V36 variety. 30 potential lines have been selected and evaluation of agronomic traits of these promising lines was carried out in 2022. From this, a total of 13 potential mutant lines and 2 mutant hybrids were further tested in the field for distinctiveness, uniformity and stability (DUS) test. This paper discusses the morphological traits distinctiveness, uniformity and stability of these potential mutant lines. Based on the observation and findings, these mutant lines have the potential to be registered as new varieties and introduced as new planting materials for kenaf in Malaysia.

INTRODUCTION

- Kenaf (*Hibiscus cannabinus* L.) which belongs to Malvaceae family is a herbaceous annual plant and, is one of the important source of raw materials for the traditional production of rope, canvas and carpet .
- A number of research on kenaf has been carried out in Malaysia, mainly in the aspects of screening of suitable varieties adaptable to local weather, development of good agronomic practices, mechanization of planting and harvesting processes.
- One of the problems faced by kenaf industry in Malaysia is the lack of kenaf varieties that are suitable to Malaysian climate.
- Nuclear Malaysia has carried out research on development of new Kenaf variety with improved characteristics. The mutant lines have the potential to be registered and used commercially.
- The 5 best-performing mutants will be selected for filing an application for the Registration of New Plant Varieties and the Granting of Breeder's Rights under the Protection of New Plant Varieties Act 2004.

OBJECTIVE

To collect morphological and agronomic data on kenaf mutant lines

METHODOLOGY

Plant Materials

13 mutant lines, 2 hybrids including the control (Variety: V36) were used & obtained from Nuclear Malaysia's seed collection as shown in Table 1.

Field Planting Of Mutant Lines

The field planting was carried out at the NKTB's field plot at Chuping, Perlis. The soil type of the plot was sandy loam and the climatic condition during this period was hot and humid. Seed sowing was done by NKTB Perlis. The plants were allowed to grow on the nursery trays for about 10 days before being transferred to the plot. Irrigation was done manually twice a day. Fertilizer, herbicide and pesticide treatments were carried out according to NKTB's standard practice (Lembaga Kenaf Dan Tembakau Negara, 2013).

Agronomic Characterization Of Mutant Lines

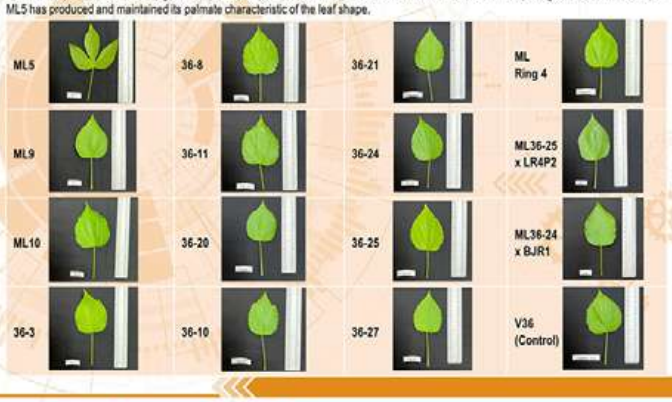
The agronomic data collected during the harvesting period; (i) plant height (cm), (ii) bast fibre weight (g), (iii) basal and middle stem diameter (mm), (iv) number of pods per plant, (v) leaf morphology, (vi) flower morphology and (vii) percentage of seed maturity. The characters for the mutant lines were analyzed and compared with the control.

No	Mutant	Dose (Gy)	Irradiation	Character
1.	ML5	300	Acute	High fiber, palmate leaves
2.	ML9	300	Acute	High fiber
3.	ML10	300	Acute	High fiber
4.	36-3	300	Acute	High fiber
5.	36-8	300	Acute	High fiber
6.	36-11	300	Acute	High fiber
7.	36-20	800	Acute	High fiber
8.	36-10	300	Acute	High fiber, fast grow
9.	36-21	800	Acute	High fiber, high seed pods
10.	36-24	1300	Acute	High fiber
11.	36-25	1300	Acute	High fiber
12.	36-27	1300	Acute	High fiber, fast grow
13.	ML Ring 4	230	Chronic	High fiber, fast grow
14.	ML36-25 x LR4P2	-	-	Tall plant
15.	ML36-24 x BJR1	-	-	Tall plant
16.	V36	0	NA	Control

Table 1. The list of 13 mutant lines, 2 hybrids, and 1 control variety (V36) that were field tested.

RESULT AND DISCUSSION

Due to unexpected weather change, a complete data was not able to be collected. However, below is the morphological data for leaf shape. ML5 has produced and maintained its palmate characteristic of the leaf shape.



CONCLUSION

A complete morphological and agronomic data on kenaf mutant lines was not obtained due to unexpected weather change that affected growth of the plants However, planting trial for another two seasons will be carried out simultaneously at Chuping and Baseri Plot. Five best lines will be setected and the data will be used to register these mutant lines.

ACKNOWLEDGMENT

The authors would like to thank various individuals and organizations for their continuous support in various aspects of the project; Nuclear Malaysia management, Agrotechnology and Biosciences Division and Research Management Centre (RMC) and NKTB for the funding and technical assistance. This project is funded under NKTB Funding.

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PALM OIL-BASED CONDUCTIVE COMPOSITE INKS

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ABSTRACT

This study investigates the production of UV-curable conductive composite ink using EPOLA®-OPV with polymer conductive and carbon particles. The conductive composite inks are developed with polypyrrole (PPy) and carbon black (CB), as well as the EPOLA®-OPV resin. The composite conductive ink's chemical reaction and properties, including the effects of conductive polymer (PPy) content, conductivity, electrical, physiochemical, mechanical and morphological, were investigated. This conductive composite polymer approach successfully produced conductive black ink. The EPOLA®-OPV has created a polymer matrix backbone network that can be filled with carbon black particles to bond and incorporate conductive polymers. The study's findings reveal that adding 15% PPy to the sample results in a low electrical resistance value of 12 kΩ, compared to adding 2% PPy. In contrast to the physical approach, the radiation-curing technology appears more promising for conductive composite ink development. The wood and the paper surfaces between the most appropriate substrate surfaces get coated with the conductive composite ink developed in this study.

OBJECTIVES

1. To develop a black ink using radiation curing technology and a conductive composite polymer system blending EPOLA®-OPV resin, polypyrrole (PPy) and carbon black (CB).
2. To analyze the chemical reactions and physiochemical properties of the conductive composite polymer/ink system.
3. To evaluate the conductive composite polymer's electrical resistance, conductivity, and adhesion to various surfaces such as paper, wood, glass, and plastic.

METHODS

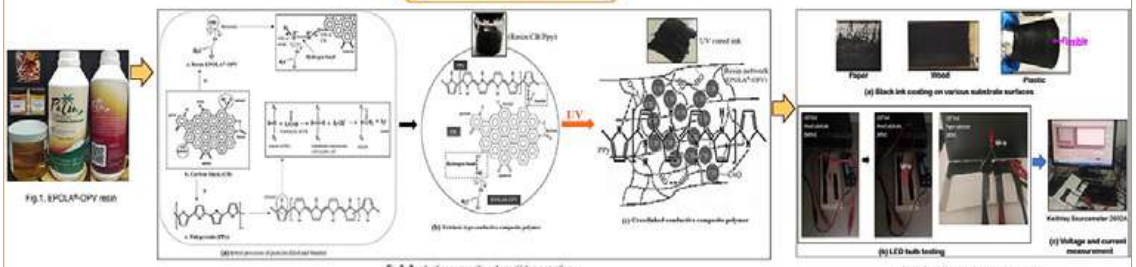

Fig.1. EPOLA®-OPV resin

Fig.2. Conductive composite polymer/ ink preparation

Fig.3. Electric resistance measurement.

RESULTS & DISCUSSION

Morphology analysis

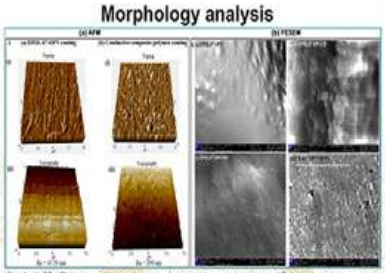

Fig. 4. (i) 3D AFM images of the surface morphology and average roughness (Ra) of ink coatings; (ii)EPOLA®-OPV and (b) conductive composite polymer coating with 15% PPy. (ii) FESEM images of ink coatings: (a) EPOLA®-OPV, (b) EPOLA®-OPV/CB, (c) EPOLA®-OPV/PPy and (d) EPOLA®-OPV/CB/PPy.

Conducting state mechanism

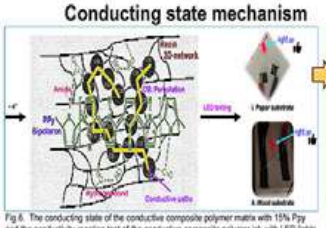

Fig.6. The conducting state of the conductive composite polymer matrix with 15% Ppy and the conductivity reaction test of the conductive composite polymer ink with LED lights.

Voltage-current measurements

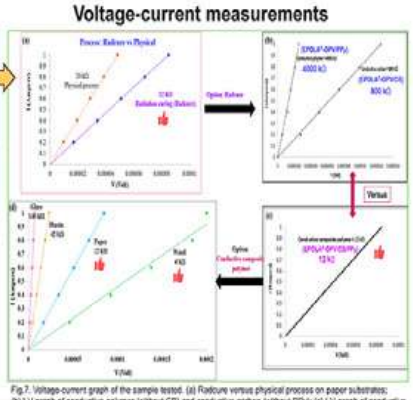

Fig.7. Voltage-current graph of the sample tested. (a) Radcure versus physical process on paper substrates; (b) I-V graph of conductive polymer (without CB) and conductive carbon (without PPy); (c) I-V graph of conductive composite polymer with 15% PPy; (d) I-V graph of conductive composite polymer (with 15% PPy) coated on various surface substrates.

Adhesion test

Table 1. Scoring of cross-hatch adhesion test tape results.

FTIR analysis

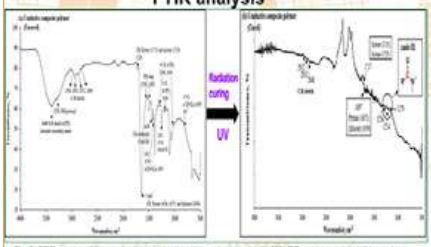

Fig. 5. FTIR spectra of the conductive composite polymer compound with 15% PPy: a) uncured and (b) cured.

CONCLUSIONS

Overall, the results show that EPOLA®-OPV resin can be applied as an additive in manufacturing conductive composite polymer/ ink. The TRL 1 activity revealed that the EPOLA®-OPV/CB/PPy mixture developed via the radiation curing process could produce conductive composite polymer/ ink. The research data presented above demonstrated an electric current flow in a conductive composite ink (EPOLA®-OPV/CB/PPy) system applied to the surface of paper and wood.

FUTURE WORK

- Future work on (EPOLA®-OPV/CB/PPy) ink is required to improve its physiochemical and mechanical properties at TRL2 due to the high electrical resistance.
- In addition to PPy, other conductive polymers should investigated to establish their utility in producing a more electrical current conducting/conductive system.

ACKNOWLEDGEMENTS

Acknowledgments were attributed to individuals who have directly and constantly contributed to and promoted this research, including the Radiation Curing and Synthesis Group (KSPS) and Radiation Processing Technology Division (BTS) professionals at the Malaysian Nuclear Agency.

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SAFE APPLICATION OF GAMMA RAY TOMOGRAPHY IN INDUSTRIAL INSPECTION

Susan Maria Sipaun, K.A. Sameera I. Saranath and Hearie Bin Hassan

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ABSTRACT

Gamma ray and x-ray tomography are non-destructive evaluation (NDE) methods in industrial inspection, offering insights into the internal structures of various materials and components. The technique's high penetration power enables detailed imaging of dense and complex structures, making it useful in sectors such as oil and gas, aerospace, automotive, and chemical processing. However, its utilisation necessitates a rigorous safety approach due to the ionising nature of gamma rays. This paper describes the safe usage of a portable gamma CT system for on-site inspection, with a specific focus on minimising exposure for operator safety.

Minimum radiation exposure for radiation workers is based on the principle of ALARA (As Low As Reasonably Achievable)

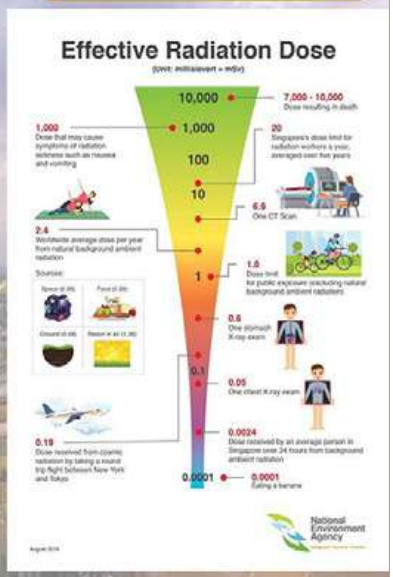
International standards (ICRP recommendations):

- Effective dose limit: 20 mSv (millisieverts) per year or 2000mR per year, averaged over 5 years
- Maximum in any single year: 50 mSv
- Assuming a standard work year of 2000 hours (50 weeks × 40 hours/week)
- Derived Hourly Rate Calculation: 20 mSv / 2000 hours = 0.01 mSv/hour = 10 µSv/hour or 1 mR per hour

Table 1. Safety Measures in Gamma Ray Tomography Inspection

Safety Measure	Primary Purpose	Cost	Effectiveness	Regulatory Requirement
SHIELDING - Lead, concrete, steel - Mobile shields	Prevent radiation exposure	High	Very High	Mandatory
TIME LIMITATION - Rotating staff - Automated systems	Reduce cumulative exposure	Low	High	Recommended
DISTANCE MAINTENANCE - Remote operation - Long-handle tools	Decrease radiation intensity	Medium	High	Recommended
PERSONAL PROTECTIVE EQUIPMENT (PPE) - OSL dosimeter - Lead apron - Lead-lined gloves	Provide individual protection	Medium	High	Mandatory
EQUIPMENT SAFETY FEATURES - Interlocks - Collimators	Prevent accidents and malfunctions	High	High	Mandatory
PUBLIC ACCESS CONTROL - Signage and barriers - Emergency preparedness	Prevent unauthorised exposure	Low	High	Mandatory

RADIATION EXPOSURE



SAFE DISTANCE

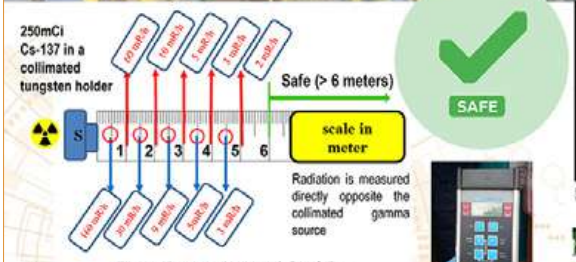


Figure 1. Dose rate when source is front facing.

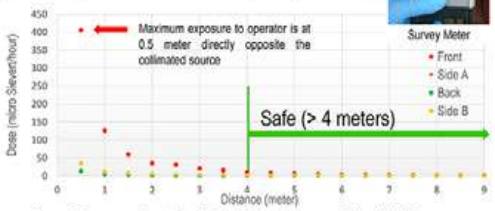


Figure 2. Exposure from 38mCi Cs-137 Gamma source in lead holder

GAMMA TOMOGRAPHY SCANNING

Fig. 4 Cross sectional image of the building pillar

Fig. 3 Gamma CT Scan on Building Pillar

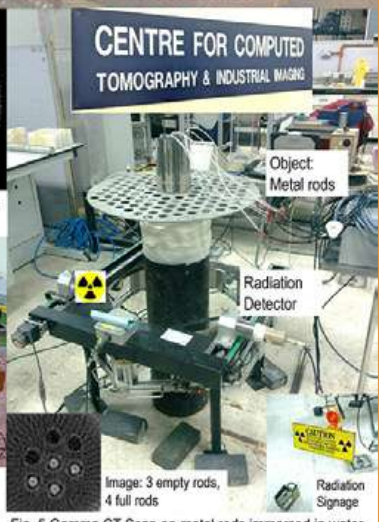


Image: 3 empty rods, 4 full rods

Fig. 5 Gamma CT Scan on metal rods immersed in water

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DETERMINATION OF NEW PARAMETERS FOR ELECTRON BEAM IRRADIATION AFTER CONVEYER MAINTENANCE ACTIVITY

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ABSTRACT

The qualification process (QP) is an essential step to be carried out after the maintenance of the conveyor system. Speed is measured by setting the speed of the conveyor on the control panel. The absorbed dose for CTA measured and a graph is plotted. The calibration curve of conveyer speed has 0.9999 an r-squared value and 0.9965 for CTA dosimeter respectively. The constant factor of dosimeter calibration curve is 0.0064 and 2% when compared to CTA equation for the new parameter setting.

QP ACTIVITIES AFTER CONVEYOR MAINTENANCE

- Speed calibration
- Dosimeter calibration
- EB characterization/dose mapping
- Condition testing and quality control
- Back in operation

INTRODUCTION

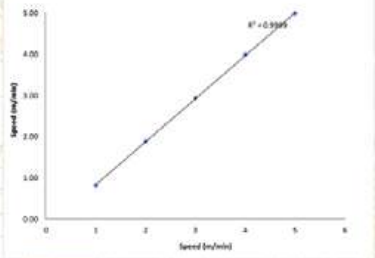
The purpose of this work is to evaluate the irradiate system performance and to ensure it is in good condition before normal operation. This activity is very important and is part of the corrective action and improvement step taken since the conveyor is stop operating on November 2023. This study proposes new irradiation parameters using conveyer systems according to different energies with new speed.

METHODOLOGY

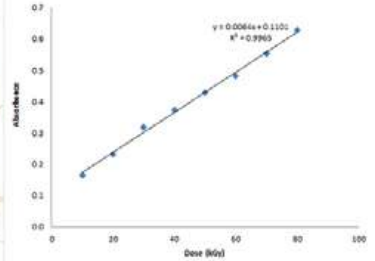
A. **Speed calibration**: Speed measured by setting on the control panel, time recorded when the trolley moved in 1.0 meter distance at 1.0, 2.0, 3.0, 4.0 and 5.0 m/min speed.
B. **Dosimeter Calibration**: CTA dosimeter arranged at setting of dose 10, 20, 30, 40, 50, 60 70 and 80 kGy. The absorbed is dose is measured, graph is plotted and analyzed.
C. **EB Characterization:** Dosimeter irradiated at 10 kGy per pass with energy of 1.0, 1.5, 2.0, 2.5 and 3.0 at calculated speed.

RESULTS AND DISCUSSIONS

A. Calibration of Conveyor Speed



B. Calibration of Dosimeter



C. EB characterization

Energy (MeV)	1.0	1.5	2.0	2.5	3.0
Speed (m/min)	2.87	2.54	2.37	2.29	2.24

CONCLUTIONS

The irradiation system has performance well with the calibration of conveyor speed and dosimeter which yield a value over 0.95 for the linear regression line, indicating good performance. The EPS3000 machine operates normally however the conveyor speed has been changed due to its limited movement below 1.0 meter/min. Therefore, a new parameter of EB characterization has been introduced in this activity.

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Comparison of PGNAA Simulation Techniques for Concrete Analysis

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Abstract

Prompt Gamma Neutron Activation Analysis (PGNAA) is an important technique for non-destructive elemental analysis of materials like concrete. Computer simulation can complement experimental PGNAA systems. This study compares the use of two Monte Carlo codes, MCNPX and PHITS, for simulating PGNAA on three concrete samples. The codes were modelled identically based on an experimental PGNAA system. Results showed that both codes identified the major elemental components of concrete, including Si, Ca, Fe, and Na. MCNPX identified more peaks overall compared to PHITS. Both codes provide reasonably accurate modelling of PGNAA for concrete analysis, with MCNPX offering more detailed spectral results. Further studies could optimize the codes for improved statistics.

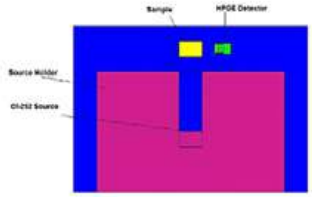


Figure 1, Basic schematic diagram of PGNAA experimental system from MCNP geometry code.

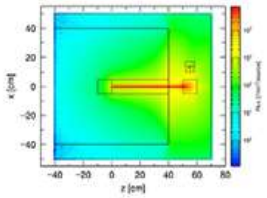


Figure 2, The particle tracking plot from PHITS simulation.

Introduction

Prompt Gamma Neutron Activation Analysis (PGNAA) is a powerful non-destructive technique for determining the elemental composition of materials like concrete. While experimental PGNAA setups are essential, computer simulations can provide a valuable complementary tool for modeling and optimizing PGNAA systems. Monte Carlo radiation transport codes are well-suited for simulating PGNAA by tracking the interactions of neutrons with the sample material and the resulting gamma-ray emissions.

This study compares the use of two widely-used Monte Carlo codes, MCNPX and PHITS, for simulating PGNAA on a concrete sample. Both codes were configured identically based on the geometry of an experimental PGNAA setup. By analyzing the simulated gamma-ray spectra, the major elemental components present in the concrete could be identified by their characteristic gamma-ray peaks.

Methodology

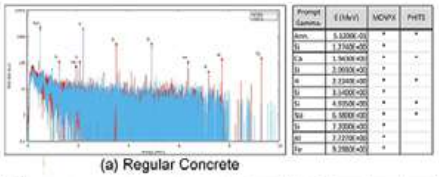
- Three different concrete samples were used in this study to simulate the detection of prompt gamma neutron activation using MCNPX and PHITS software.
- The sample size (10 cm x 10 cm x 10 cm) and position are the same for the three concrete samples.
- The simulation setups are illustrated in Figure 1 and Figure 2, where the simulated HPGe detector is placed 90 degrees from the incoming thermal neutron source.
- The gamma-ray spectrum was tallied and the respective plotted graph is shown in Figure 3.
- The resulting peak is compared with the IAEA-PGAA database for the most intense prompt gamma-ray.

Conclusion

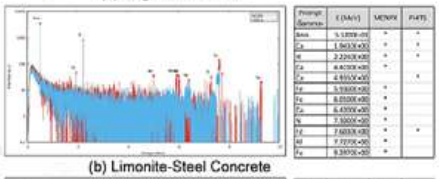
MCNPX predicted a more detailed gamma-ray spectrum with 10 total peaks detected compared to 5 peaks for PHITS. The higher peak resolution in MCNPX allowed better separation of closely-spaced gamma lines and capturing of minor gamma signatures. However, PHITS showed good performance in resolving the predominant peaks for the key concrete components. The results can be used to develop the portable PGNAA system in the future.

Results

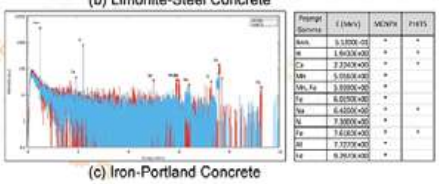
Figure 3 illustrates the MCNPX and PHITS simulation results. The three concrete samples used were (a) Regular Concrete (ρ = 2.3 g/cm3), (b) Limonite-Steel Concrete (ρ = 4.5 g/cm3), and (c) Iron-Portland Concrete (ρ = 5.9 g/cm3). The table on each graph shows the prompt gamma-ray energy peaks found from the simulations. The results show most of the expected prompt gamma-ray peaks are found by using MCNPX while PHITS only able to generate a few peaks. Although some other materials in the concrete sample are not showing due to the very small percentage present in the concrete. The results suggested that by using MCNPX the PGNAA system can be accurately simulated and modelled, thus giving advantages in the development of the experimental system in the future.



(a) Regular Concrete



(b) Limonite-Steel Concrete



(c) Iron-Portland Concrete

Figure 3, The prompt gamma-ray spectrum from MCNPX and PHITS simulations.

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PHYSICOCHEMISTRY STUDIES OF IRRADIATED MODIFIED BIOCHAR FROM AGRICULTURAL WASTE FIBRE VIA LOW POWERED MICROWAVE ASSISTED PYROLYSIS

Ahmad Zuhdi Mohd On, Muhammad Harith Iqbal Nor Hisham,Muhammad Hazim Muhammad Sayuti, Siti Salwa Mohammad Shirajuddin, Khairil Nor Kamal Umar, Mohammed Iqbal Shueb, Nazaruddin Zakaria, Mohd Faizal Abd Rahman

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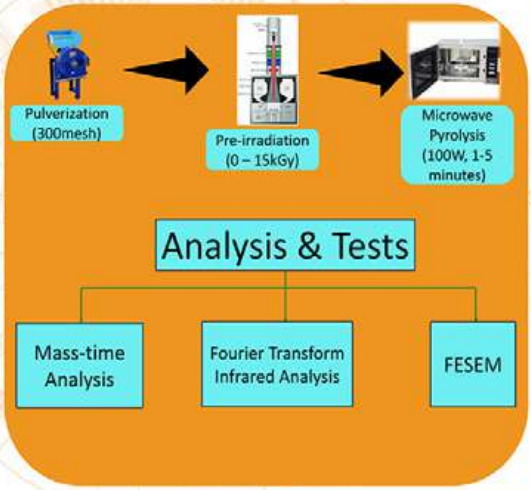
ABSTRACT

Biochar was commercially produced from various biomass sources such as agriculture waste or animal waste. This carbon based material have a potential to be used in various sectors such as agricultural, medicine and manufacture fields. It was produced by conventional pyrolysis which the process was operated in an inert condition. Conventional pyrolysis requires excessive energy consumption to produce the biochar. This project incorporated low powered microwave assisted pyrolysis technique as an alternative process to overcome the excessive energy. Rice husks (RH) and palm oil empty fruit bunch (EFB) was irradiated modified with range of dose exposure from 0 to 15 kGy with increment of 5 kGy. The irradiated fibers were pyrolysed with low powered microwave (100W) for a range of time. The highest weight loss observed for both RH and EFb at 15 kGy was at 19.28 % (4 mins) and 18.63% (2 mins) respectively. The weight loss was verified by the loss hydroxyl peak (3300 cm-1) by using Fourier-transform infrared spectroscopy (FTIR). This was confirmed by the morphological irregularities surface of fibers using Field emission scanning electron microscopy (FE-SEM) with 200x magnification. The radiation dose depicted of molecular scission interaction of fiber which extensively absorbing radio frequency of microwave. The project can be comprehensively investigate the surface area and porosity by performing Brunauer-Emmett-Teller (BET).

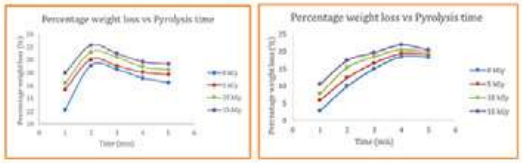
INTRODUCTION

- **Biochar** to be used in agricultural field as plant growth promoter. The cellulose structure to be used in some application such as activated carbon, catalytic material and supercapacitor.
- Agricultural waste fibre such as EFB and rice husk made up **8 MILLION TONNES** per year.
- High energy on **CONVENTIONAL PYROLYSIS** compare **MICROWAVE PYROLYSIS**
- E-beam to be incorporated to boost the molecular scissioning of the agicultural fibre.

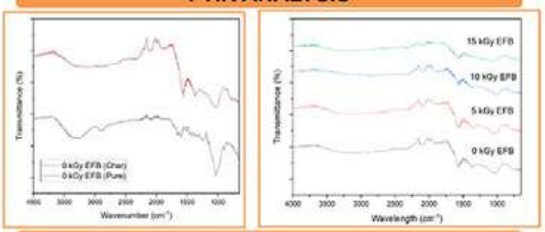
METHODOLOGY



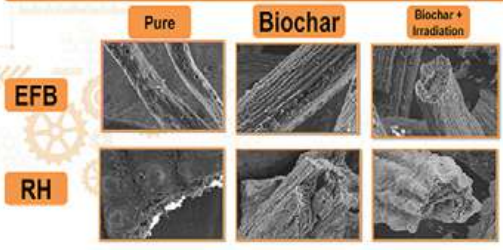
RESULTS & DISCUSSION



FTIR ANALYSIS



FESEM ANALYSIS



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CHARACTERIZATION OF COBALT OXIDE NANOPARTICLES PREPARED BY CO-PRECIPITATION METHOD

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INTRODUCTION

Over the past few years, cobalt oxide nanoparticles have been employed in a wide range of applications, including nanosensors, nanoelectronics devices, and catalysts due to its distinctive electrical, catalytic, magnetic, and optical properties. Many methods of synthesizing cobalt oxide nanoparticles have been reported by various researchers. Wet chemical reactions such as co-precipitation method are one of the most common synthesis techniques used. It is mostly due to the advantage of a simple and low-cost approach. This method also allows the production of high yield and purity of cobalt oxide which makes it easier to produce large quantities of nanoparticles. The particle size and morphology of nanoparticles can be controlled by adjusting the reaction conditions like pH, temperature, and concentration of reactant. This research aims to produce cobalt oxide nanoparticles by using co-precipitation method and to characterize it by using XRD and FESEM.

METHODOLOGY

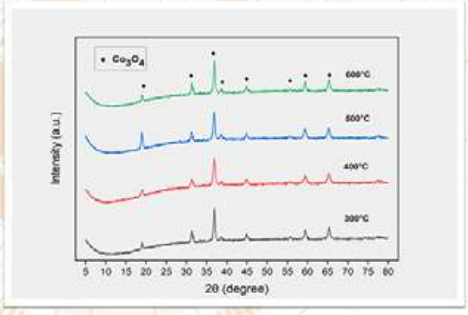
Synthesis of materials

$CoCl_2$ and NaOH solution of a desired concentration was prepared. Then, the cobalt solution was added dropwise to the NaOH solution while stirring. Precipitate formed was filtered and washed several times with DI water and was dried in oven at 80°C for 24 hours. The end product, cobalt hydroxide was then calcined in furnace for 2 hours at different temperatures of 300°C to 600°C.

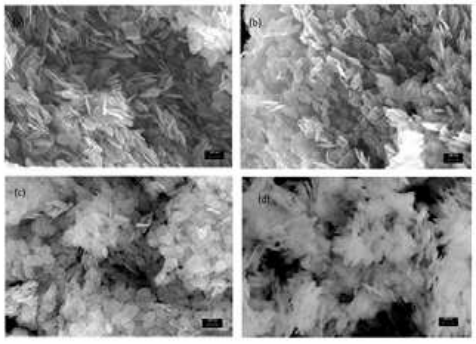
Characterization

Structural characterization of the samples was performed using XRD PANalytical X'Pert PRO, operated at 40 kV and 30 mA with 2θ in the range of 5°-80°. Surface morphology of the samples was investigated using Field Emission Scanning Electron Microscopy (FESEM), Carl Zeiss (GeminiSEM 500).

RESULTS AND DISCUSSION



XRD patterns for Co_3O_4 at various calcination temperatures



FESEM images of Co_3O_4 at a) 300°C b) 400°C c) 500°C and d) 600°C

CONCLUSION

Cobalt oxide nanoparticles were successfully synthesized and characterized using XRD and FESEM. The XRD results show that pure cobalt oxide (Co_3O_4) can be formed at low calcination temperature of 300°C with cubic crystal structure. Co_3O_4 nanoparticles which have plate-like shapes show an increase in size with increasing calcination temperature. The nanoparticles produced are in the range of 96 nm to 100 nm. Therefore, it is proven that this technique is capable of producing high-purity metal oxide nanoparticles ideal for a variety of applications.

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[2] P. Xu, Z., & C. Zeng, H. (1998). *Journal of Materials Chemistry*, *8*(11), 2499-2506.

[3] Iravani, S., & Varma, R. S. (2020). *Green Chemistry*, *22*(9), 2643-2661.

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HEAVY RARE EARTH ELEMENTS (HREE) RECOVERY FROM XENOTIME VIA ALKALINE FUSION: EFFECT OF FUSION TEMPERATURE

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Materials Technology Group (MTeG), Industrial Technology Division (BTI)

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ABSTRACT

Xenotime is abundant in Malaysia and contains **valuable elements**, so-called **critical resource material (CRM)**, from tin mining tailings. A satisfactory grade of REEs content in xenotime was detected and confirmed by XRF techniques for HRRE recovery. The traditional xenotime digestion process focuses on the H_2SO_4 roasting process, or alkaline digestion process, but neglects the environmental impact. However, with the increase in applications and demands of HREE in industry, processing xenotime became a national need. Therefore, **understanding the fused behaviors of xenotime** can promote and enhance the HREE recovery process. In this study, the **effect of temperature on xenotime fused with NaOH was studied**. Alkaline fusion approach selected to **transform phosphate into hydroxide** due to its existence, which is not preferable in further hydrometallurgical processing. The experiment was carried out for **3 hours** at different temperatures **(250 °C, 275 °C, 300 °C, and 350 °C)** with a **ratio of xenotime to NaOH of 1:2**. Results from X-Ray Fluorescence (XRF) for elemental analysis, Stereo Microscope, and Field Emission Scanning Electron Microscope (FESEM) for morphological and particles size analysis indicated that **HREE recovered** in the range of **100.0-179.3%** with **100% phosphate removal**.

Keywords: *Alkaline Fusion, Phosphate, Rare Earth Element (REE), Xenotime*

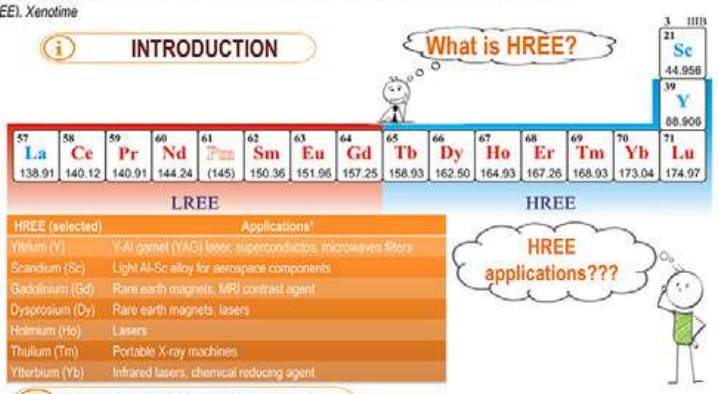
OBJECTIVE

To study effect of temperature on xenotime fused with NaOH

METHODOLOGY

Xenotime mixed with NaOH flakes
↓
Fusion at different temperature for 3 hours
↓
Wash for 3 times
↓
Rinse with hot water until the mixture reach neutral pH
↓
Analysis
- ✓ Elemental Analysis;
- ✓ Particle Size Analysis; and
- ✓ FESEM with EDAX)

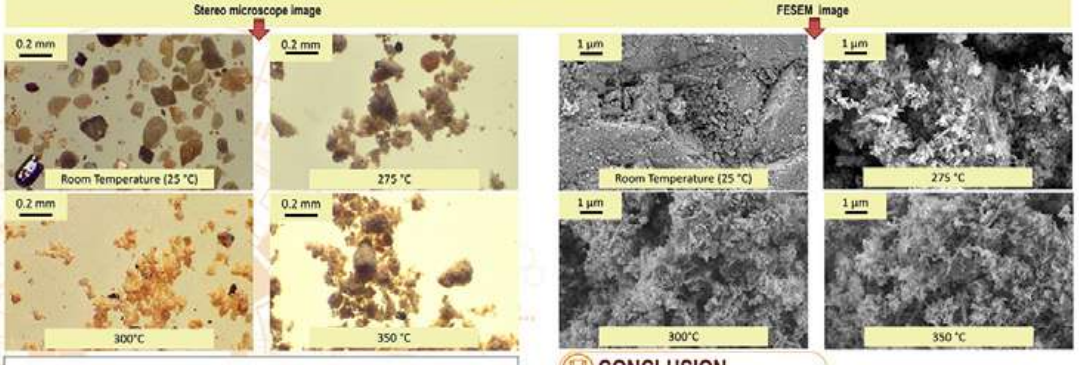
INTRODUCTION

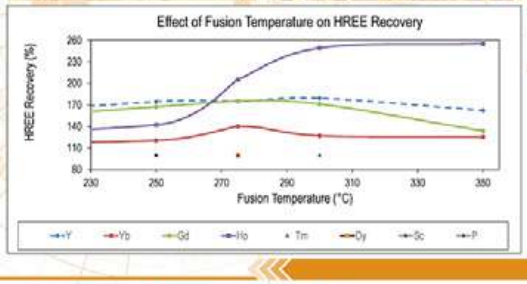


HREE (selected)	Applications[1]
Yttrium (Y)	Y-Al garnet (YAG) laser, superconductos, microwaves filters
Scandium (Sc)	Light Al-Sc alloy for aerospace components
Gadolinium (Gd)	Rare earth magnets, MRI contrast agent
Dysprosium (Dy)	Rare earth magnets, lasers
Holmium (Ho)	Lasers
Thulium (Tm)	Portable X-ray machines
Ytterbium (Yb)	Infrared lasers, chemical reducing agent

RESULTS AND DISCUSSION

Effect of fusion temperature on particle size reduction. Increasing fusion temperature (275 – 350 °C) can reduce the particle size as shown in figure below (stereo microscope and FESEM image). Fine particles were believed could help and accelerate leaching step in further experimental step for HREE extraction[2].





CONCLUSION

- HREE recovery can be greatly improved after alkaline fusion process.
- Fusion temperature on xenotime at **275 °C** could highly recovered **ytterbium** (140.2%) and **gadolinium** (175.5%). Where as for **yttrium** recovery was highest (179.3%) at **300 °C** and **holmium** recovery start to plateau above 300 °C. Interestingly, **scandium** appear upon fusion at **275 °C**. Same goes to **thulium** and **dysprosium** as these element can be detected after fused at temperature as low as **250 °C**.
- **100% phosphate were remove upon alkaline fusion.**
- The **particles size** had been remarkably **reduced** with alkaline fusion process that can be aided in the leaching process in further step to enhanced the HREE recovery.

REFERENCES

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2. Ruan et al., 2019, *ACS Omega* 4; 9813-9822

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DESIGN OF EXPOSURE ROOM FOR INDUSTRIAL RADIOGRAPHY USING PHITS

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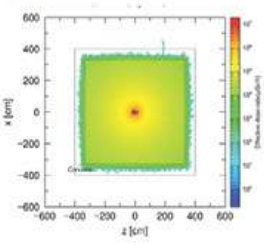
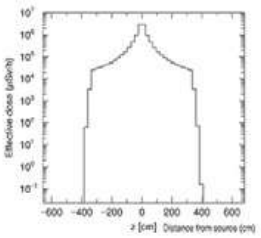
ABSTRACT

Bunkers or exposure rooms are crucial structures designed to protect against the release of radioactive materials into the environment. Evaluating the effectiveness of exposure room design is essential for ensuring adequate protection. In this study, the Monte Carlo particle transport simulation code, PHITS (Particle and Heavy Ion Transport Code System) will be used, to evaluate exposure room design and its ability to mitigate radioactive releases. These investigate various aspects of bunker design, including the thickness of walls, and the materials used in construction. By assessing the walls, it can evaluate the effectiveness of different design configurations. This evaluation helps in optimizing exposure room to enhance protection against potential hazards. The results obtained through PHITS simulations shows decreasing in dose rate with 70 cm thickness wall using high-density concrete. This work will continue with different layout and materials for shielding. This will contribute to improved understanding and informed decision-making regarding exposure room.

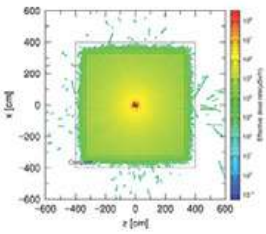
NO MAZE



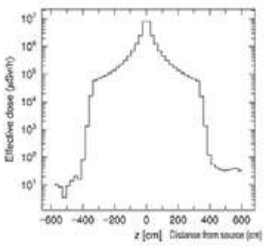
Ir-192 Dose Distribution at 50 Ci



Ir-192 Effective Dose rate at 50 Ci

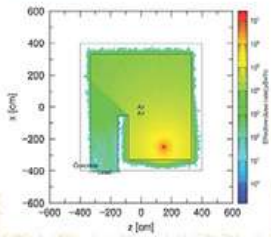


Co-60 Dose Distribution at 50 Ci

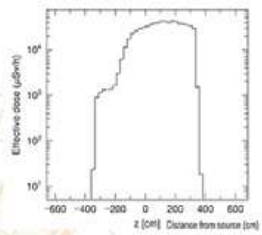


Co-60 Effective Dose rate at 50 Ci

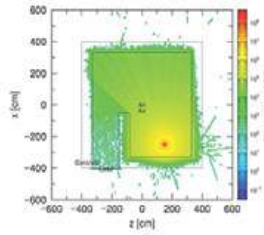
MAZE



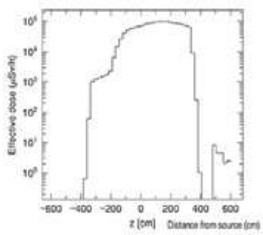
Ir-192 Dose Distribution at 50 Ci



Ir-192 Effective Dose rate at 50 Ci

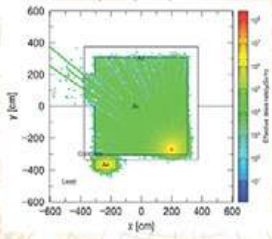


Co-60 Dose Distribution at 50 Ci

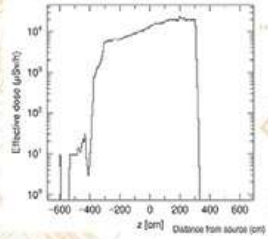


Co-60 Effective Dose rate at 50 Ci

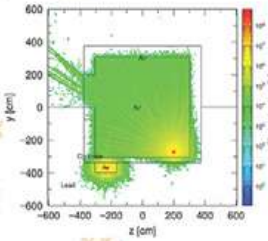
2 LEVELS



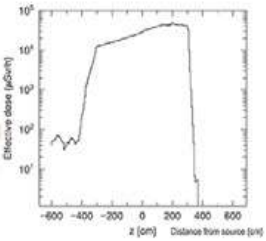
Ir-192 Dose Distribution at 50 Ci



Ir-192 Effective Dose rate at 50 Ci



Co-60 Dose Distribution at 50 Ci



Co-60 Effective Dose rate at 50 Ci

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Effect of Irradiated PET Waste on Concrete Performance: A Study

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Introduction

The development of concrete incorporating irradiated waste PET aims to enhance durability, reduce environmental impact through plastic recycling, provide lightweight properties, improve insulation, potentially lower costs, and enable versatile applications in construction. This research is dedicated to optimizing its integration to promote sustainable building practices and enhance resource efficiency.

Background

Plastic pollution is a significant environmental challenge, with PET being one of the most commonly discarded plastics. Irradiated PET, which has undergone a treatment process to improve its properties, can potentially serve as a valuable resource in concrete production, offering both sustainability and enhanced material performance.

Experimental

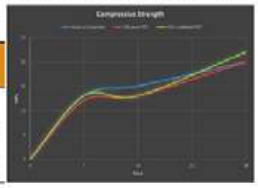
Findings

The irradiated samples showed some increment in their mechanical, thermal properties, degree of crosslink and degree of crystallinity after being bombarded with electron beam. Findings with different dose was summarized below.

Sample Description	Tm (°C)	Tg (°C)	Xc (%)
PET	260.10	67.34	17.921
PET 50	265.08	66.70	21.8575
PET 100	264.25	66.28	22.4054
PET 150	279.41	66.45	35.1575
PET 200	261.82	65.67	31.9325

The optimum dose of irradiated PET which at 150kGy used as a filler in concrete production. 5% irradiated PET used as a fine aggregate replacement. Findings of characterization of irradiated PET concrete performance was summarized below.

Pulse velocity (km/s)	
Control	3.6264 (Good)
PET	3.2269 (Medium)
rPet	3.4481 (Medium)



Conclusion

In conclusion, substituting fine aggregate with irradiated PET in concrete has been found to increase its compressive strength, suggesting that this method can significantly improve the performance of the concrete.

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Recovery of Neodymium and Dysprosium from Acetic Acid Leaching Solution of Xenotime by Solvent Extraction

Khaironie Mohamed Takip, Roshasnorlyza Hazan, Nur Aqilah Sapiee, Jacqueline Kones, Norhazirah Azhar, Wilfred Paulus, Nor Asniza Ariffin and Muhammad Faiz Fadzel

N.U.R NUKLEAR UNTUK RAKYAT

Abstract

This study investigates the recovery of neodymium (Nd) and dysprosium (Dy) from xenotime minerals using solvent extraction. The goal was to determine the efficacy of acetic acid (CH_3COOH) as a leaching solution for extracting Nd and Dy using Di-(2-ethylhexyl) phosphoric acid (D2EHPA) in kerosene as the extractant. The extraction process involved acid leaching followed by solvent extraction, with the resulting concentrations of Nd and Dy analyzed using Energy Dispersive X-Ray Fluorescence (EDXRF). The results showed that the highest extraction efficiencies for Nd and Dy were 99.4% and 99.3%, respectively, achieved at a leaching solution concentration of 1M and an aqueous-to-organic phase ratio of 1. Optimal extraction conditions were found to be at 30°C and 20 minutes. This study demonstrates that CH_3COOH can be effectively used as a leaching medium for extracting Nd and Dy from xenotime minerals with D2EHPA, making it a promising approach for recovering these critical rare earth elements.

Keywords: Xenotime, CH_3COOH, neodymium, dysprosium

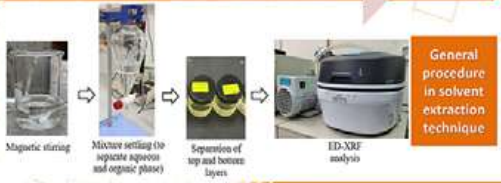
Introduction

Rare earth elements (REEs) are critical for various high-tech applications, but their extraction from both primary and secondary sources is a complex and challenging process.(Qi 2018). Xenotime, a significant mineral source in Malaysia, contains neodymium (Nd) and dysprosium (Dy), which can be extracted through a three-step process involving digestion, separation, and extraction. Alkaline digestion using sodium hydroxide (NaOH) has been shown to be a more effective method than traditional acid-based digestion methods (Farzaneh et al. 2017). After digestion, the resulting REE hydroxide precipitate is filtered and then leached with non-organic acids. Organic acids like citric and acetic acid have been used for secondary sources, but not for primary sources (Gergoric et al. 2019). Solvent extraction using reagents like D2EHPA has been shown to be an effective approach for extracting REEs.

Objective

This study aims to evaluate the efficacy and potential of acetic acid as a leaching medium for the extraction of neodymium and dysprosium from a primary mineral source, xenotime.

Material and Methods



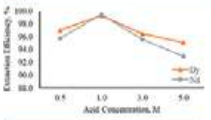
General procedure in solvent extraction technique

Results

REE concentration in acetic acid solution before extraction	
Acid Concentration (M)	0.5, 1, 3 and 5
Aqueous to Organic (A/O) Ratio	1:1, 1:2, 1:3 and 1:4
Extraction Temperature (°C)	30, 40, 50, and 60

REE concentration in acetic acid solution before extraction

REE	Atomic Number	REE Concentration (%) 0.5M	1M	2M	3M
HREE					
Y	39	69.55	71.46	66.86	68.26
Gd	64	2.30	2.73	2.35	2.32
Dy	66	5.19	6.47	6.57	6.89
Ho	67	1.18	1.78	1.48	1.65
Tm	69	1.21	1.32	1.18	1.01
Yb	70	4.60	4.77	7.33	7.00
LREE					
Nd	60	0.59	0.90	1.19	1.06
Sm	62	0.68	0.94	0.53	0.40
La	57	ND	0.44	0.63	0.66
NORM					
Th	90	ND	ND	0.15	0.14
U	92	0.55	0.99	0.29	0.22



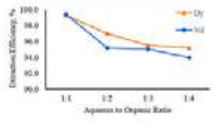
Effect of acid concentration

$$\%E = \frac{D \times \frac{V_O}{V_A}}{1 + (D \times \frac{V_O}{V_A})} \times 100$$

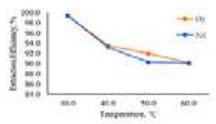
Extraction Efficiency (%)

$$D = \frac{C_O}{C_A}$$

Distribution Coefficient



Effect of aqueous-to-organic ratio



Effect of temperature

Conclusions

- ✓ Dy and Nd successfully extracted from acetic acid leached solution of xenotime using 30% D2EHPA achieving extraction efficiencies of 99.3% for Dy and 99.4% for Nd.
- ✓ Acetic acid has been found to be a potent leaching medium for the extraction of rare earth elements

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Qi, D. 2018. Extraction of Rare Earths from RE Concentrates. Hydrometallurgy of Rare Earths: 1–185.

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HEAT TREATMENT EFFECT ON THE STRUCTURAL & OPTICAL PROPERTIES OF TiO_2 NANORODS THIN FILMS

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ABSTRACT

TiO_2 has gained attention as a suitable photoelectrode for the water splitting reaction to produce green hydrogen and oxygen. This is due to its high photocatalytic activity, high resistance towards photo corrosion and low cost. In this study, TiO_2 nanorods were synthesized using a simple hydrothermal method with FTO glass as the substrate and was then heat up to different temperatures of calcination. The prepared samples were characterized using X-ray diffraction (XRD) and ultraviolet-visible light spectroscopy (UV-Vis). XRD analysis confirms the formation of rutile phase of TiO_2 with tetragonal structure. The calculated band gap values of TiO_2 nanorods was found to decrease with increasing calcination temperatures from the optical absorption spectra. The results show that conducting heat treatment on the TiO_2 nanorod had changed the materials's properties of the sample compared to uncalcined TiO_2 nanorods. This work offers a promising hydrothermal method for growing well-aligned TiO_2 single-crystal nanorods that can be employed in electrolyser applications.

Keywords: XRD, UV Vis, TiO_2 rutile, band gap

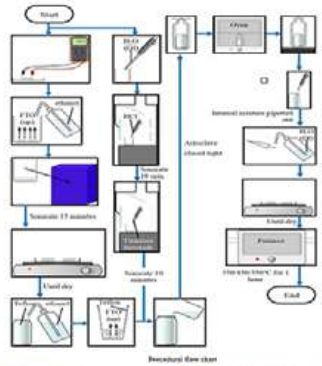
INTRODUCTION

The effect of heat treatment on the structural and optical properties of TiO_2 nanorods thin films has been extensively studied in the literature. Heat treatment is a crucial process that can significantly alter the crystallinity, phase composition, and morphology of TiO_2 films, which in turn affects their optical characteristics such as band gap energy, light absorption, and transmission properties. Several studies have investigated the impact of heat treatment temperature on the structural properties of TiO_2 films. Zhao et al. (2007) reported that heating TiO_2 nanoparticles above 600°C leads to phase transformation, with crystallite and pore sizes increasing with increasing temperature. They also found that surface area, pore volume, lattice strain, and dissolution density decrease with increasing heat treatment temperature. The optical properties of TiO_2 films are also influenced by heat treatment. Yang et al. (2009) observed that the band gap energies of TiO_2 nanoparticles decrease with increasing heat treatment temperature. Joo et al. (2005) studied the transmission spectra of TiO_2 films with different heat treatment temperatures and found that the optical properties are significantly affected by the thermal processing. Cheng et al. (1995) used chemical precipitation methods to synthesize TiO_2 nanoparticles and studied the impact of heat treatment on their properties. In summary, heat treatment can alter the crystallinity, phase composition, and morphology of TiO_2 films, which in turn affects their optical characteristics and performance in various applications such as photocatalysis, sensors, and solar cells.

OBJECTIVE

To investigate the effect of calcination temperature on structural and optical properties of TiO_2 nanorods thin films

MATERIALS & METHODS



RESULTS & DISCUSSIONS

Fig. 1

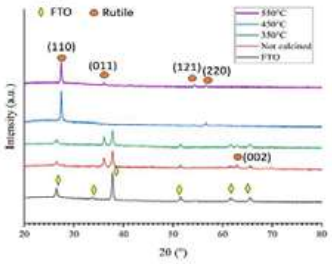


Table 1

Fig. 1 XRD diffractogram
XRD patterns of the prepared TiO_2 with different calcination temperatures. Six significant peak exists were found to be related to rutile (27.4°, 36.1°, 41.3°, 54.3°, 56.7° & 62.8°). The diffractogram shows pure TiO_2 phase without any trace of other compound.

Table 1 Crystal hablur parameter
Crystallite size is increasing with increasing of calcination temperatures. This can be associated to enhanced diffusion processes that facilitate grain growth. The domain crystal plane for this uncalcined and 350 °C sample is (011), and for 450°C and 550 °C is (110). This growth orientation will affect the performance of photocatalyst.

Fig. 2

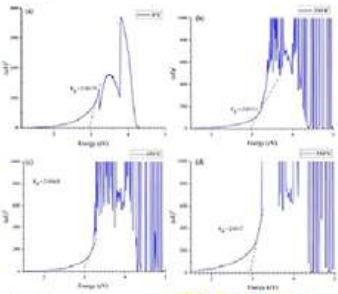


Fig. 2 UV Vis Analysis
When the calcination temperatures is increased, it's will affect the value of the band gap energy Direct band gap of TiO_2 pristine was significantly decreased respectively. This phenomenon influenced by the growth of crystallite size. These changes significantly impact the optical properties of TiO_2, which are crucial for its performance as photocatalyst.

CONCLUSION

The prepared samples were successfully calcined at different calcination temperatures of 350°C, 450°C and 550°C. Calcination of the TiO_2 nanorod sample has been proven to increase the crystallite size and reduce the band gap. It is also increase the optical absorbance of the sample. Future works of photocatalysis characterization will be conducted to see the performance of calcined samples in water splitting application.

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FABRICATION OF IRRADIATED NICKEL OXIDE NANOFIBERS BY ELECTROSPINNING TECHNIQUE

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N.U.R NUKLEAR UNTUK RAKYAT

ABSTRACT

Nickel oxide nanofibers, NiO NFs through a mixture of Ni Acetate/polyvinylpyrrolidone, PVP has been produced using electrospin technique, and then followed with calcination of electrospun composite nanofibers. The effect of applied voltage on the morphological structure of nanofibers was studied. Nanofibers Ni Acetate/PVP and NiO NFs have been characterized by FESEM and XRD. The results of the study show that the optimum calcination temperature for the production of NiO nanofibers is 500°C. An Electron Beam, EB with energy of 1MeV and current was set at 10mA was use for irradiating the samples. This is to study the modification of physicochemical characteristics of the samples.

INTRODUCTION

Nickel oxide, NiO nanofibers are good candidates for many applications due to large surface area, psuedo-one dimensional structure and semiconducting properties. NiO nanofibers can be fabricated using the electrospinning technique. This process involves the application of an electric field to a polymer solution containing nickel precursors, which causes the solution to eject a charged jet towards a collector, resulting in the deposition of ultrathin NiO nanofibers [Figure 1]. Electrospinning technique is considered the efficient ways to fabricate nanofibers with diameters down to tens of nanometers from various materials such as polymers, metal oxides and composites. There are three basic components to be used in an electrospinner a high voltage supply, a needle of small diameter with syringe that is connected to a syringe pump and a collector [1-3].

OBJECTIVE

To fabricate irradiated Nickel oxide (NiO), nanofibers (NFs) via electrospinning technique.

MATERIALS AND METHOD

Fabrication of Nickel Oxide, NiO nanofibers.

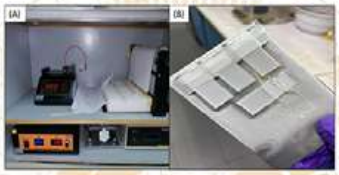

Fig 1.(A) The electronspinning setup (B) The collection of NiAc/PVP nanofibers.

RESULTS

The X-ray spectra in figure 2, shows the present of NiO nanofibers after the calcination process and irradiated NiO nanofibers. While figure 3(A) shows the FESEM results of NiAc/PVP nanofibers, NFs. After the calcination process the formation of NiO NFs are shown in figure 3(B) and figure 3(C) the irradiated of NiO NFs. The electrospinning NiAc/PVP NFs give smooth surface without any beads.

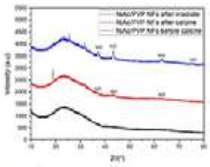

Fig. 2 The XRD spectra of NiO nanofibers.

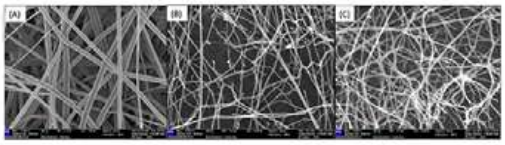

Fig. 3(A) The morphology of the nanofibers before calcination, (B) After calcination and (C) After irradiation of NiO NFs.

CONCLUSIONS

The characterization results show that the Nickel oxide nanofibers can be easily prepared by electrospinning technique via optimized synthesis route parameters. The study parameters of the solution such as concentration, mixing ratio, molecular weight, surface tension, conductivity and viscosity are important to fabricate the nanofibers. The modification of physicochemical characteristics of the samples by using EB irradiation for the structural stability. The electrospinning technique to fabrication of nanofibers is useful for application such as renewable energy, water treatment and sensor.

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PRELIMINARY STUDY ON THE EFFECT OF VOLTAGE FOR RUST REMOVAL USING ELECTROLYSIS METHOD

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Abstract

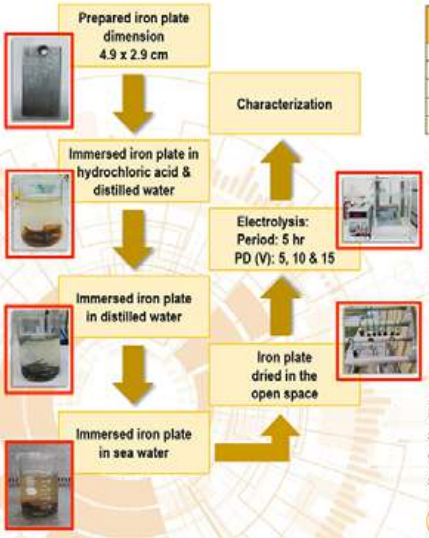
Artefacts stored in a museum or gallery have artistic and historical value that is beneficial for current and future generations. However, metal artefacts tend to rust. One of the methods used to prevent this is electrolysis. Electrolysis is widely used in the conservation of metal artefacts as it can remove rust and preserve the original condition of the artefact. A study of rust samples was carried out using the electrolysis method in order to determine the optimum voltage. This study was conducted using voltages of 5V, 10V and 15V respectively for 5 hours. Analysis was carried out using a stereo microscope, hardness tester, X-Ray fluorescence spectroscopy, X-Ray diffractometer and balance. From the results, it was found that the optimal voltage is at 5V.

Keywords: ***artefacts, rust removal, electrolysis, voltage***

Introduction

Artefacts made from ferrous metal were mostly used in the past as weapons, home furnishings, and symbols of a country's government. However, most of these metal materials were discovered by researchers damaged and nearly completely destroyed due to rust. As a result, artefact conservation and preservation are critical. To remove rust from samples without destroying the archaeological material, proper processes must be used. The conventional methods commonly used to overcome this problem are soda blasting and conventional cleaning [1, 2, 3]. However, these techniques have the disadvantage of not being able to remove rust at a corner and depth of the artefact. Therefore, the electrolysis process is one of the approaches to be emphasized in order to remove the rust.

Methodology



Results and Discussion

Fig 1: Image for original, rust, 5V, 10V and 15V samples under stereo microscope

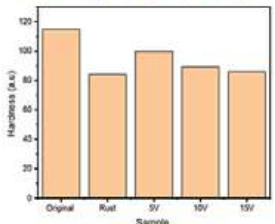


Fig 2: Hardness tester result

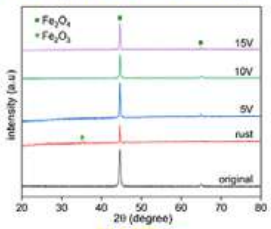


Fig 3: XRD data

Table 1: mass different & XRF data for original, rust, 5V, 10V and 15V samples

Sample	Mass (±0.001g)			XRF data
	Before	After	Different	Fe element (%)
Original	19.655	-	-	99.083%
Rust	22.6703	-	-	97.577%
5V	22.3137	22.1963	0.1174	99.293%
10V	22.5877	22.4856	0.1021	99.437%
15V	22.0574	21.9253	0.1321	99.433%

- The image in Fig. 1 signified that removing rust using the electrolysis method is successful.
- The sample treated with 5V demonstrated a hardness value that is closest to the original sample, as illustrated in Fig. 2, compared to the samples treated with other voltages.
- The success of the electrolysis process is further evidenced by the disappearance of the Fe_2O_3 peak from the XRD spectrum as depicted in Fig. 3.
- As shown in Table 1, the reduction in mass of the plate after the electrolysis process, is also significant evidence of the successful derusting (reduction) process.
- Additionally, X-ray fluorescence (XRF) analysis was performed to verify that the samples were composed of ferrous materials.

Conclusion

Based on XRD and mass differential analysis, the electrolysis process exhibited minimal variation across different voltages. However, the hardness of the material significantly decreased at higher voltages (e.g., 10V and 15V). To mitigate this reduction in hardness, which is critical for heritage samples, the optimal electrolysis voltage was determined to be 5V.

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A REVIEW ON PHOSPHATE LEACHING FROM MONAZITE MINERAL USING ALKALINE TREATMENT

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KEYWORD

Monazite, Rare earth elements, Phosphate recovery, Solid-liquid extraction

ABSTRACT

Monazite is an orthophosphate mineral that contains rare earth elements that can be obtained from various other minerals in the world. The high demand for rare earth elements and phosphates as by-products has increased in the use of high technology and consumer products. After mining, monazite minerals are comminuted and ore refined before the next process, namely hydrometallurgy and pyrometallurgy, is carried out for phosphate recovery. The cracking process is an important process to break down the mineral structure into elements of rare earth elements and concentrated phosphate. This method can be carried out by autoclave leaching, atmospheric leaching, mechanical decomposition dan fusion. The concentration of cracking produces a phosphate solution that is dissolved through the solid-liquid extraction method. This paper reviews cracking discovery to recover phosphate from monazite to facilitate further REE processes

INTRODUCTION

Monazite is a unique phosphate deposit with (Ce, La, Nd, Th) (PO^4, SiO^4) chemical properties. This commonly appears as small separated grains, throughout igneous and metamorphic rocks like granite, pegmatite, schist, and gneiss. All such grains also weather-resistant and become distributed from the host rock in downslope soils and sediments. There also exploited by the rare earth and thorium value.

AUTOCLAVE LEACHING

Trisodium phosphate was first discovered by G. Calkins et al. (1950) at the Battelle Memorial Institute for the autoclave-based recovery of thorium and uranium from monazite sand [1]. 30% caustic solution reacts with 100% monazite size passing 0.0075mm (200 mesh) for 4 hours at 200 °C. The weight ratio of caustic to sand used in the reaction is 2:1, or 150 g of caustic to 75 g of monazite. Filtering and washing with water are used to remove the trisodium phosphate, and hydrochloric acid is used to dissolve mixed hydroxide. This technique digests more than 98% of the sand.

ATMOSPHERIC LEACHING

Rohden et al. (1957) at the Battelle Memorial Institute pioneered the finding of trisodium phosphate utilizing open digestion of monazite [2]. Alkaline digestion required a combined 1 ton of sodium hydroxide and 1 ton of monazite 100% passing 0.075mm (200 mesh). 1 ton of sodium hydroxide is made at a concentration of 65% and heated for 2 to 5 hours at 140°C to 145°C. Monazite can be broken down to up to 98% to 100% of its original composition in 3 to 4 hours, according to research. Trisodium phosphate crystallization resulted in the production of 1.5 ton of trisodium phosphate.

MECHANOCHEMICAL DECOMPOSITION

The breakdown of monazite with caustic soda and monazite grinding in one step were the subjects of a study by Mcerson et al. in 1957. In comparison to alternative caustic exchanges, the use of ball milling eliminates the generation of reaction products that surround mineral grains and further reduces caustic use by 50%[3]. In a ball mill that had been heated to 130 °C, Mcerson et al. (1957) broke down monazite using solid sodium hydroxide. In the following stage, the undissolved residue is subjected to a second reaction in a ball mill with a 650 gL-1 sodium hydroxide solution.

FUSION

Caustic fusion technique employing sodium hydroxide was initially investigated, and it was reported in United States Patent 617,636 (1899) [1]. With the usage of high temperatures, the reaction products are too hard, making the solid mass difficult to manipulate, which is one of the flaws in this pyrometallurgical process. For this reason, the possibility of carrying out the reaction in an aqueous solution was investigated.

CONCLUSION

From the review study, it was found that caustic conversion decomposition is mostly used for phosphate treatment on monazite. Phosphate removed at an early stage for further rare earth cracking processes, potentially as a commercial by-product. The known uses of phosphate produced are cleaning agent, sugar, food additive, lubricant, stain remover, textile, fertilizer, and degreaser.

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SOLVENT EXTRACTION OF CERIUM FROM ACIDIC CHLORIDE MEDIUM USING SYNERGIST EXTRACTANT

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N.U.R NUKLEAR UNTUK RAKYAT

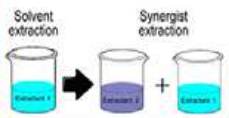
INTRODUCTION

COMMERCIAL REEs MINERAL SOURCES

- 55-60% of RE oxide
- 24-29% of phosphate oxide
- 5-10% of thorium oxide
- 0.2-0.4% of uranium oxide

EXTRACTION METHODS

- Precipitation
- Electrophoresis
- Chromatography
- Floatation
- Ion-exchange
- Solvent extraction



Type of extractants:
- Acidic organophosphorus (P204, PS07, PC-88A)
- Neutral organophosphorus (TBP, Cyanex 923)
- Amines (Aliquat 336)
- Bifunctional ionic liquids (imidazole)

EXTRACTION METHODS

Drawbacks:
- Tendancy of extractants loss
- Formation of emulsion
- Use of diluents – release of undesired VOCs

Advantages:
- Better extraction capability
- Higher selectivity of REEs
- Reduction in the formation of emulsion
- Reduction in the release of VOCs
- Improve the REEs separation

OBJECTIVES

- To extract the rare earth chloride from monazite mineral.
- To optimize the synergist extractant in extracting Ce using solvent extraction.
- To achieve the synergist extraction efficiency of Ce more than 50%.

EXPERIMENTAL

No.	Methods / Steps
1.	Preparation of aqueous and organic solution a) Aqueous b) Organic
2.	Aqueous and organic solution was mixed and stirred together around 10 minutes at RT.
3.	The mixture solution was separated in separatory funnel.

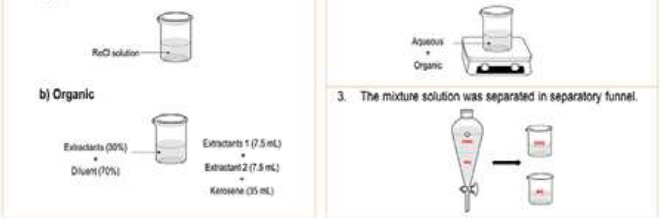


Figure 1: Experimental procedure of synergistic solvent extraction

RESULTS & DISCUSSION

SYNERGISTIC EXTRACTION EFFICIENCY

- The experiments were carried out under acidic chloride solution (0.2 M) at organic-to-aqueous (O/A) phase ratio of 1.
- The concentration of Ce in the aqueous phase before and after the extraction was measured spectrometrically using Energy dispersive X-ray Fluorescence (ED-XRF).
- Ce extraction efficiency was determined using equation below:.

$$\text{Efficiency of Ce extraction} = \frac{\text{Before} - \text{After}}{\text{Before}} \times 100$$

Table 1: Efficiency of Ce extraction

Sample ID	Ratio	Extractant 1	Extractant 2	Efficiency of Ce (%)
S01	-	TBP	-	2.4
S02	-	D2EHPA	-	46.2
S03	-	Cyphos IL	-	73.2
S04	-	Aliquat 336	-	39.7
S05	1:1	TBP	D2EHPA	70.7
S06	1:1	TBP	Cyphos IL	66.2
S07	1:1	TBP	Aliquat 336	42.0
S08	1:1	D2EHPA	Cyphos IL	94.1
S09	1:1	D2EHPA	Aliquat 336	51.6
S10	1:1	Cyphos IL	Aliquat 336	51.2

TBP: Tributyl phosphate
D2EHPA: Di-(2-ethyl hexyl) phosphoric acid
Cyphos IL : Trihexyl(tetradecyl)phosphonium bis(2,4,4-trimethylpentyl)phosphinate
Aliquat 336: Trioctylmethylammonium chloride

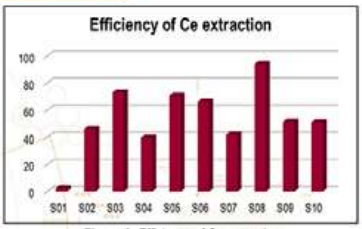


Figure 2: Efficiency of Ce extraction

Table 2: The extraction of Ce between different extractants

Extractant	Samples
Single	S01, S02, S03, S04
Synergist	S05, S06, S07, S08, S09, S10

- The results show that the synergistic extraction system enhanced the extraction efficiency compared to the single extraction system.
- From the results in Figure 2, it was found that the extraction of Ce from acidic chloride medium using synergist extractants **between D2EHPA and Cyphos IL** gives the highest extraction efficiency of **94.1%**, followed by TBP/D2EHPA (70.7%), TBP/Cyphos IL (66.2%), D2EHPA/Aliquat 336 (51.6%), Cyphos IL/Aliquat 336 (51.2%) and TBP/Aliquat 336 (42.0%).

CONCLUSION

- ✓ Extraction of rare earth chloride from monazite mineral was successfully achieved.
- ✓ Synergist extractants in extracting cerium from acidic chloride medium using solvent extraction techniques at laboratory scale was successfully achieved.
- ✓ Synergist extractant of D2EHPA/Cyphos IL gave the highest Ce extraction efficiency (94.1%) compared to other extractants.
- ✓ The synergist extractant of Ce is more efficient compared to single extractant under room temperature.

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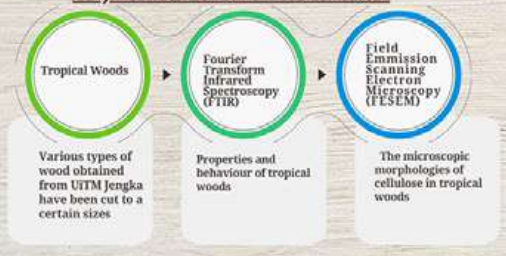
PreLiMiNaRy STuDy on tHe PRoPeRTiEs oF MaLaYSiA TrOPiCaL WooDS

Suhaila Hani Ilias, Nurliana Roslan

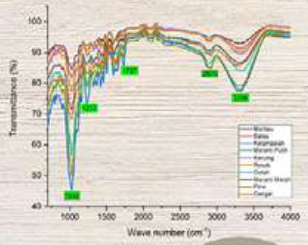
INTRODUCTION

Malaysia tropical wood stands out as the most crucial natural organic material in human history, being among the first materials utilized by humans. It has been used to create crucial items such as shelters, tools, furniture, weapons, boats, coaches, and religious or symbolic works of art. This makes it exceptionally significant for cultural heritage conservation in Malaysia. A preliminary study of Malaysian tropical wood includes a variety of species such as Balau, Resak, Pine, Getah, Keruing, Kelampaian, Merbau, Meranti Merah, Meranti Putih, and Cengal. Tropical wood is a complex composite of biopolymers, with cellulose being the most vital component, making up 40-50% by weight. Cellulose, a linear polymer of glucose, can form ordered assemblies at the nanoscale, such as crystallites, fibrils, and fiber. This high degree of organization, along with its hydrophilic nature, makes cellulose the primary constituent of wood's cellular structure. Lignin, another significant macromolecule, is present in wood at concentrations of 25–30% and contributes to the wood's strength and rigidity. Fourier Transform Infrared Spectroscopy (FTIR) is an analytical technique used to identify organic, polymeric, and, in some cases, inorganic materials. By analyze tropical woods using FTIR, we can gain a comprehensive understanding of their properties and behavios. FTIR provides valuable information about the chemical composition, structure, and properties of the wood. Key aspects that can be studied using FTIR include the cellulose, hemicellulose, and lignin content. Additionally, the crystallinity of cellulose in the wood can be assessed by examining the ratio of the intensities of specific FTIR bands. These absorption bands offer insights into the wood's chemical structure. The microscopic morphologies of cellulose in tropical woods were characterized using Field Emission Scanning Electron Microscopy (FESEM).

OBJECTIVE & METHODOLOGY



FOURIER TRANSFORM INFRARED SPECTROSCOPY (FTIR)



RESULTS & DISCUSSION

FIELD EMISSION SCANNING ELECTRON MICROSCOPY (FESEM)

ELEMENTAL ANALYSIS

TROPICAL WOODS	% CARBON	% OXYGEN
MERBAU	56.2	4.69
BALAU	54.1	39.6
KELAMPAIAN	55.5	36.5
MERANTI PUTIH	51.5	40.6
KERUING	59.6	31.6
RESAK	55.6	36.2
GETAH	54.3	38.2
MERANTI MERAH	52.6	40.4
PINE	51.4	41.2
CENGAL	54.1	38.1

INFRARED SPECTROSCOPY ABSORPTION

NO.	EXP.	LITERATURE	FUNCTIONAL GROUP	BAND ASSIGNMENT	POSSIBLE NUTRIENT TYPE	TROPICAL WOODS
1	1032	1045-1053	Methylene	C-O component	Carbohydrate	Merbau, Balau, Kelampaian, Meranti Putih, Keruing, Resak, Getah, Meranti Merah, Pine, Cengal
2	1233	1230-1238	Ether and oxy compound	C-H component	Protein (Amide III)	Merbau, Balau, Meranti Putih, Keruing, Resak, Getah, Meranti Merah, Pine, Cengal
3	1737	1740-1720	Carbonyl compound	C=O stretching	Lipids	Merbau, Balau, Kelampaian, Meranti Putih, Keruing, Resak, Getah, Meranti Merah, Pine, Cengal
4	2870	2853-2860	Ether and oxy compound	CH2 lipids	Amine Salt	Merbau, Balau, Meranti Putih, Keruing, Resak, Getah, Meranti Merah, Pine, Cengal
5	3298	3273-3293	Common inorganic ions	O-H symmetric	Water	Merbau, Balau, Meranti Putih, Keruing, Resak, Getah, Meranti Merah, Pine, Cengal

CONCLUSION

Tropical wood is main been consist of cellulose, hemicelluloses and lignin. Generally, O-H stretching absorption bends (around 3306 cm^{-1}) and C-H absorption bands (around 2896 cm^{-1}) have contributions from all these type of tropical woods.

ACKNOWLEDGEMENT

The author extends gratitude to the staff of the School of Wood Industry at UiTM Jengka, Pahang for providing the tropical woods.

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QUICK SCREENING METHOD FOR Ra-226 DETERMINATION IN WATER SAMPLES

Yii Mei-Wo, Nooradilah Abdullah, Salahuddin Muhamad

ABSTRACT

Present of Ra-226 in water is of concern due to its radiotoxicology. Limits were set for Ra-226 concentration in waters by authorities to ensure public safety. Ra-226 measurement can be performed by various methods such as through gamma spectrometry after secular equilibrium or via alpha/beta energies after chemical purification and measured with alpha spectrometry or liquid scintillation counter. These methods were either time consuming or required chemical separation before measurement. A new approach is discussed in this article to screen Ra-226 quickly without neither have to wait for secular equilibrium nor involve complicated chemistry process.

INTRODUCTION

- Ra-226 is significant radionuclide in water.
- Ra-226 decays into radon gas (Rn-222), contributing to environmental and health risks.
- Long-term exposure can lead to diseases like lymphoma, bone cancer, and leukemia.

EXPERIMENTAL

Standards Set Preparation

Blank : 10 mL DW + 10 mL cocktail

0.1 mL Ra-226 + 9.9 mL DW + 10 mL cocktail

0.2 mL Ra-226 + 9.8 mL DW+ 10 mL cocktail

0.3 mL Ra-226 + 9.7 mL DW + 10 mL cocktail

0.4 mL Ra-226 + 9.6 mL DW + 10 mL cocktail

0.5 mL Ra-226 + 9.5 mL DW + 10 mL cocktail

Ra-226 = 15.0618 Bq/g, cocktail = ULTIMA Gold F, DW = Distill water

Sample Preparation

10 mL spiked water (158 Bq/L) + 10 mL cocktail

10 mL unknown sample 1 + 10 mL cocktail (0.5 Bq/L with gamma spectrometry), Ref. date 10th Jan 2020)

10 mL unknown sample 2 + 10 mL cocktail (0.5 Bq/L with gamma spectrometry), Ref. date 17th Aug 2023)

Counting using Liquid Scintillation Counter **Perkin-Elmer Tri-Carb 5110TR**

RESULTS AND DISCUSSION

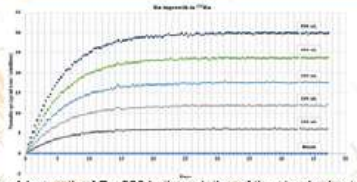

Figure 1 Ingrowth of Rn-222 in the solution of the standard set

Table 1 Net count rate and calculated specific activity for sample set

Sample	Spiked sample			Unknown sample 1			Unknown sample 2		
Counting	Time different (days)	Net cpm	Calculated specific activity (Bq/L)	Time different (days)	Net cpm	Calculated specific activity (Bq/L)	Time different (days)	Net cpm	Calculated specific activity (Bq/L)
First	4.12	186	163.8	4.21	-1	< 0.55	4.25	4	3.43
Second	7.35	259	163.5	7.43	0	< 0.58	7.47	3	1.86
Third	14.30	330	165.4	14.39	0	< 0.58	14.43	3	1.49
Fourth	21.18	352	166.8	21.27	0	< 0.55	21.31	3	1.41
Fifth (after equilibrium)	31.37	361	167.8	31.42	0	< 0.55	31.46	4	1.85
Average	-	-	165.5 ± 17.4	-	-	< 0.56	-	-	2.0 ± 0.3

- Count rate was increased over the time for the five vials that spiked with Ra-226, while the count rate for blank vial remained constant over the time
- The growth in count rate was due with the ingrowth of Rn-222. The more Ra-226 that been spiked into the vial, it would result higher count rate.
- The count rates reached the maximum value and assumed to achieve the secular equilibrium between Ra-226 and Rn-222 This value remained constant after 27 days (> 7 half-lives of Rn-222) which agreed with findings reported by Yu et al.(2011).
- Experimental values match theoretical values within ±4%.
- For the unknown sample 2, the net cpm gave some reading but the net cpm values were similar throughout the months, which indicating these counts should not be due to the Rn-222 ingrowths but likely due to some unknown interference such as chemical/colour quenching. As mentioned by Krishnaswami and Cochran (2008), in an enclosure airtight condition, radon, can be removed only by decay and not by adsorption or precipitation.

CONCLUSION

From this study, we can concluded that the method/approach proposed can be used to make a quick screening of Ra-226 activity concentration in the water. It's particularly useful and accurate for measurement of the high radioactive sample but encounters some confusion for low concentration sample. However, this method can still be used for screening by applying a higher detection limit. The usage of this approach / method can avoid the time needed to wait for secular equilibrium prior to measurement, which can be helpful when one required to make urgent decision.

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MEASURING THE CONCENTRATION OF PLUTONIUM ISOTOPES, PU-239+240 IN SEDIMENT SAMPLE USING ALPHA SPECTROMETRY AT KOREA INSTITUTE OF NUCLEAR SAFETY (KINS)

Mohd Zuhair Mohd Sanusi, Noor Fadzilah Yusof, Jeonghyeon Ryu, Chaeyeon Lee, Cheolsu Kim, Daejin Kim

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INTRODUCTION

The distribution of plutonium isotopes in sediment is attributed to multiple factors. The predominant source is the global radioactive atmospheric fallout resulting from nuclear weapon testing conducted between 1945-1980, the Chernobyl nuclear accident in 1986 and Fukushima Daiichi Nuclear Power Plant (FDNPP) disaster in 2011 (Galuszka and Migaszewski 2018). The most common technique used for measuring plutonium isotopes in environmental sample including sediment sample is alpha spectrometry (Rameback, H., et al 2020). Moreover, alpha spectrometry is one of the best and most sensitive assays for determining very low activity environment sample (Skwarzec, B., et al 2016).This study focuses on measuring concentration of Pu isotopes $Pu^{239+240}$ in sediment sample using alpha spectrometry at Korea Institute of Nuclear Safety (KINS).

RESULT

Table 1. show of result for determination of concentration Pu-239+240

Sample	Weight of SRM 4357 (g)	Concentration of $Pu^{239+240}$ (mBq/g)	Certification value, $Pu^{239+240}$ (mBq/g)	Relative bias (%)
1	4.0572	10.98	10.4	5.56
2	4.1269	10.79	10.4	3.70
3	4.2416	10.14	10.4	-2.54

Table 2. shows the amount of Pu-242 tracer for each sample and the chemical recovery

Sample	Concentration of Pu^{242}(g)	Recovery (%)
Blank	2.0678	85.53
1	2.0722	94.56
2	2.0716	94.58
3	1.9146	103.12

MATERIAL & METHOD

The sample was dried in an oven at about 70°C for 3 hours. In order to remove organic material, the sample was ashed using furnace about 500°C almost 16 hours. A Pu-242 tracer was added into sample before it was dissolved in concentrated $HNO_3$and H_2O_2. To remove suspended matter, sample was filtered using a decompression filter device through 0.55mm the Whatman filter paper. The filtered sample was treated by NH_4OH continuously until a precipitate formed in the alkaline solution. A centrifuge machine was used to separate the supernatant from the precipitate at a speed of 4000 rpm. After centrifugation, the separated precipitate was collected. The reduction of precipitate was achieved using HNO_3 and $C_6H_8O_6$. The separation of Pu was executed using TEVA resin by treated with HNO_3 and HCl. Electrodeposition was performed at 1 A for 90 minutes. The determination of Pu isotopes in the sample was counted using alpha spectrometry system.

DISCUSSION

The data on the concentration of $Pu^{239+240}$shows values nearly equal to the certified value. However, samples 1 and 2 shows values higher than certified value by10.4 mBq/g whereas, sample 3 shows a relative bias of -2.54 %. The higher values in the experimental results compared to certified value probably indicate measurement errors or uncertainties in experimental setup. The chemical recovery of Pu^{242} was 85.63% for the blank sample and 94 -103% for the samples. A chemical recovery higher than 100% is commonly considered abnormal and indicative of errors in the experimental procedure. The alpha peak of blank and samples showed only a few counts at background levels, suggesting that no contamination occurred during experimental procedure.

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INTER-COMPARISON EXERCISES FOR DETERMINATION OF GAMMA EMITTING RADIONUCLIDES: RAS LABORATORY PARTICIPATION

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ABSTRACT

This paper presents the outcomes of Radiochemistry and Environment (RAS) Laboratory's participation in inter-comparison exercises, aligned with ISO 17025 quality system implementation and accreditation requirements. RAS laboratory engaged in international exercises for the determination of anthropogenic and natural radionuclides in various food and environmental samples. In 2023, RAS laboratory has participated in three inter-laboratory comparison (ILC) or proficiency test (PT) that were internationally organized by International Atomic Energy Agency (IAEA) and National Centre for Food Science (NCFS) of Singapore Food Agency (SFA). The reported results from RAS laboratory were predominantly in good agreement with the established reference values reported, demonstrating the laboratory's proficiency and adherence to international standards.

Keywords: ISO 17025, proficiency test, accreditation, IAEA

INTRODUCTION

The implementation of a robust quality management system, such as ISO 17025, is crucial for laboratories to ensure the accuracy and reliability of their testing and calibration results. Accreditation to ISO 17025 provides formal recognition of a laboratory's competence. As part of the accreditation process, participation in inter-laboratory comparison (ILC) or proficiency test (PT) is essential for validating analytical methods and maintaining quality standards (Standards Malaysia 2018). Focusses on gamma emitting radionuclides, this test is designed to evaluate the performance of laboratories and their equipment in accurately detecting and measuring gamma radiation.

OBJECTIVE

The objective of this paper is to discuss the performance of Radiochemistry and Environment (RAS) Laboratory in inter-comparison exercise for the determination of both natural and anthropogenic gamma emitters in various environmental samples.

METHODOLOGY

A high purity germanium detector used to measure gamma emitting radionuclides in this test. The samples were counted for over 50,000 seconds with an analytical precision of ± 10% at the 95% level of confidence. The detector has a relative efficiency of 25% and surrounded by well-designed shield consisting of lead and copper. The gamma spectrometry detector was calibrated using multi-nuclide standard source. The certified reference material SOIL-6 was used for quality control evaluation. Analysis results were evaluated based on accuracy, precision and ζ-score. In 2023, RAS laboratory involved in three PT as detailed in Table 1:

Table 1: PT code and its description

PT code	Details
PT1	ASEAN Interlaboratory Comparison (NCFS-PT2023-01)
PT2	RML PT-Test (IAEA-RML-2023-01)
PT3	PT-ALMERA (IAEA-TERN-2023-01/02)

1. Accuracy

$$Bias_{value} = \frac{Value_{reported} - Value_{ref}}{Value_{ref}} \times 100\%$$

2. Precision

$$P = \sqrt{\left(\frac{u_{ref}}{Value_{ref}}\right)^2 + \left(\frac{u_{reported}}{Value_{reported}}\right)^2} \times 100$$

$$Bias_{value} \leq k^* P$$

3. Z-scores

$$Z = \frac{value_{reported} - value_{ref}}{z^*}$$

$$z^* = 1.483 \times median\ of\ |value_{n,reported} - value_{ref}|$$

RESULTS & DISCUSSION

Table 2. Summary of radionuclides tested in PT for year 2023

No	PT	Tested	Result in agreement	Percentage (%)
1	NCFS-PT2023-01	2	2	100
2	IAEA-RML-2023-01	5	4	80
3	IAEA-TERC-2023-01/02	23	10	43
		Average		74

Table 3. Evaluation of the PT for NCFS-PT2023-01

Radionuclide	Reference value (Bq/kg)	Reported value (Bq/kg)	Relative bias (%)	Result
^{134}Cs	73.56 ± 1.9	73.56 ± 11.39	-7.3	Satisfactory
^{137}Cs	25.7 ± 1.7	26.21 ± 3.77	2.2	Satisfactory

Table 4. Evaluation of the PT for IAEA-RML-2023-01

Radionuclide	Reference value (Bq/kg)	Reported value (Bq/kg)	Relative bias (%)	Precision	Final Score
^{54}Cs	0.320 ± 0.002	0.280 ± 0.020	-12.5	Pass	Accepted
^{137}Cs	0.0742 ± 0.0006	NR	NR	NR	NR
^{133}Ba	0.160 ± 0.001	0.160 ± 0.010	0.0	Pass	Accepted
^{134}Cs	0.378 ± 0.002	0.360 ± 0.070	-4.6	Pass	Accepted
^{137}Cs	0.198 ± 0.002	0.190 ± 0.030	-4.1	Pass	Accepted

NR = not reported

Table 5. Evaluation of the PT for IAEA-TERC-2023-01/02

Sample Code	Radionuclide	Reference value (Bq/kg)	Reported value (Bq/kg)	Relative bias (%)	Precision	Final Score
01	^{60}Co	14.7 ± 0.7	13.98 ± 1.34	-4.9 (20)	Pass	Accepted
	^{238}U	5.60 ± 0.28	NR	NR (20)	NR	NR
	^{241}Am	22.3 ± 1.1	19.36 ± 2.74	-13.2 (20)	Pass	Accepted
02	^{125}Sb	73.0 ± 3.6	95.62 ± 16.47	31 (20)	Pass	No
	^{134}Cs	40.0 ± 2.0	34.08 ± 5.71	-14.8 (20)	Pass	Accepted
	^{137}Cs	44.1 ± 2.2	39.97 ± 6.34	-9.4 (20)	Pass	Accepted
	^{210}Pb	5.23 ± 0.26	NR	NR (30)	NR	NR
	^{226}Ra	6.32 ± 0.32	NR	NR (30)	NR	NR
04	^{40}K	584 ± 20	514.48 ± 79.97	-11.9 (30)	Pass	Accepted
	^{134}Cs	6.93 ± 0.50	7.28 ± 1.30	5.1 (30)	Pass	Accepted
	^{137}Cs	270 ± 17	276.91 ± 50.93	2.6 (30)	Pass	Accepted
	^{208}Tl	11.8 ± 0.8	NR	NR (30)	NR	NR
	^{210}Pb	26.6 ± 1.8	NR	NR (30)	NR	NR
	^{212}Bi	32.9 ± 1.9	NR	NR (30)	NR	NR
	^{212}Pb	32.9 ± 1.9	NR	NR (30)	NR	NR
	^{214}Bi	20.8 ± 1.0	NR	NR (30)	NR	NR
	^{214}Pb	20.8 ± 1.0	NR	NR (30)	NR	NR
	^{226}Ra	20.8 ± 1.0	25.47 ± 3.62	22.5 (30)	Pass	Accepted
	^{228}Ac	32.9 ± 1.9	NR	NR (30)	NR	NR
	^{232}Th	23.0 ± 1.5	NR	NR (30)	NR	NR
	^{235}U	1.22 ± 0.15	NR	NR (30)	NR	NR
05	^{134}Cs	5.40 ± 0.21	5.3262 ± 0.0651	-1.4 (30)	Pass	Accepted
06	^{134}Cs	7.84 ± 0.31	7.4962 ± 0.0742	-4.4 (30)	Pass	Accepted

NR = not reported

Figure 1. Relative bias for PT1

Figure 2. Relative bias for PT2

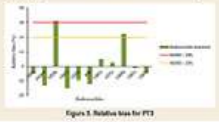

Figure 3. Relative bias for PT3

CONCLUSION

The overall performance evaluation results of the RAS laboratory presented a high number of acceptable scores. It was noted that only one radionuclide that need for corrective action in the analysis process. Meanwhile, half of the radionuclides are not the routine radionuclides analyse at the RAS laboratory and can be considered for analysis. RAS laboratory's performance in the 2023 inter-comparison exercise for the determination of gamma emitting radionuclides demonstrates the laboratory's competence and adherence to ISO 17025 standards. The results confirm the laboratory's ability to produce accurate and reliable data, reinforcing the importance of inter-comparison exercises in the quality assurance process.

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LEVEL OF TOTAL ARSENIC AND TOTAL MERCURY IN SELECTED BIVALVE SPECIES FROM PENINSULAR MALAYSIA

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N.U.R NUKLEAR UNTUK RAKYAT

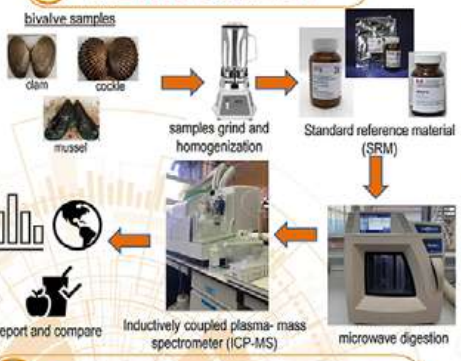
ABSTRACT

Arsenic (As) and mercury (Hg) levels in marine organisms are critical environmental and public health concerns. These toxic elements can accumulate in bivalves and pose significant consumer risks. Monitoring of these elements is essential to ensure the safety of seafood consumption. In this study cockles, clams and mussels were collected from Melaka and Pahang states for the determination of total As and total Hg levels. The bivalve tissues were digested using microwave digester and analyzed using inductively coupled plasma-mass spectrometer (ICP-MS). The total As in the bivalve samples ranged between 0.85 ± 0.04 mg kg^{-1} and 1.60 ± 0.27 mg kg^{-1}. Meanwhile, the total Hg in the bivalve samples was from 0.004 ± 0.002 to 0.007 ± 0.002 mg kg^{-1}. The result of the elements was compared with the local and global guidelines. This research provides the latest information for food safety and risk assessment studies in the regional and national levels.

INTRODUCTION

- Bivalve, as filter feeders, play a significant role in the marine ecosystem by filtering water and accumulating various substances, including contaminants.
- Among these contaminants, arsenic and mercury are of particular concern due to their toxicity and potential health impacts on both marine life and humans.
- Arsenic (As) is a naturally occurring element found in the Earth's crust, and its presence in marine environments can result from natural processes such as volcanic activity and the weathering of rocks, as well as from anthropogenic sources like industrial discharges and agricultural runoff (Luvonga et al., 2020).
- Similarly, mercury (Hg), primarily released into the environment through industrial activities such as coal combustion and mining, poses severe ecological and health risks due to its ability to bioaccumulate in marine organisms and biomagnifies through the food web (Fui et al., 2022; Haris et al., 2020).
- In Malaysia, the guidelines of As and Hg levels in bivalves are established based on organic As and methyl-Hg. According to the Malaysian Food Regulation 1985, the Malaysian Food Regulations 1985, the maximum allowable limit for organic As is 1.0 mg kg^{-1}, meanwhile for methyl-Hg is set at 0.5 mg kg^{-1}.
- Due to the high cost and tedious analytical methods for speciation analysis, the routine bivalve samples analysis for organic As and methyl-Hg were screened for total As and Hg levels prior to speciation analysis in the majority of worldwide laboratories.
- **Objective of the study**: To determine the level of total As and Hg in selected bivalve samples from Melaka and Pahang states and compare with the local and global guidelines.

METHODOLOGY



COMPARISON WITH GUIDELINES

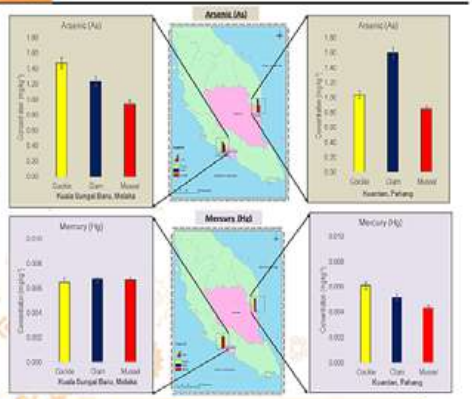
The Malaysian Food Act 1985 guidelines specify the maximum permissible level of organic As at 1.0 mg kg^{-1}. Based on the analysis of total As in bivalve samples from both locations, the clam and cockle samples exceeded the total of 1.0 mg kg^{-1} level. Therefore, it is compulsory and recommended for further As speciation analysis for clam and cockle samples from both locations to investigate the species of As in the samples. Meanwhile for Hg, all bivalve samples in both locations were below than the methyl-Hg guideline from the Malaysian Food Act 1985.

CONCLUSIONS

As for conclusion, the distribution of total As and Hg levels cockle were examined for the clam, cockle and mussel samples from Kuala Sungai Baru, Melaka and Kuantan, Pahang. The As and Hg distribution pattern for all three bivalve samples was similar due to the similar geological and urbanization regions. However, the difference level of these element between bivalve samples may due to biological factors. It is recommended to perform further As speciation analysis for clam and cockle samples to understand the safety risk of bivalve consumption in the local areas. The further analysis of Hg in the food chain also was important to investigate the potential of Hg biomagnification across the food chain. This study newest data of As and Hg food safety and risk assessment in the bivalve samples from local areas of Melaka and Pahang states.

RESULT & DISCUSSION

SRM/CRM	Arsenic (As)			Mercury (Hg)		
	Obtain result (mg kg^{-1})	Certified Value (mg kg^{-1})	Recovery (%)	Obtain result (mg kg^{-1})	Certified Value (mg kg^{-1})	Recovery (%)
Mussel Tissue NIST SRM 2976 (n=3)	15.14 ± 0.43	13.3 ± 1.8	113.83 ± 3.24	0.056 ± 0.001	0.061 ± 0.04	91.56 ± 1.59
DogFish Liver NRCC CRM DOLT-5 (n=3)	29.32 ± 0.09	34.6 ± 2.4	87.4 ± 2.66	0.26 ± 0.02	0.44 ± 0.18	80.64 ± 5.2
Oyster Tissue NIST SRM 1566b (n=3)	6.52 ± 0.40	7.65 ± 0.66	85.17 ± 5.35	0.028 ± 0.003	0.037 ± 0.0013	76.56 ± 9.17



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3- Haris, H., Aris, A. Z., Mokhtar, M. Bin, & Looi, L. J. (2020). The accumulation of metals and methylmercury in Nerita lineata and the relation to intertidal surface sediment concentrations. *Chemosphere*, 245. https://doi.org/10.1016/j.chemosphere.2019.125890

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A NEW APPROACH FOR THE PREPARATION OF CHITIN FROM GAMMA IRRADIATED SHRIMP SHELL

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N.U.R NUKLEAR UNTUK RAKYAT

INTRODUCTION

A study was conducted to investigate the impact of gamma irradiation on the extraction of chitin from shrimp shells. The shrimp shells were exposed to gamma irradiation of up to 100 kGy and then subjected to a process of extracting chitin using less harsh organic acid and alkaline reactions at a temperature of 80°C for a duration of 5 hours. The thermal stability and chemical composition of pure and treated shrimp shells was assessed using TGA. The analysis of the pristine shrimp shell revealed the presence of chitin, protein, and calcium carbonate. The analysis conducted using EDX, TGA, and FTIR demonstrated that the composition of the recovered shrimp shell is almost equivalent to pure chitin produced using a commercial procedure.

OBJECTIVES

- To study gamma irradiation as a tool for pretreatment process of shrimp shell to form chitin
- To characterize shrimp shell after demineralization and deproteination process with the aid of gamma irradiation

METHODOLOGY

Figure 1. Chitin extraction using a commercial process

Figure 2. Chitin extraction with the aid of gamma irradiation

RESULTS & DISCUSSION

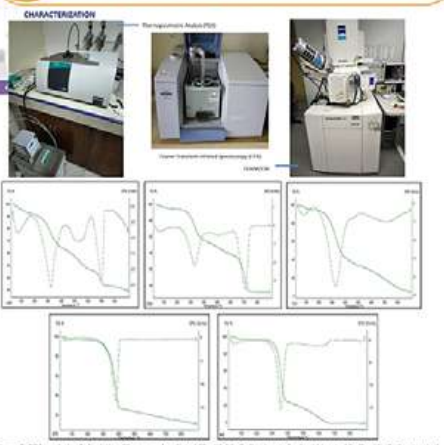

Figure 3. TGA analysis of a) pristine SS, gamma irradiated SS with b) alkaline treated , c) acid treated S, d) acid-alkaline treated and e) commercial chitin (SS=shrimp shell)

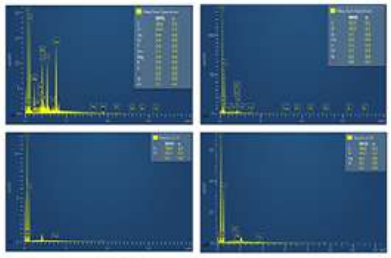

Figure 4. Elemental analysis (EDX) of a) pristine SS, gamma irradiated SS with b) acid treated , c) acid-alkaline treated and d) commercial chitin (SS=shrimp shell)

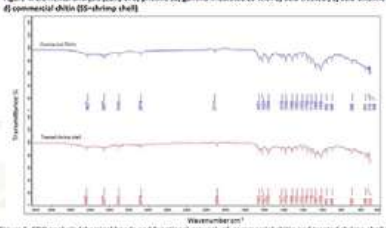

Figure 5. FTIR analysis (chemical bonds and functional groups) of commercial chitin and treated shrimp shell with the function of gamma irradiation

CONCLUSIONS

An effective and environmentally friendly method for extracting chitin from shrimp shells has been devised utilizing moderate organic acid and alkaline with the aid of gamma irradiation. The chemical composition (TGA), functional groups (FTIR), and elemental analysis (EDX) findings showed that the chitin generated using the suggested technique was of high purity when compared to commercial chitin.

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PROFICIENCY TEST RESULTS FOR Sr-90 ANALYSIS AT RADIOCHEMISTRY AND ENVIRONMENT LABORATORY, AGENSI NUKLEAR MALAYSIA

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ABSTRACT

Strontium-90 (Sr-90) is a radioactive isotope with significant health risks due to its long half-life and bone-seeking properties. Accurate analysis of Sr-90 is essential for environmental monitoring and safety assessments. This paper presents the results of proficiency tests (PT) conducted at Radiochemistry and Environment Laboratory, Agensi Nuklear Malaysia from 2021 to 2023. The tests included two types of proficiency assessments each year involving three sample types: water, simulated contaminated surface, and seawater, totalling nine samples. Out of these, four results were in acceptable range, one in warning range, and four were not acceptable. The results provide a comprehensive evaluation of the laboratory's performance in Sr-90 analysis, highlighting areas of accuracy, precision, and compliance with international standards, and suggesting areas for improvement.

INTRODUCTION

Strontium-90 (Sr-90) is a radioactive isotope produced by nuclear fission, posing significant environmental and health risks due to its bone-seeking properties and long half-life of approximately 28.8 years. Accurate detection and quantification of Sr-90 are critical for environmental monitoring, public health, and regulatory compliance. This study presents proficiency test (PT) results conducted at RAS from 2021 to 2023, evaluating the lab's performance in Sr-90 analysis across various sample types.

MATERIALS AND METHOD

Year	PT Code	Sample No.	Sample Type
2021	IAEA-TEL-2021-04 Part II	2	Spiked water
2021	IAEA–RML–2021–01	S21N020	Seawater
2022	IAEA-TERC-2022-02 Part II	1, 2	Spiked water
2022	IAEA–RML–2022–01	S22N20	Seawater
2023	IAEA-TERC-2023-02	2	Spiked water
2023	IAEA-TERC-2023-02	5,7	Simulated contaminated surface
2023	IAEA–RML–2023–01	S23N020	Seawater

Low background gross alpha/beta counting system

RESULTS AND DISCUSSION

Sample No.	Assigned Value (Bq/L)	Reported Value (Bq/L)	Relative Bias (%)	P value (%)	Final Score
S21N020	0.618 ± 0.005	0.744 ± 0.045	20.4	6.0	Warning
S22N020	0.816 ± 0.007	0.770 ± 0.050	-5.6	6.5	Accepted
S23N020	0.708 ± 0.006	0.446 ± 0.027	-36.9	6.1	Not Accepted

Sr-90 Analysis Results for Seawater Samples

Sample No.	Assigned Value (Bq/sample)	Reported Value (Bq/sample)	Relative Bias (%)	P value (%)	Final Score
5/2023	2.25 ± 0.10	8.37 ± 0.11	272.0	4.63	Not Accepted
7/2023	4.52 ± 0.22	10.19 ± 0.12	125.4	5.01	Not Accepted

Sr-90 Analysis Results for Simulated Contaminated Surface

Sample No.	Assigned Value (Bq/L)	Reported Value (Bq/L)	Relative Bias (%)	P value (%)	Final Score
2/2021	146.8 ± 8.4	248.5 ± 14.9	69.28	8.29	Not Accepted
1/2022	26.4 ± 0.007	23.66 ± 2.91	-10.38	13.71	Accepted
2/2022	7.42 ± 0.45	6.64 ± 0.82	-10.51	13.76	Accepted
2/2023	14.2 ± 0.7	13.92 ± 0.88	-2.0	8.02	Accepted

Sr-90 Analysis Results for Spiked Water Samples

- The results indicate significant variability in the lab's proficiency in Sr-90 analysis.
- Only 4 out of 9 samples were accepted, demonstrating issues in accuracy and precision.
- High biases in several samples suggest potential flaws in sample preparation, measurement, or method calibration.
- Specific challenges include underestimation in spiked water samples and overestimation in simulated contaminated surface samples, possibly due to inadequate correction for Y-90.

CONCLUSION

The outcome indicates that while the laboratory demonstrated capability in accurately analysing Sr-90 in some instances, there are significant areas that require improvement. The accepted results affirm that RAS can achieve accurate and precise Sr-90 measurements under certain conditions. However, the instances of warning and failure highlight inconsistencies in the laboratory's analytical procedures or potential issues in the radiochemical separation and measurement processes. Continuous participation in PT schemes and adherence to international standards will be crucial in maintaining and improving the laboratory's analytical performance.

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VALIDATION OF URANIUM ANALYSIS PROCEDURES IN ENVIRONMENTAL SAMPLES USING RADIOCHEMICAL SEPARATION AND ALPHA SPECTROMETRY

Nurrul Assyikeen Md. Jaffary, Jalal Sharib @ Sarip, Chriscius Anthonius, Mohd Tarmizi Ishak

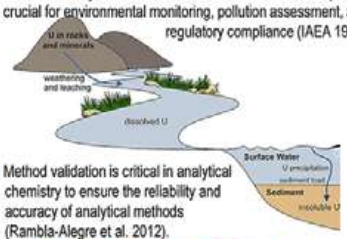
N.U.R NUKLEAR UNTUK RAKYAT

ABSTRACT

This study validates the in-house method used at the Radiochemistry and Environmental Group (RAS) for analyzing uranium isotopes (^{234}U, ^{235}U, and ^{238}U) in environmental samples through radiochemical separation and alpha spectrometry. The procedure, tested with IAEA-385 and IAEA-412 certified reference materials, shows high accuracy, precision, and repeatability, demonstrating its ruggedness and robustness for reliable uranium analysis in sediment samples.

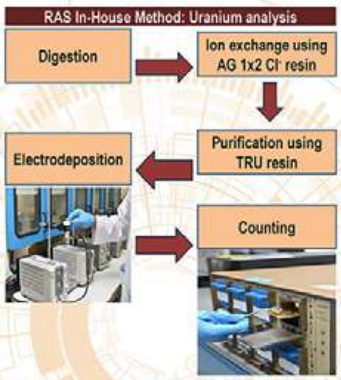
INTRODUCTION

- Accurate analysis of uranium in environmental samples is crucial for environmental monitoring, pollution assessment, and regulatory compliance (IAEA 1997).



- Method validation is critical in analytical chemistry to ensure the reliability and accuracy of analytical methods (Rambla-Alegre et al. 2012).

METHODOLOGY



RESULTS AND DISCUSSION

Specificity

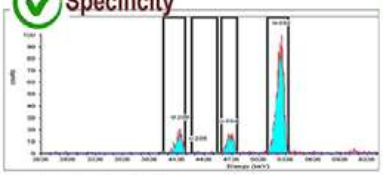


Figure 1 Uranium isotopes peak spectrum

- ✓ ^{234}U, ^{235}U, and ^{238}U were identified at their respective energy ranges (Figure 1)
- ✓ No peak energy interferences were observed.
- ✓ Effective uranium separation from the sample matrix was demonstrated.
- ✓ Accurate isotope identification within a narrow energy range of approximately 200 keV was achieved.

Accuracy

Table 1 ^{234}U, ^{235}U, and ^{238}U measurement data using IAEA-385 and IAEA-412

IAEA-385 Certified value	^{234}U (37.3±1.7 Bq/kg)	^{235}U (1.30±0.11 Bq/kg)	^{238}U (36.4±1.7 Bq/kg)	Recovery
Sample no.	Lab value (Bq/kg)	Lab value (Bq/kg)	Lab value (Bq/kg)	
1	35.96±4.4	2.57±1.2	35.07±4.4	93.07
2	34.64±3.85	2.62±1.17	35.00±3.85	95.05
3	35.8±4.43	2.01±1.2	32.9±5.07	92.2
4	30.8±4.74	2.55±1.25	33.54±5	88.75
5	28.49±4.49	2.05±1.27	29.1±4.51	92.23
6	35.72±4.4	1.13±1.03	30.41±4.76	81.93
Mean	31.75±3.76	1.30±1.26	29.34±3.90	88.47
U-score	0.14	0.08	0.04	
Relative bias, %	2.01	7.14	0.54	
R.S.D, %	7.72	47.63	10.01	
Z-Score	0.25	0.16	0.09	
IAEA-412 Certified value	^{234}U (29.0±2.8 Bq/kg)	^{235}U (1.36±0.05 Bq/kg)	^{238}U (31.2±1.7 Bq/kg)	Recovery
Sample no.	Lab value (Bq/kg)	Lab value (Bq/kg)	Lab value (Bq/kg)	
1	22.59±3.52	1.88±1.32	24.86±4.18	101.96
2	25.84±4.06	2.40±1.21	28.28±3.59	91.92
3	25.72±3.59	2±0.99	26.12±3.59	109.87
4	23.72±4.3	2.78±1.53	25.74±4.45	70.62
5	28.49±4.56	1.2±1.14	25.39±4.16	81.17
6	34.56±4.75	1.25±0.98	27.15±3.97	92.17
Mean	30.92±4.25	1.74±1.02	26.29±3.76	91.95
U-score	0.38	0.36	1.19	
Relative bias, %	6.62	28.38	15.72	
R.S.D, %	14.38	58.64	2.98	
Z-Score	0.43	0.60	0.26	

- ✓ Calculated u-scores < 1.64 indicated no significant bias and demonstrated high accuracy (Table 1).

Robustness

- ✓ The method's robustness was demonstrated by consistent performance across various CRMs, using IAEA-385 and IAEA-412, yielding good results (Table 1).

Repeatability

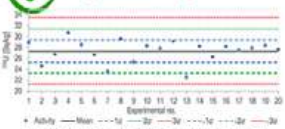


Figure 2 ^{234}U Radioactivity (Bq/kg) measured in IAEA-385

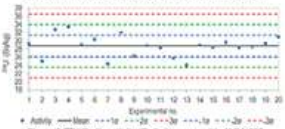


Figure 3 ^{238}U Radioactivity (Bq/kg) measured in IAEA-385

- ✓ Repeatability was confirmed by consistent results from successive measurements under the same conditions (within ±3σ)
- ✓ Figures 2&3 illustrate the method's reliability over repeated analyses.

Precision

- ✓ Recovery rates were consistently above 80%, indicating reliability (Table 1).
- ✓ RSD values for ^{234}U and ^{238}U were below 20%, showing consistent performance (Table 1).
- ✓ Z-scores for ^{235}U showed no significant deviation from certified values, indicating precision.

Ruggedness

Table 2 Uranium radioactivity value reported by different analyst

No of replicates	^{234}U (Bq/kg)		^{235}U (Bq/kg)		^{238}U (Bq/kg)	
	Analyst NAZ	Analyst FTN	Analyst NAZ	Analyst FTN	Analyst NAZ	Analyst FTN
1	35.96±4.4	32.29±3.91	2.57±1.2	2.36±0.91	35.07±4.4	33.30±4.04
2	34.64±3.85	32.25±4.12	2.62±1.17	2.03±0.94	35.00±3.85	34.83±3.47
3	35.8±4.43	31.82±3.93	2.06±1.27	2.17±0.9	32.9±5.07	35.19±3.26
4	30.8±4.74	32.1±3.91	2.55±1.25	2.06±0.79	33.54±5	35.25±3.2
5	28.49±4.49	31.68±3.83	2.05±1.27	1.29±0.73	29.1±4.51	35.36±3.29
6	35.72±4.4	35.68±3.71	1.13±1.03	1.13±0.88	30.41±4.76	35.15±3.63
7	25.42±4.79		3.27±1.79		26.41±4.94	
Mean	31.75±3.76	30.97±3.89	1.30±1.26	1.83±0.86	29.34±3.90	34.54±3.50
U score	0.04	0.30	0.19	0.04	0.25	0.77
Z score	0.11	1.45	1.42	0.80	0.46	0.86

- ✓ Calculated U score <1.64, demonstrated consistent results across different analysts (Table 2)
- ✓ The results confirmed that the method maintains high accuracy and precision regardless of who conducts the analysis.

CONCLUSION

The RAS in-house method for analyzing uranium isotopes ^{234}U, ^{235}U, and ^{238}U in environmental samples has demonstrated high selectivity, accuracy, precision, repeatability, ruggedness, and robustness through tests with IAEA-certified reference materials IAEA-385 and IAEA-412, confirming its reliability for uranium analysis in sediment samples

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Taburan Keradioaktifan Radionuklid Semulajadi Dalam Tanih Sekitar Taman Alam Kuala Selangor (KSNP), Selangor

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N.U.R NUKLEAR UNTUK RAKYAT

ABSTRAK

Bahan radioaktif semulajadi adalah penyumbang utama kepada pendedahan radiasi kepada manusia dan alam sekitar. Peningkatan bahan radioaktif semulajadi di dalam persekitaran, terutamanya dalam tanah, memerlukan perhatian dan pemantauan kerana ia merupakan salah satu laluan dedahan radiasi kepada manusia dan masyarakat setempat. Kajian dan pemantauan terhadap taburan dan penentuan aktiviti radionuklid semulajadi boleh digunakan sebagai panduan dan rujukan, terutamanya semasa pendedahan bahan radioaktif yang tidak dirancang. Sampel tanah permukaan dari beberapa lokasi yang dikenal pasti di sekitar kawasan sekitar Taman Alam Kuala Selangor (KSNP) telah diambil untuk dianalisis. Pengukuran kepekatan radioaktif dalam sampel tanah telah dijalankan menggunakan sistem pengiraan spektrometri gamma yang dilengkapi dengan pengesan Gemanium Ketulinan Tinggi (HPGe). Keputusan yang diperoleh menunjukkan bahawa julat kepekatan radioaktiviti ^{238}U adalah antara 19.34 hingga 35.40 Bqkg^{-1}, ^{232}Th adalah dari 24.20 hingga 45.70 Bqkg^{-1}, ^{226}Ra adalah antara 22.18 hingga 36.10 Bqkg^{-1}, ^{228}Ra adalah antara 24.70 hingga 40.44 Bqkg^{-1} dan ^{40}K berjulat antara 12.88 hingga 56.75 Bqkg^{-1}, dengan nilai purata masing-masing 24.64 Bqkg^{-1}, 32.18 Bqkg^{-1}, 23.85 Bqkg^{-1}, 26.70 Bqkg^{-1} dan 30.20 Bqkg^{-1}. Nilai kepekatan radioaktiviti radionuklid ini didapati rendah atau setara dengan nilai yang dilaporkan dalam kajian lepas.

Katakunci: Spektrometri gama, Tanah, Bahan Radioaktif Semulajadi, Pengesan HPGe.

PERNYATAAN MASALAH

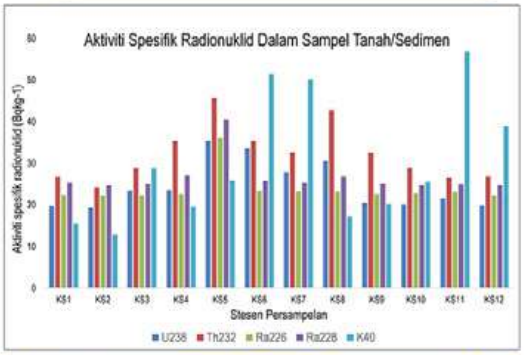
Data NORM penting dalam dalam pemantauan radioaktiviti persekitaran

Keperluan untuk wujudkan pengkalan data/kemaskini kepekatan radionuklid terrestrial

Malaysia masih kurang maklumat berkenaan :
i) taburan kepekatan radionuklid terrestrial/daratan
ii) pengkalan data mengenai analisis risiko radiologi dan kesihatan

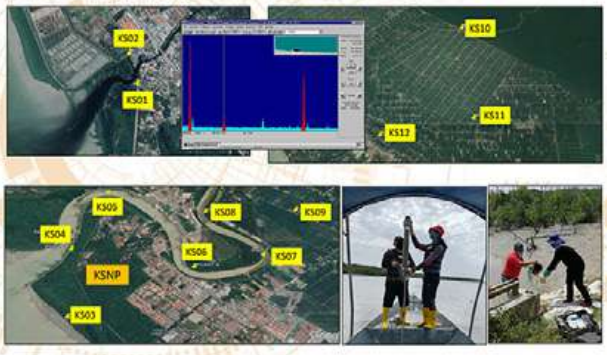
Asas untuk mengesan sebarang aktiviti pencemaran radioaktif pada masa hadapan di kawasan kajian.

KEPUTUSAN & PERBINCANGAN



Lokasi	Aktiviti khusus radionuklid (Bqkg^{-1})					Rujukan
	^{238}U	^{226}Ra	^{228}Ra	^{232}Th	^{40}K	
KSNP, Selangor	24.64 (19.34 – 35.40)	32.18 (24.20 – 45.70)	23.85 (22.18 – 36.10)	26.70 (24.70 – 40.44)	30.20 (12.88 – 56.73)	*Kajian ini*
Sembrong, Johor	21	24	27	28	24	Abdul Adziz, M. I. et al.,2024 [14]
Repository Facility, Bukit Kledang, Perak	-	21	-	33	21	Adziz, M. I. & Khoo, K. S. 2018 [13]
Kinta District, Perak	12–426	-	-	246	-	Lee et al., 2007 [9]
Pulau Pinang	-	64 - 799	-	16 - 667	-	Almayahi et al., 2012 [10]
Dengkil, Selangor	31.64 – 449.15	-	-	27 - 103	-	Yasir, S. M. et al., 2007 [11]
Malaysia	66	67	-	82	310	UNSCEAR Report, 2000 [12]
Thailand	114	48	-	40	400	
Japan	29	30	-	28	310	
China	33	32	-	41	440	
Worldwide mean	35	33	-	36	474	

METODOLOGI



KESIMPULAN

Kepekatan aktiviti min ^{238}U, ^{226}Ra, ^{228}Ra dan ^{232}Th adalah setanding dengan data min seluruh dunia

^{40}K, nilainya lebih rendah (30.2 Bqkg^{-1}) berbanding dengan nilai min seluruh dunia (474 Bqkg^{-1}) dan nilai Malaysia (310 Bq/kg^{-1})

Nilai purata bagi radionuklid ^{226}Ra dan ^{232}Th adalah setanding dengan kajian terdahulu dan lebih rendah daripada nilai purata yang dicatatkan dari kajian sebelum ini untuk kawasan tertentu di Semenanjung Malaysia.

PENGHARGAAN

Ahli projek IAEA RAS 7037 dan juga semua kakitangan Kumpulan Radiokimia dan Alam Sekitar (RAS), Bahagian Teknologi Sisa dan Alam Sekitar (BAS)

SEMINAR R&D NUKLEAR MALAYSIA 2024

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KEMENTERIAN SAINS, TEKNOLOGI DAN INOVASI

NUKLEAR MALAYSIA

BERYLLIUM-7 CONCENTRATION IN RAINWATER OF TWO SEASONS STUDY (KAJIAN KEPEKATAN BERYLLIUM-7 DI DALAM AIR HUJAN DUA MUSIM)

N.U.R NUKLEAR UNTUK RAKYAT

Jalal Sharib@Sarip*, Dainee Fardzila Ahmad Tugi, Mohd Tarmizi Ishak, Mohd Izwan Abdul Adziz, Nurrul Assyikeen Md Jaffary

Abstract

This paper is a study carried out to identify the concentration of Beryllium-7, ^{7}Be in rainwater for two seasons. This study was conducted at several stations in Peninsular Malaysia involving the collection of rainwater samples during the dry and wet seasons using rain sample collectors. Rainwater samples that have been collected and taken directly to the Radiochemistry and Environment Group (RAS), Nuclear Malaysia to ensure that the process of preparation and analysis in the laboratory can be carried out immediately to prevent the concentration of ^{7}Be from not decreasing. The ^{7}Be concentration was filtered in Whatman qualitative filter paper, which is basically used to determine and identify materials in qualitative analysis techniques and then dried. It is then calculated using Gamma Spectrometry for 24 hours with a detector efficiency of 20% with the uncertainty used to calculate the detector error γ is 95% confidence level, which is within ± 10%. The results of the analysis show that the concentration of ^{7}Be is quite different overall in the three study stations, ranging from 0.58 to 3.62 Bql^{-1} and 1.81 to 4.29 Bql^{-1} for the dry and wet seasons, respectively. Meanwhile, the mean value of 7Be concentration as a whole is 1.06 and 2.29 Bql^{-1}in the dry and wet seasons. However, the average result of 7Be concentration analysis from this study found that it is not much different in value from the results reported by other researchers. In conclusion, the concentration of ^{7}Be in the rainwater both seasons from this study did not have a significant different for all study stations (p value > 0.05).

Keywords: Study, Concentration, Beryllium-7, Rainwater

Introduction:

Rain is a process involving precipitation that exists in liquid form, very different from the precipitation process of snow, hail and sleet. Whereas, in the process of rain formation, the presence of a thick atmospheric layer to find temperatures above the melting point of ice is essential, which is near and above the Earth's surface. The term 'washout' refers to the situation when precipitation removal exceeds the availability of ^{7}Be in the atmosphere leading to a reduction in the concentration of rainwater ^{7}Be activity across an event and following a high-magnitude or prolonged rainfall event.

Objective:

Thus, the main objective of this paper is to identify the distribution of ^{7}Be concentration in rainwater at several stations in Peninsular Malaysia. Hence, rainwater collected in three study areas containing ^{7}Be in rainwater can be used as a database in Peninsular Malaysia.

Material and Methodology

Study area

Several stations in different places were identified to take rainwater samples for several months

Rainfall sample processing

^{7}Be was extracted by chemical precipitation using a procedure based on that described by Bojanowski et al. (1983).

Counting and analysis

Filtered paper containing a concentration of ^{7}Be should be dried and then counted using a 24-hour gamma spectrometer with 20% detector efficiency at 477. 6 KeV (figure 1). Therefore, the uncertainty used to calculate the detector error γ is the 95% confidence level, which is within ± 10%.

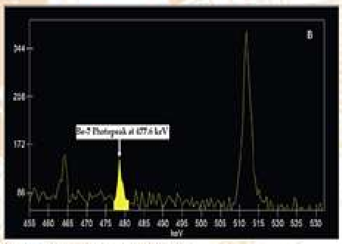

Figure 1: Photo peak of Beryllium-7, ^{7}Be at 477.6 KeV

RESULTS AND DISCUSSION

The analysis results from this study can be seen in table 1 and figure 4 from an individual rainwater samples throughout the sampling period. Analysis results have shown that the concentration of ^{7}Be varies from 0.58 Bq l^{-1} to 3.62 Bq l^{-1} and and 1.81 to 4.29 Bql^{-1} for the dry and wet seasons, respectively. Meanwhile, the mean value of ^{7}Be concentration as a whole is 1.06 and 2.29 Bql^{-1}in the dry and wet seasons. However, the average result of ^{7}Be concentration analysis from this study found that it is not much different in value from the results reported by other researchers (Table 1 and Figure 2).

Table 1: An individual ^{7}Be concentrations (Bq/L) in two seasons in Bangi, Senawang and Timah Tasoh stations, Peninsular Malaysia.

Station	Average ^{7}Be Con (Bq/L)	Another study (reference)
Bangi, Selangor Darul Ehsan	2.2	
	1.4	
	0.58	
	3.57	
	1.81	
	0.76	
	1.18	
	1.4	
	1.26	
Senawang, N. Sembilan	0.81	
	0.77	
	3.62	
	2.6	
	0.98	
	2.46	
	2.26	
Timah Tasoh, Perlis	0.59	
	1.57	
	0.82	
	2.33	
	4.29	
	0.96	
	0.59	
This study	1.06 and 2.29 Bql^{-1}	in dry and wet seasons
Australia	0.02 to 5.99	Wallbrink and Murray, 1994
UK	0.50 to 1.59	Brown et al., 1988
UK	0.39 to 2.74	Peirson, 1963

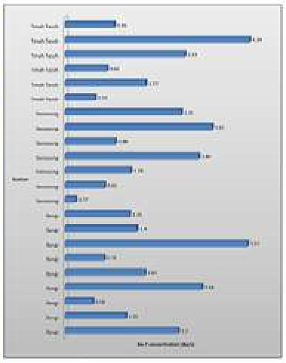

Figure 2: An individual ^{7}Be concentrations (Bq/L) in the rainfall in two seasons at three sampling stations

CONCLUSION

The results of the analysis show that the concentration of ^{7}Be is quite different overall in the three study stations, ranging from 0.58 to 3.62 Bql^{-1} and 1.81 to 4.29 Bql^{-1} for the dry and wet seasons, respectively. Meanwhile, the mean value of ^{7}Be concentration as a whole is 1.06 and 2.29 Bql^{-1}in the dry and wet seasons. However, the average result of ^{7}Be concentration analysis from this study found that it is not much different in value from the results reported by other researchers. In conclusion, the concentration of ^{7}Be in the rainwater both seasons from this study did not have a significant different for all study stations (p value > 0.05). Hence, a more extensive study should be done by increasing the number of sampling stations to strengthen the theory that the concentration of ^{7}Be in rainwater can be used as a database in Peninsular Malaysia.

ACKNOWLEDGEMENTS

The author would like to express his gratitude for the cooperation and assistance provided by the members of the study that are directly and indirectly involved, especially in the activities of sampling, preparation and analysis for the entire sample throughout the course of the study to ensure that this research project runs smoothly, ends successfully and the sharing of research papers that will be published continues.

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DEVELOPMENT OF A CAESIUM-137AIRBORNE DISTRIBUTION MAP USING CTBT DATA

Bashillah Baharuddin, Ahmad Ibraheem Abu Bakar ,Azni Abdul Aziz, Mohamad Syahiran Mustaffa Nazran Harun and Ahmad Hasnulhadi Che Kamaruddin

N.U.R NUKLEAR UNTUK RAKYAT

INTRODUCTION

Since 1946, the Asia Pacific region has encountered significant radiological contamination risks due to various human activities, including nuclear tests (most recent by DPRK in 2017) and reactor accidents. The region also experienced a millennial reactor accident in 2011- the TEPCO Fukushima Nuclear Power Plant accident[1]. The incident released long-lived fission products, predominantly volatile isotopes of iodine and cesium[2], into the atmosphere; and has raised serious concerns about radiological contamination, particularly in nearby countries such as Malaysia. Understanding atmospheric and hydrological processes is crucial for assessing the transport and impact of anthropogenic radionuclides and for developing effective monitoring and mitigation strategies. Once released into the environment, radionuclides are subject to natural processes such as wind patterns, precipitation, evaporation, and water currents[3], which can transport them over varying distances. This study contributes to environmental radiological monitoring and the understanding of radionuclide transport by utilizing data from the Comprehensive Nuclear-Test-Ban Treaty (CTBT) database. CTBT data were selected due to its complete database on anthropogenic radionuclides.

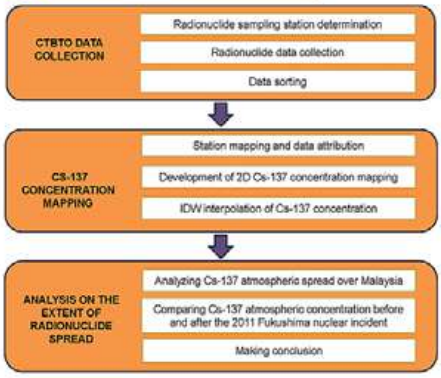
STUDY OBJECTIVES

1. To collect, compile and sort the data of relevant airborne anthropogenic radionuclide by seasonal monsoon, sourcing from the CTBTO radionuclide database, within the Asia Pacific region surrounding Malaysia.
2. To develop and visualize the spread of airborne anthropogenic radionuclides, specifically Cs-137, using ArcGIS Pro.

NOVELTY

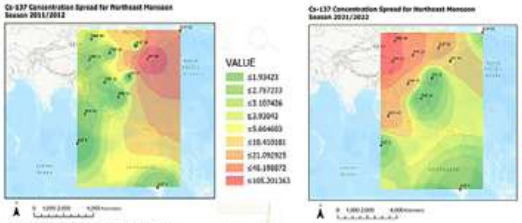
1. Previous studies focused on the Asia Pacific region due to significant nuclear activities over the past two decades. Consequently, Malaysia, in the southwest of the radionuclide concentration mapping, was primarily analyzed from the northeast to the east, excluding the western region. Using the RN42 station at Tanah Rata as a corner point also led to the omission of certain areas within Peninsular Malaysia from the analysis.
2. Presently, there is no airborne Cesium-137 distribution map available that spans from Japan to the Malaysian environment.

METHODOLOGY

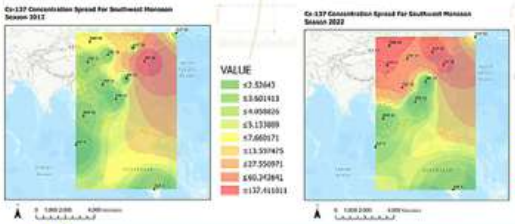


RESULT AND DISCUSSION

Northeast Monsoon 2011/2012 & 2021/2022



Southwest Monsoon 2012 & 2022



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Heartfelt gratitude to
1. the Malaysian Nuclear Agency,
2. the Preparatory Commission for the Comprehensive Nuclear Test Ban Treaty, and
3. the International Islamic University Malaysia.

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STATISTICAL ANALYSIS OF MONSOONAL IMPACTS ON ANTHROPOGENIC RADIONUCLIDE DISPERSION TOWARDS MALAYSIA EAST COAST

Bashillah Baharuddin, Nur Ameera Amnudin , Anis Syuhada Ishak, Norain Isa, and Ahmad Hasnulhadi Che Kamaruddin

INTRODUCTION

For many years, the Asia Pacific region has been persistently threatened by radiological contamination, stemming from natural events like earthquakes and human-made incidents such as nuclear accidents and weapons testing. On March 11, 2011, Japan experienced a record-breaking 9.0-magnitude earthquake, followed by a massive tsunami. The Fukushima Daiichi Nuclear Power Plant (FDNPP) suffered a power outage, leading to reactor overheating and hydrogen explosions. These explosions released radioactive materials into the environment, with substances discharged into the ocean via atmospheric fallout and the direct release of contaminated coolant water. For this study, data is sourced from the IAEA Marine Radioactivity Information System (MARIS) and the Malaysian Nuclear Agency database. The data will be analyzed using ArcGIS for spatial distribution and SPSS for statistical relationships. The findings are expected to have significant implications for environmental and public health policies, aiding in conservation efforts, and public health measures, and enhancing future preparedness and response strategies for radiological threats.

STUDY OBJECTIVES

a) To quantify and analyze temporal trends of ^{137}Cs, with a focus on the impacts of monsoonal variations.
b) To apply the Inverse Distance Weighted (IDW) interpolation method to identify hotspots in regions with sparse data.
c) To propose zoning based on guidelines established by international regulatory bodies.

NOVELTY

A zoning map of the long-term presence of radiocesium in marine environments particularly for Malaysia's east coast has not yet been developed, even more than a decade after the FDNPP accident.

METHODOLOGY


Northeast Monsoon


Southwest Monsoon

RESULT AND DISCUSSION

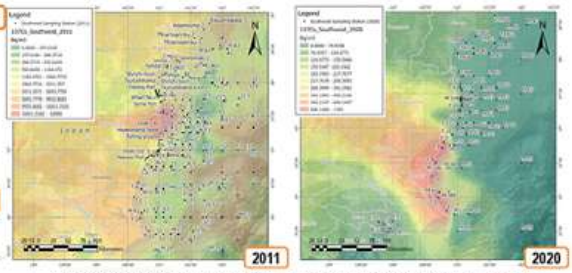
1

Analysis of Variance (ANOVA) for the North Pacific Ocean

Monsoon	Samples		SS	df	MS	F	p
Southwest Monsoon	Marine	Between Groups	2.90×10^7	10	2.90×10^7	20.69	1.34×10^{-17}
		Within Groups	6.42×10^7	45	1.43×10^6		
		Total	9.59×10^7	55			
	Atmosphere	Between Groups	0.00	10	0.00	2.14	0.15
		Within Groups	0.00	8	0.00		
		Total	0.00	18			
Northeast Monsoon	Marine	Between Groups	4.36×10^7	9	4.84×10^6	1.98	0.07
		Within Groups	1.05×10^8	43	2.45×10^6		
		Total	1.49×10^8	52			
	Atmosphere	Between Groups	0.00	10	0.00	0.53	0.84
		Within Groups	0.00	13	0.00		
		Total	0.00	23			

SS: Sum of Squares, MS: Mean Square, df: Degree of Freedom, F: F-ratio, p: p-value

2



Spatial distribution of ^{137}Cs for the Southwest monsoon in 2011 and 2020 for the North Pacific Ocean.

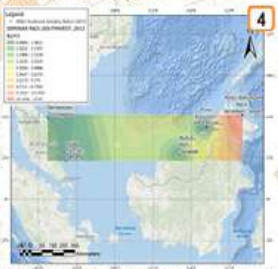
3

Analysis of Variance (ANOVA) for the Malaysian coast

Monsoon	Samples		SS	df	MS	F	p
Southwest Monsoon	Marine	Between Groups	30.08	5	6.02	1.68	0.23
		Within Groups	35.90	10	3.59		
		Total	65.98	15			
	Atmosphere	Between Groups	0.00	10	0.00	2.14	0.15
		Within Groups	0.00	8	0.00		
		Total	0.00	18			
Northeast Monsoon	Marine	Between Groups	0.15	1	0.15	-	-
		Within Groups	0.00	9	-		
		Total	0.15	1			
	Atmosphere	Between Groups	0.00	10	0.00	0.53	0.84
		Within Groups	0.00	13	0.00		
		Total	0.00	23			

SS: Sum of Squares, MS: Mean Square, df: Degree of Freedom, F: F-ratio, p: p-value

4


Spatial distribution of ^{137}Cs for the Southwest monsoon in 2012 along the Malaysian coast.

5


Zoning of ^{137}Cs concentration along the Malaysian coast during the 2012 Southwest monsoon based on Jabatan Tenaga Atom Guidelines.

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Heartfelt gratitude to (1). the Malaysian Nuclear Agency, (2). the Preparatory Commission for the Comprehensive Nuclear Test Ban Treaty, and (3). the

MONTE CARLO STUDIES ON DEPTH PENETRATION OF THE LOW ENERGY ELECTRON ACCELERATOR USING PHITS IN DIFFERENCE DISTANCE OF PTFE MATERIAL

Mohd Azhar Ahmad, Mohd Faiz Mohd Zin, Dr. Leo Kwee Wah, Mukhlis Mokhtar, Abd Halim Bajan, Rokiah Mohd Sabri, Puteri Nuraliah Husna Mohd Tajuddin

N.U.R NUKLEAR UNTUK RAKYAT

Introduction

Low-energy electron accelerators are widely utilized in various scientific and industrial applications. Malaysian Nuclear Agency has successfully developed a Low Energy Electron Accelerator (LEEA) with the maximum energy of 250 keV and beam current output of 30 mA. There are several parameters to be tested and studied including the depth penetration profiles of electrons in material after passing through titanium foil and the air.

In this study, we use Particle and Heavy Ion Transport Code System (PHITS) to perform Monte Carlo simulations of low-energy electron penetration in PTFE materials in different distance to enhance the understanding of electron-matter interactions and provide data that can be used to optimize the design and application of LEEA.

OBJECTIVE

The objective of the study is:

1. To investigate how low-energy electrons penetrate into polytetrafluoroethylene (PTFE) material
2. To determine the depth penetration profiles of low-energy electrons penetrate into PTFE material.
3. To analyze the effect of distance by examine the distance between the scanning window and the PTFE material affects the penetration depth of electrons.

METHODOLOGY

The geometry setup is design based on the dimensional size of LEEA, including the accelerator tube, 25 µm titanium scanning window and positioning of the PTFE samples varying distances (5,7,9 cm) from the scanning window as shown in Figure 1.

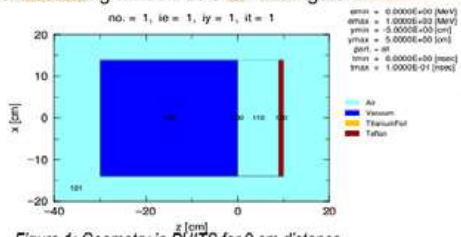

Figure 1: Geometry in PHITS for 9 cm distance

RESULTS AND DISCUSSIONS

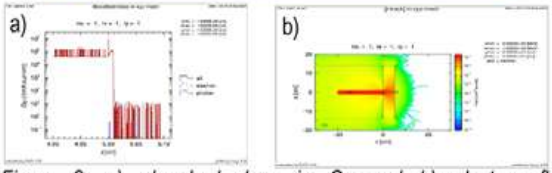

Figure 2: a) absorbed dose in Gy and b) electron flux (1/cm2/source) for 5cm from Ti scanning window to PTFE sample

The study is confirming that increasing the distance between the scanning window and the sample PTFE material leads to a decrease in penetration depth. Figure 3 shows that distance of 5cm give highest depth penetration around 80 µm compare with 70 µm and 60 µm for 7 cm and 9 cm, respectively.

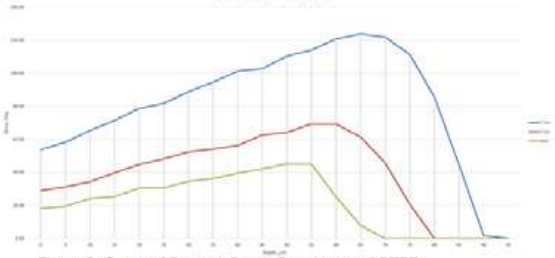

Figure 3: Graph of Dose vs Depth Penetration of PTFE

CONCLUSION

This study successfully employed the Monte Carlo simulation method using PHITS to investigate the depth penetration of low-energy electrons in PTFE materials in different distance from 5 cm, 7cm to 9 cm from window to the sample. The findings demonstrate that the penetration depth of low-energy electrons is highly dependent on the distance and material's density. Energy deposition profiles indicate that low-energy electrons deposit most of their energy near the material's surface, with rapid attenuation as depth increases. This characteristic makes low-energy electrons particularly useful for applications requiring surface-level treatments.

FUTURE WORK

Further research is recommended to explore the effects of different geometries and more complex materials on electron penetration to optimize electron beam applications across multiple fields.

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ASSESSMENT OF STRUCTURAL INTEGRITY OF BIOLOGICAL SHIELDING STRUCTURE AT REACTOR TRIGA PUSPATI (RTP)

Hasniyati Md Razi, Muhammad Khairul Ariff Mustafa, Na'im Syauqi Hamzah, Mohamad Amiruddin Mohamad Rosli, Muhammad Zulhelmi Mahadi, Mohd Huzair Hussain, Noor Azreen Masenwat, Julia Abdul Karim

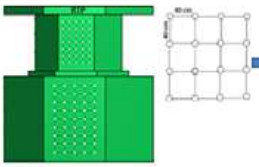
Abstract

Over its operational lifetime, Reactor TRIGA PUSPATI (RTP) has undergone several aging processes, which may impact the structural integrity of the biological shielding. To ensure ongoing safety, the RTP needs regular inspections, including tests for concrete strength and overall structural health. The rebound hammer is a tool used to quickly estimate concrete strength. This research aims to assess the RTP's structural health by considering factors like material condition and the effects of aging.

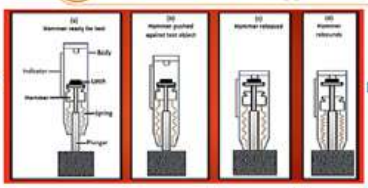
Introduction

Over its operational lifetime, Reactor TRIGA PUSPATI (RTP) has undergone several aging processes, which may impact the structural integrity of the biological shielding. To ensure the continued safety and reliability of the RTP, comprehensive monitoring and inspection assessment are essential involving regular assessments of the biological shield's structural integrity, including concrete strength testing, reinforcement condition evaluation, and overall structural analysis. The rebound hammer is a non-destructive testing tool commonly to estimate concrete compressive strength in-situ. It operates by measuring the rebound distance of a spring-loaded mass after impact with the concrete surface. To effectively utilize the rebound hammer for assessing the RTP biological shielding, a detailed test protocol, including test locations, number of readings, and data recording, has be established. Thus, this research aims to assess the structural integrity of the biological shielding at RTP by considering factors such as material properties, loading conditions, and aging effects.

Methodology



The testing process involves pressing the rebound hammer at 40cm intervals on the selected biological shielding surface.



(a) The hammer is held perpendicular to the concrete surface (b) The spring is compressed fully (c) The spring is released, propelling the mass towards the concrete (d) The mass rebounds due to concrete resistance. A slide indicator measures the rebound distance.

Average Rebound Number	Quality of Concrete
>40	Very Good Hard Layer
30 to 40	Good Layer
20 to 30	Fair
<20	Poor Concrete
0	Delaminated

Quality of the concrete was evaluated by referring to this table.

Results and Discussion

Test Location	Average Rebound Number	Quality of Concrete
Ground Level		
Beam Port 1	43.6	Very Good Hard Layer
Beam Port 2	44.2	Very Good Hard Layer
Beam Port 3	42.9	Very Good Hard Layer
Beam Port 4	42.2	Very Good Hard Layer
Sample Storage	42.0	Very Good Hard Layer
Level 1		
Beam Port 1	37.8	Good Layer
Beam Port 2	32.7	Good Layer
Beam Port 3	34.3	Good Layer
Beam Port 4	34.1	Good Layer
Sample Storage	33.0	Good Layer
Thermal Coloum	33.0	Good Layer

- The RTP's concrete surface was evaluated using a rebound hammer at 344 points.
- Ground Level concrete showed very good hardness (rebound values 42.0-44.2).
- Concrete variations were observed, with Beam Port 2 and Sample Storage areas showing the highest and lowest rebound values.
- Level 1 concrete showed good layer (rebound values 37.8-32.7)
- Concrete variations were observed, with Beam Port 1 and Beam Port 2 areas showing the highest and lowest rebound values.
- The average rebound value for the entire RTP wall was 39.2, indicating high durability.

Conclusion

- This investigation assessed the condition of the RTP wall primarily through rebound hammer testing. Results indicate that the concrete generally meets or exceeds required standards for its role as a biological shield within the Reactor TRIGA PUSPATI.

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KEMENTERIAN SAINS, TEKNOLOGI DAN INOVASI

NUKLEAR MALAYSIA

PRELIMINARY INVESTIGATION OF [68Ga]Ga-DOTA-DMDP OF ISOLATED PHENOLIC COMPOUND AS PET IMAGING AGENT

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N.U.R NUKLEAR UNTUK RAKYAT

ABSTRACT

This study aims to radiolabel the [68Ga]Ga-DOTA-isolated phenolic compound ([68Ga]Ga-DOTA-DMDP), which has the potential as a PET imaging agent. The study also focused on the optimization and evaluation of the DMDP compound with DOTA before the radiolabelling procedure. 1,4,7,10-Tetraazacyclododecane-1,4,7-tris (acetic acid)-10-(4-aminobutyl) acetamide (DOTA-NH2) was conjugated to DMDP (previously treated with DSC to produce DMDP with ester) later purified by using the preparative HPLC to remove the unconjugated DOTA-NH2. The pure compound of DOTA-DMDP compound showed it is possible to be labelled with 68Ga and produce an RCP of more than 97%. The optimization of the radiolabelling method of 68Ga-DOTA-DMDP was found to be at pH 4 by using the sodium acetate buffer, with heating at a temperature of 90 °C for at least ten minutes and remained >97% for five hours post radiolabelling kept at room temperature. Finally, we have developed a new 68Ga radiopharmaceutical that can be used as a PET cancer imaging agent.

INTRODUCTION

The development of new diagnostic agents for molecular imaging like PET, combining high affinity toward receptors, high in vivo stability and optimal pharmaco-kinetic profile, remains a challenge. To produce a PET imaging agent, we need to use bifunctional chelating agents (BFCA) or bifunctional linkers. The BFCA contains one functional group for creating a stable bond to a biomolecule and one chelator that can coordinate with a radiometal. The combination of these two modalities allows BFCA to act as a bimodal agent, either as the visualization source for molecular imaging or to exhibit cytotoxic effects in radiotherapy. The linker is not directly involved in the complexation but plays an important role in surface stabilization by providing high thermodynamic stability and kinetic inertness between the radioisotope and the carrier molecule (Mangin et al., 2021; Lattuada et al., 2011; Liu, 2008).

Among bifunctional linkers such as DOTA, NOTA, NODAGA and more available in the market, DOTA is one of the most important chelators used for radiolabelling purposes, as it forms very stable complexes with various M2+ and M3+ ions, including most of the radiometals used in nuclear medicine such as 68Ga, 90Y, 111In, and 177Lu. Thus, DOTA is the commonly used chelator for the derivatization and radiolabeling of bioactive molecules intended for non-invasive in vivo imaging and therapeutic applications (Wadas et al, 2010). Natural phytocompounds are considered an important source of cancer chemopreventive and chemotherapeutic agents. Coumarins have been recognized to possess anti-inflammatory, antioxidant, antiallergic, hepatoprotective, antithrombotic, antimicrobial, anti-arrhythmic, anti-osteoporosis, antiviral, and anticarcinogenic activities. In this study, two major geranylated 4-phenylcoumarins; DMDP-1 & -2 isolated from the bark of Mesua elegans (Clusiaceae), locally known as "pokok penaga", were subjected to prepare the [68Ga]Ga-DOTA-isolated phenolic compound ([68Ga]Ga-DOTA-DMDP) prior to the radiolabelling procedure.

EXPERIMENTAL

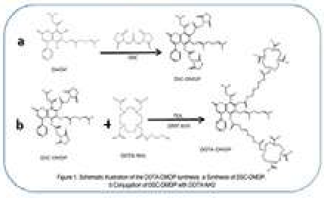
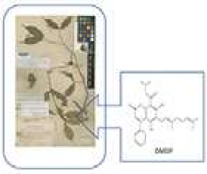


Figure 1: Schematic illustration of the DOTA-DMDP synthesis: a Synthesis of DSC-DMDP b Conjugation of DSC-DMDP with DOTA-NH2



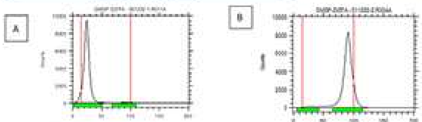


Figure 4.14: The RCP analysis for ^{68}Ga-DOTA-DMDP using ITLC-SG strip and 0.1M ammonium acetate: methanol (1:1, v/v) as mobile phase. A represents the peak for free Ga-68 and B represents the peak for ^{68}Ga-DOTA-DMDP

CONJUGATION OF DOTA-DMDP

Isolated phenolic compound (DMDP, 34.6 mg, 0.0729 µmol) was dissolved in anhydrous DMF (200 µL). The solution was added with N,N-Disuccinimidyl carbonate (DSC, 37.35 mg, 0.1458 µmol), ending with a pH of 4-5. The pH was raised to 5-6 by adding 0.1 M NaOH (45-50 µL). The mixture solution was stirred for two hours at room temperature. Purification by semi-preparative HPLC afforded the desired compound of DSC-DMDP as a yellowish solid after dried by evaporator (14.2 mg).

1,4,7,10-Tetraazacyclododecane-1,4,7-tris (acetic acid)-10-(4-aminobutyl) acetamide (DOTA-NH2, 14.1 mg, 0.0225 µmol) was dissolved in WFI (400 µL). The solution was added TEA (40ul) and sonicated for fifteen minutes. The DOTA-NH2 solution was added to DSC-DMDP (14.2 mg, 0.0225 µmol) which was dissolved with anhydrous DMF (300 µL) ending with a pH of 10. The pH was decreased to 8-9 by adding 1.0 M HCl. The mixture solution was stirred for four hours at room temperature. Purification by semi-preparative HPLC gave the desired product as colourless solution. The purified DOTA-DMDP was lyophilized for further testing.

RADIOLABELLING METHOD

The conjugated DOTA-DMDP was radiolabelled with Ga-68 as follow: 8.0-10.0 mg of dried DOTA-DMDP was dissolved with 1000 µl DMF anhydrous/WFI as stock solution. 50 µL (~700 µg) of the stock solution was mixed with 18.5-20.0 MBq in 1.0 ml of [68Ga]GaCl3 fresh eluate from the 68Ge/68Ga generator. The solution was added with 65.0-70.0 µl of 1.0 M sodium acetate (NaOAc), stirred and measured the pH as 3.9-4.0. The mixture was then heated at 90 °C for ten minutes. Determination of degree of labelling and colloid formation was achieved through instant radio-thin layer chromatography (ITLC) as described by Breeman et al., 2011). Briefly, ITLC-SG paper was used as stationary phase and for detection of colloidal-68Ga, 1.0 M ammonium acetate/methanol 1:1 (v/v) was utilized. Developed, dried strips were analyzed with an ITLC scanner of AR2000, Eckert-Ziegler, Germany (Figure 2).

ACKNOWLEDGEMENTS

The author is thankful to team members of Kumpulan Teknologi Radiofarmaseutikal (KTR) from the Medical Technology Division, Malaysian Nuclear Agency (Nuklear Malaysia), for their support for this research. Research at Nuklear Malaysia is part of the ongoing activities of the Ministry of Science, Technology and Innovation (MOSTI), especially in the field of nuclear medicine and is fully supported by government funding (RMK12).

RESULTS AND DISCUSSION

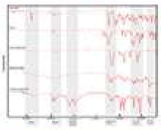
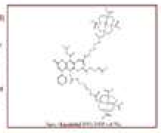


Figure 3: Fourier transform infrared spectroscopy (FT-IR) spectra comparing DMDP, DSC, DSC-DMDP and DOTA-DMDP in comparison with the spectrum for the DOTA-NH2. Full spectra of DOTA-DMDP on those absorption bands directly related to the identification of successful conjugation of DMDP with DOTA-NH2 are highlighted in light grey.



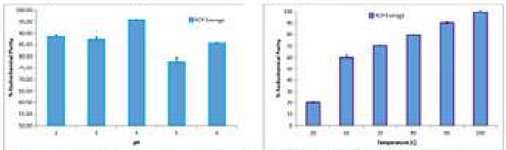
The formation of [68Ga]Ga-DOTA-DMDP is influenced by main variables such as 1) pH range, 2) incubation temperature and 3) incubation time. Based on the results from Figure 5-1, RCP was achieved of more than 90.00% at pH 4.0. The RCP was highest at pH 4.0 and weakest at pH 6.5. In a strongly acidic condition (pH < 3) Ga3+ becomes less and unavailable for radiolabeling. This is not the case for pH 4.0 at which pH a reactive [68Ga]GaOH- intermediate complex, susceptible for complexation with DOTA, is formed majorly (Hazin 2008 and Tsionou et al., 2017).

CHARACTERIZATION OF DSC-DMDP AND DOTA-DMDP

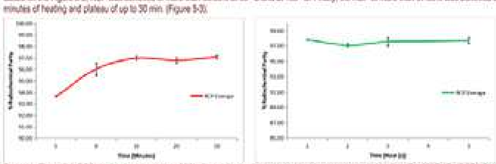
The two steps conjugation of purified DSC-modified DMDP and DOTA-modified DMDP were analyzed by using the fourier infrared spectroscopy.

PREPARATION OF 68Ga ELUTION

5.0 mL of 0.05 M HCl was prepared in 10 mL syringe and attach to the inlet of the 68Ge/68Ga generator. The 68Ge/68Ga generator outlet needle was inserted into the 1.0 mL eppendorf tube placed inside the lead shield container then 1.0 mL of the 0.05 M HCl was pushed out manually. Then the outlet needle was inserted into the 10 mL vial container placed in the lead shield container and the remaining hydrochloric acid was pushed out and collected as Ga-68 stock solution. The Ga-68 stock eluate activity (4.0 mL by 0.05 M HCl) was determined by the dose calibrator (Capintec CRC-55tR, Florham Park, NJ, USA) set at the Ga-68 window.



Based on the Figure 5-2, RCP was achieved of more than 90.00% at 90 °C and at 100 °C. Finally, the RCP of more than 97.00% was achieved after 10 minutes of heating and plateau of up to 30 min. (Figure 5-3).



Based on Figure 5-4, RCP obtained was more than 97% of up to 5 hours kept at room temperature post radiolabelling. The [68Ga]Ga-DOTA-DMDP preparation was found to be stable after five hours post-radiolabelling and has the potential to be used as a PET cancer imaging agent. Further studies need to be carried out, especially stability at serum challenge to mimic the in vivo condition.

CONCLUSIONS

We have developed a new potential PET imaging agent radiolabeled with 68Ga that could possibly be used as a cancer diagnostic agent in nuclear medicine. Due to preliminary investigation, further tests should be carried out using NMR and LC-MS methods to obtain more information on the conjugated compound prepared by this strategy.

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OCCUPATIONAL UVR EXPOSURE: CASE STUDY FROM A UV DISINFECTION SYSTEM

Shamesh Raj Parthasarathy, Zulkifli Yusof and Zuhaili Zainuddin

N.U.K.R
NUKLEAR UNTUK RAKYAT

INTRODUCTION

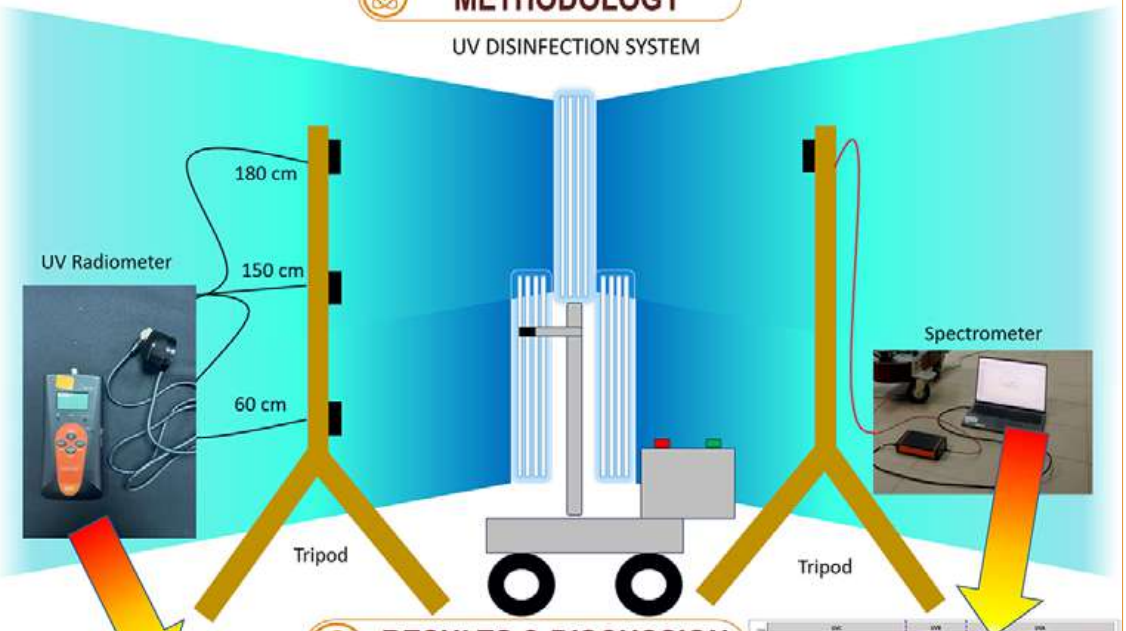
UV radiation (UVR) is known to cause adverse health effects that can manifest over both short and long term. UVR is absorbed in the skin and the adverse health effects are mostly confined to the skin and eyes. Protection against UVR emitted from artificial sources is generally straightforward where sources are used in a controlled work environment.

OBJECTIVE

The study aims to :

- Determine and assess the UVR from the UV Disinfection System
- Analyze the UVR level based on the International Commission on Non-Ionizing Radiation Protection (ICNIRP) Guidelines
- Raise awareness in UVR Safety in workplaces and surrounding area

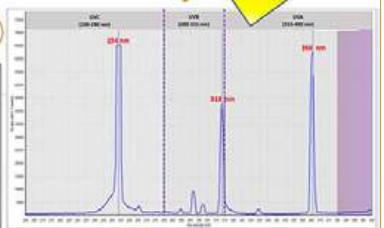
METHODOLOGY



RESULTS & DISCUSSION

Distance (cm)	Average Irradiance (μW/cm²)	Effective Irradiance (W/m²)	t_{eff} max [minute(s)]
Surface 0	7709	9.11	0.05
50	1037	1.23	0.40
100	362	0.43	1.20
200	110	0.13	4.00
300	51	0.06	8.00
400	17	0.02	25.00
500	6	0.01	71.00
600	0	0	N.A.

Table 1: Average irradiance, effective irradiance & the permissible exposure duration at the Front of the UV Disinfection System at 150cm



CONCLUSION

- Minimum distance of any personnel not wearing any PPE should at least be 600 cm
- PPE in terms of full-face UV Shield & UV gloves should be worn for direct operations

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NAVIGATING LASER SAFETY IN INDUSTRIAL AND MEDICAL SETTING

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INTRODUCTION

Lasers continue to shape our world, bridging medicine and industry. The primary hazard from lasers is eye and skin exposure to the laser beam itself. The concentrated energy in a laser beam can cause permanent damage to the retina and cornea of the eye, including blindness, as well as potentially severe skin burns

OBJECTIVE

This study aims to :

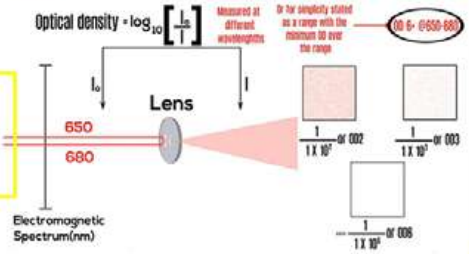
- Gauge the level of understanding & awareness of Industrial & Medical personnel on Laser Safety parameters
- Investigate the challenges faced in Laser safety
- Raise awareness in Laser Safety in workplaces and surrounding area

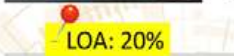
METHODOLOGY

- 20 personnel from organizations consisting of industrial & medical field were enquired on the important aspects of laser safety.
- Focus area of the discussion, survey, investigation & determination on the Level of Awareness (LOA) (%) on:
  - Personal Protective Equipment (PPE) on choosing the right Optical Density (OD) number for each laser safety glasses
  - Personal Protective Equipment (PPE) specifically on the correct usage & maintenance of the laser safety glasses
  - Identification of Laser Controlled Area (LCA) & Nominal Hazard Zone (NHZ)
  - Engineering control when dealing with open beam laser involving usage of laser safety barrier, interlock, beam block & IR viewer

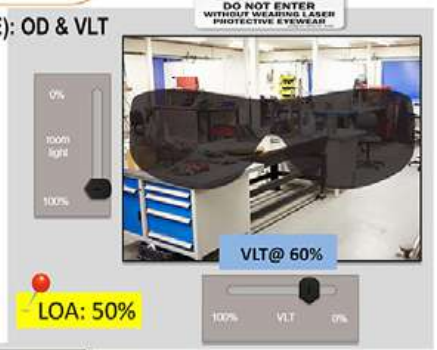
RESULTS & DISCUSSION

❑ Personal Protective Equipment (PPE): OD & VLT





❑ LCA VS NHZ



CONCLUSION

- Vital to understand OD & how it relates to laser safety.
- Laser eye protection should be visually inspected for defects prior to use.
- Safety measures within LCA mitigate risks associated with laser use.
- Engineering control measures are essential in any setting in maintaining a safe and secure work environment.
- Raising awareness about laser safety is crucial to prevent accidents and protect both professionals and the public.

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STUDY ON EFFECT OF HOLDER TO ENVIRONMENTAL DOSIMETER OSL

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N.U.R NUKLEAR UNTUK RAKYAT

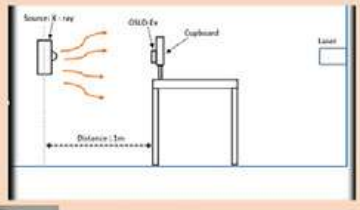
INTRODUCTION & IMPORTANCE OF STUDY

- Natural background radiation is a radiation that present in the environment and the major source of human exposure to low-level ionising radiation
- The natural background radiation is emitted from a variety of natural and artificial sources. The Earth's crust itself is filled with natural radioactive sources
- Environmental radiation monitoring is performed for the purpose of assessing the dose to the general public from a nuclear or radiological facility

PUBLIC DOSE LIMIT

1 mSv/year

METHODOLOGY



1 SAMPEL PREPARATION

- ANNEALING : 15 s
- READ INITIAL READING & RAW DATA

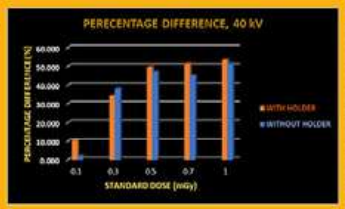
Read data : MICROSTAR READER

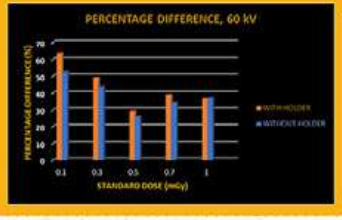
2 IRRADIATION SET UP

- SOURCE : X-Ray
- ENERGY : 40 kV & 60 kV
- CURRENT : 10 mA
- IN AIR

RESULTS & DISCUSSION

- Percentage difference between Standard dose and Measured dose at energy 40 kV & 60 kV
- Percentage difference without holder at all dose : < 50%





- The average differences between osl with holder and without holder :
  - 40 kV : 4.5 %
  - 60 kV : 4.8 %

CONCLUSION

- Percentage difference of OSLD without holder < with holder for both energy (40 kV & 60 kV)

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2. J.S.S.Petrovic, Z.I.Knezevic, N.L.Kr2anovic, M.C.Major, M.Z.Zivanovic, O.F.Ciraj-Bjelac, (2021), Review of The Thermoluminescence Dosimetry Method For The Enviromental Dose Monitoring, Nuclear Technology & Radiation Protection (2021) Vol 36, No 2, pp.150-162.
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Comparison of air kerma measurements between Medical Physics Laboratory (MPL), Malaysian Nuclear Agency and the IAEA Dosimetry Laboratory for X-radiation qualities used in general diagnostic radiology

Asmaliza Hashim, Mohd Taufik Dollah, Wan Hazlinda Ismail, Asmahani Ibrahim, Nur Shahriza Zainuddin

N.U.R NUKLEAR UNTUK RAKYAT

INTRODUCTION

- MPL – accredited laboratory for MS ISO/IEC 17025:2017 (No SAMM: 275) with scope of calibration in diagnostic radiology
- MS ISO/IEC 17025:2017 requirement clause 7.7 - Ensuring the validity of results by participation in interlaboratory comparisons
- To ensure MPL's calibration services meet international standards - participated in comparisons programme

OBJECTIVES

- To demonstrate the measurements and calibrations services are equivalent with international standard
- To verify the consistency and validate the calibration procedure applied at the MPL
- To fulfill the MS ISO/IEC 17025:2017 requirement clause 7.7

METHODS

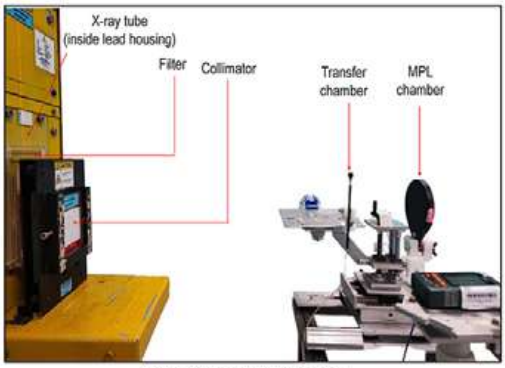
- The comparison was performed in terms of air kerma, K_a
- Transfer chamber Exradin 3 was sent to MPL
- MPL chamber: PTW Model TW34060 (connected with electrometer PTW UNIDOS Model T10005)
- X-ray source: Philips MG165, manufactured by the YXLON International X-Ray GmbH
- Added filter: Al for RQR quality; Al and Cu for RQT quality with (99.9% purity)
- 4 radiation qualities was selected:

Radiation quality	HVL (mm Al)	X-ray tube voltage (kV)	Tube current [mA]
RQR-2	1.42	40	7.0
RQR-5	2.52	70	2.5
RQR-10	6.62	150	1.5
RQT-9	8.15	120	2.5

- FDD = 100cm
- Beam diameter = 17cm

Transfer chamber: Exradin 3

MPL chamber: PTW Model TW34060



Experiment set-up for comparison

RESULTS AND DISCUSSION

- The IAEA calibration coefficients, N_{ref} - used as reference values
- The result of the comparison is $R = N_{part}/N_{ref}$
- N_{part} - calibration coefficient determined by the MPL
- The percentage deviation of R - used as an action level
- This percentage deviation must be ≤ ±2.5 % (0.975 ≤ R ≤ 1.025)

Beam Code	Participant						IAEA						Comparison Results**	
	HVL (mm Al)	Air kerma rate (mGy/min)	N_K (SSDL)* (mGy/nC)	U (k = 2) (%)	Traceability	Traceability date	HVL (mmAl)	Air kerma rate (mGy/min)	N_K (IAEA)* (mGy/nC)	U (k = 2) (%)	Traceability	Traceability date	$R = N_K$ (SSDL) / N_K (IAEA)	U_R (k = 2) (%)
RQR-2	1.42	9	7.99	1.7	IAEA	2023-09-28	1.42	42	7.96	1.3	PTB	2019-10-18	1.003	2.2
RQR-5	2.52	11	7.97	1.7	IAEA	2023-09-28	2.57	38	7.91	1.3	PTB	2019-10-18	1.008	2.2
RQR-10	6.62	18	7.92	1.7	IAEA	2023-09-28	6.71	40	7.89	1.3	PTB	2019-10-18	1.003	2.1
RQT-9	8.15	11	7.91	1.8	IAEA	2023-09-28	8.47	41	7.90	1.3	43756.0	2019-10-18	1.001	2.2

- The results showed the R to be in reasonable agreement (1.001 - 1.008)
- Standard uncertainty of the comparison of about 2.2%
- The results of comparison was **ACCEPTABLE**
- Valid for 5 years
- Fulfill the MS ISO/IEC 17025 requirement
- Measurements and calibrations services provided by the MPL equivalent with international standard

CONCLUSION

The comparison result is an invaluable mechanism for ensuring the precision and accuracy of MPL measurement capabilities. The acceptable results demonstrate that the MPL maintains a high standard of measurements and calibrations on par with international standard.

ACKNOWLEDGEMENT

The authors wish to express sincere thanks to KMS staff for assistance given for this work.

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MAPPING AND PROFILLING OF RADIOFREQUENCY ELECTROMAGNETIC FIELD RADIATION EXPOSURE IN SELECTED LOCATION IN KUALA NERUS, TERENGGANU

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N.U.R NUKLEAR UNTUK RAKYAT

ABSTRACT

Radiofrequency Electromagnetic (RF EMF) Field are used in a lots of application, mainly for communication. These day, wireless communication become a need and play a vital role in human life. To allow wireless communication connected via mobile phones, communication tower must be around the area of the user. The increasing numbers of communication tower raise a concern on the health effects of RF EMF toward human. This study involved 12 communication tower around Kuala Nerus, Terengganu. Kuala Nerus is the new district in the state of Terengganu which had been declared as a separate district from Kuala Terengganu in 2014. The RF EMF safety assessment was conducted using broad band electromagnet probe. The RF level in this safety assessment was measured in unit V/m and μW/cm². RF EMF radiation levels measured from this study were compared to the exposure limits toward human as mentioned in Mandatory Standard issued by the Malaysian Communications and Multimedia Commission (MCMC) and the International Commission on Non-Ionizing Radiation Protection (ICNIRP). Result of the study show that RF radiation level at Kuala Nerus, Terengganu is still far below the permissible exposure limit by MCMC and ICNIRP.

INTRODUCTION

The assessment on RF EMF around Base Station Tower (BST) was conducted by Non-Ionising Radiation (NIR) Group, Malaysian Nuclear Agency. This study was undertaken in collaboration with Universiti Sultan Zainal Abidin (UniSZA). Kuala Nerus was selected because of UniSZA was located in this district and it was the newest district and the most populous district in Terengganu. The measurement encompassed at 12 selected locations in Kuala Nerus. The measurement was arranged to include both the electric field strength and power density at identified locations. Measured radiations were assessed and evaluated against the exposure limits and the recommendations of standard guidelines issued by the MCMC Mandatory Standard, determination No.5 of 2021 and ICNIRP.

OBJECTIVE

- To determine and assess RF EMF radiation present in all accessible places at selected area in Kuala Nerus.
- To analyse the RF radiation compliance emitted by selected base station tower in Kuala Nerus based on the Malaysian Communications and Multimedia Commission (MCMC) Mandatory Standard and International Commission on Non-Ionising Radiation Protection (ICNIRP) guidelines.

METHODOLOGY

Select 12 BST Location → Conduct 6 minutes measurement using Broadband Meter → Evaluate Data

RESULTS & DISCUSSION

Figure 1: The location of assessment at selected location in Kuala Nerus

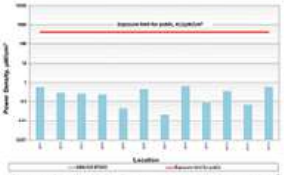

Figure 2: A plot of power density in μW/cm² against location of measurement (and their comparison with MCMC exposure limit for public)

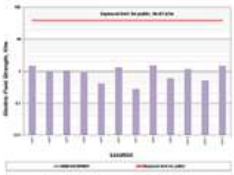

Figure 3: A plot of electric field strength in V/m against location of measurement (and their comparison with MCMC exposure limit for public)

At all of measurement locations, the averaged radiation levels were found to vary between 0.02 μW/cm² to 0.59 μW/cm² (0.27 V/m to 1.49 V/m) of which the highest level measured at BST12 (Kampung Banggol Paya Terung) that corresponds to about 0.143% lower than the MCMC exposure limit for public.

CONCLUSIONS

The radiofrequency (RF) radiation present at selected area in Kuala Nerus, Terengganu were measurable but of very low levels. The electrical field strengths were well below the exposure limits stipulated by the MCMC Mandatory Standard, Determination No.5 of 2021 for members of the public. The presence of the RF radiation emitted by the base station tower installed at 12 selected locations combine with the present loads and the background radiation would not lead to any significant radiation exposure received by members of the public working or living in the area of concern. Residential area, school, mosque and retail area does not give any significant changes to the RF radiation level as the selected area was actually located near residential area. A new RF Safety Assessment should be done if there are any changes to the existing antenna on the base station tower.

ACKNOWLEDGMENTS

The author would like to acknowledge the Non Ionising Group (NIR), Radiation Health & Safety Division (BKS), Malaysian Nuclear Agency for supporting this research. The author also thankful to UnisZa and all person involve and for the necessary help during the measurement activity in Kuala Nerus, Terengganu.

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Ketepatan geo-lokasi GPS dalam aplikasi Sistem Pemantauan Opearasi Tugas (SPOT-Me)

Yii Mei-Wo

N.U.R NUKLEAR UNTUK RAKYAT

ABSTRAK

SPOT-Me ialah aplikasi mudah alih dibangunkan oleh MAMPU untuk merekod waktu kerja pegawai secara elektronik. Namun, aplikasi ini menghadapi cabaran dalam ketepatan lokasi GPS, dengan rekod lokasi kadang-kadang sehingga 1.5 km berbeza dari lokasi sebenar, walaupun ianya masih dianggap sebagai berada dalam kawasan pejabat. Kesilapan ketepatan bagi lokasi waktu masuk (28.6%) didapati adalah 2.3 kali ganda lebih tinggi berbanding waktu keluar (12.5%). Ketidaktepatan lokasi ini didapati tidak dipengaruhi oleh keadaan cuaca, lokasi di dalam atau luar bangunan, atau masa merekod. Walau bagaimanapun, penambahbaikan ketepatan GPS boleh dicapai dengan mengintegrasikan aplikasi tersebut dengan perkhidmatan lokasi seperti "*Google Maps*".

PENGENALAN

Perkhidmatan Awam mula menggunakan Sistem Kad Perakam Waktu pada 1981 untuk memantau kehadiran pegawai, dan kemudian menggantinya dengan Sistem Perakam Waktu Elektronik mengikut Surat Pekeliling Am Bil. 1 Tahun 2004 (PKP 2023). SPOT-Me, aplikasi mudah alih yang diperkenalkan oleh MAMPU mulai Ogos 2020, membolehkan rekod waktu secara atas talian melalui peranti mudah alih dengan fungsi geo-lokasi GPS untuk memantau kehadiran dan pergerakan pegawai (PKP 2023; SEKP 2023). Walaupun mempunyai manfaat dalam merekod kehadiran dan memantau pergerakan pegawai menggunakan GPS, SPOT-Me menghadapi cabaran seperti kesukaran akses sistem, ketidak-sempurnaan rekod lokasi, dan ketepatan geo-lokasi GPS. Sebagai penyelia "Kumpulan Radiokimia dan Alam Sekitar", kajian ini dilakukan untuk menilai ketepatan GPS SPOT-Me dalam merakam kehadiran di dua lokasi berbeza setiap hari selama tiga bulan.

EKSPERIMEN

- Tempoh: Hari bekerja Jan – Mac 2024, pagi (masuk), petang (keluar)
- Peranti: Xiaomi model Redmi 9A
- Ralat jarak: < 1 meter

- Lokasi daftar masuk
- GPS: 2.912943°N, 101.771469°E
- Kawasan terbuka
- Data: 49 set

- Lokasi daftar keluar
- GPS: 2.912810°N, 101.771668°E
- Dalam bilik
- Data: 48 set

KEPUTUSAN

Lokasi masuk direkod sebagai "dalam pejabat"

Lokasi keluar direkod sebagai "dalam pejabat"

KESIMPULAN

1. SPOT-Me boleh direkod di dalam/luar bangunan.
2. Ketepatan GPS SPOT-Me ada ralat sehingga 1.5 km tetapi masih direkod sebagai "dalam pejabat".
3. Cuaca cerah, berkabus, mendung, dan hujan tidak mempengaruhi ketepatan geo-lokasi GPS SPOT-Me.
4. Lokasi peranti boleh dikesan dengan tepat walaupun butang lokasi tidak sentiasa dihidupkan, tetapi peranti telah berada di lokasi itu untuk satu tempoh masa tertentu.
5. Disyorkan untuk mengaktifkan aplikasi kedudukan seperti *Google Maps* bersama SPOT-Me untuk memastikan ketepatan geo-lokasi GPS yang lebih baik.

RUJUKAN

- PKP, Pekeliling Ketua Pengarah, (2023), Garis Panduan Pelaksanaan Sistem Pemantauan Operasi Tugas (SPOT-Me) di Agensi Nuklear Malaysia, Pekeliling Ketua Pengarah Bil 06/23, NM.BKP.01.01.02 Jld.2 (19), Nuklear Malaysia, Bangi.
- SEKP, Surat Edaran Ketua Pengarah, (2023), Garis Panduan Pelaksanaan Sistem Pemantauan Operasi Tugas (SPOT-Me) di Agensi Nuklear Malaysia, NM.BKP.01.01.02 Jld.2 (20), Nuklear Malaysia, Bangi.

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AUDIT SISTEM PENGURUSAN KUALITI MS ISO/IEC17025: 2017 MAKMAL RADIOKIMIA DAN ALAM SEKITAR (RAS)

Norfaizal Mohamed, Nooradilah Abdullah dan Muhammad Izzat Muammar Ramli

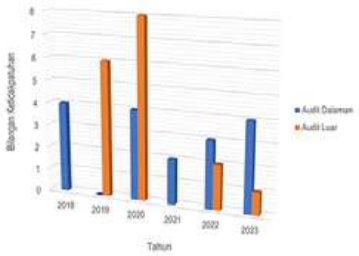
N.U.R NUKLEAR UNTUK RAKYAT

PENGENALAN

Audit kualiti merupakan salah satu komponen penting yang harus dipatuhi dalam sistem pengurusan kualiti ISO/IEC 17025. Ia bertujuan untuk memastikan pelaksanaan dan prosedur yang ditetapkan digunapakai di samping menambahbaik dan meningkatkan lagi tahap operasi sesebuah organisasi. Makmal Radiokimia dan Alam Sekitar (RAS) telah memperolehi akreditasi MS ISO/IEC 17025 sejak 8hb Disember 2005. Bermula dari tahun tersebut, Makmal RAS telah mengharungi beberapa siri audit dalam dan luar, di dalam usaha mengekalkan akreditasi MS ISO/IEC 17025. Kertas kerja ini akan membincangkan mengenai ketidakpatuhan (NC) yang diperolehi hasil daripada audit-audit tersebut dan tindakan pembetulan yang telah diambil oleh Makmal RAS bermula dari tahun 2018 hingga 2023 mengikut standard MS ISO/IEC 17025:2017.

KETIDAKPATUHAN YANG DIPEROLEHI

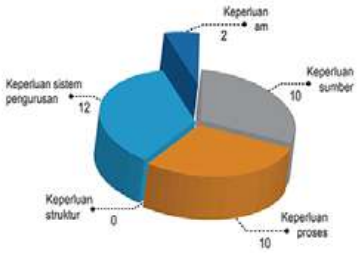
Hasil dari audit yang dijalankan, Makmal RAS telah menerima 34 ketidakpatuhan masing-masing 17 dari audit dalaman dan audit luar. Klausa-klausa di bawah keperluan sistem pengurusan menerima ketidakpatuhan yang paling tinggi iaitu sebanyak 12 ketidakpatuhan, diikuti dengan keperluan sumber dan proses iaitu masing-masing sebanyak 10 ketidakpatuhan. Manakala klausa 6.6 (khidmat yang disediakan oleh pembekal luar) merupakan menyumbang yang tertinggi iaitu sebanyak 4 ketidakpatuhan, diikuti dengan klausa 6.4 (peralatan), 8.2 (dokumentasi sistem pengurusan) dan 8.5 (tindakan untuk menangani risiko dan peluang) iaitu masing-masing sebanyak 3 ketidakpatuhan.



Rajah 1. Bilangan ketidakpatuhan yang diperolehi

TINDAKAN PEMBETULAN

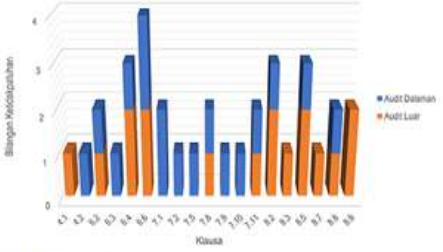
Makmal RAS telah mengambil tindakan pembetulan terhadap semua ketidakpatuhan yang diperolehi hasil dari audit dalaman dan audit luar. Tindakan pembetulan yang diambil adalah bagi memastikan semua prosedur dan amalan di Makmal RAS mengikut kehendak standard selain dari menambahbaik proses sedia ada. Kesemua tindakan pembetulan ini telah berjaya diambil dalam tempoh masa yang ditetapkan bagi memastikan ianya tidak menjejaskan kualiti output Makmal RAS.



Rajah 2. Pecahan ketidakpatuhan mengikut keperluan

AUDIT KUALITI: SUATU PEMERHATIAN

Melalui audit kualiti yang dijalankan, adalah diharapkan agar pihak luar (juruaudit) dapat membantu mengenalpasti kekurangan dan kelemahan yang ada dalam sistem pengurusan kualiti yang diamalkan. Pemilihan juruaudit juga adalah penting kerana merekalah yang akan melihat secara keseluruhan pelaksanaan sistem pengurusan kualiti di sesebuah makmal. Berpengetahuan dan berpengalaman dalam bidang yang diaudit merupakan kriteria utama dalam memastikan juruaudit yang dipilih itu mampu menjalankan audit kualiti dengan berkesan. Tujuan pelaksanaan audit kualiti ini bukanlah untuk mencari kesalahan sebaliknya untuk membantu pihak makmal memastikan semua klausa di dalam standard MS ISO/IEC 17025 diamalkan dan dipatuhi. Kerjasama kedua-dua belah pihak adalah penting bagi memastikan perjalanan audit kualiti itu benar-benar memberi manfaat dan berkesan terutama kepada pihak makmal.



Rajah 3. Pecahan ketidakpatuhan mengikut klausa

KESIMPULAN

Audit kualiti merupakan komponen penting yang perlu dipatuhi oleh setiap makmal dalam melaksanakan MS ISO/IEC 17025. Audit dalaman bertujuan untuk membantu makmal menghadapi audit luar agar semua kekuatan dan kelemahan sesuatu proses itu dapat dikenalpasti. Keberkesanan sesuatu audit kualiti itu bergantung kepada banyak faktor antaranya juruaudit yang berpengetahuan dan berpengalaman serta tindakan pembetulan yang dilaksanakan.

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NUKLEAR MALAYSIA 2024

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Seminar R&D Agensi Nuklear Malaysia

CTBTO PREPARATORY COMMISSION

NUKLEAR MALAYSIA

STRENGTHENING MALAYSIA'S NATIONAL DATA CENTRE (My-NDC) CAPABILITY AND CAPACITY THROUGH INTERNATIONAL PARTNERSHIP

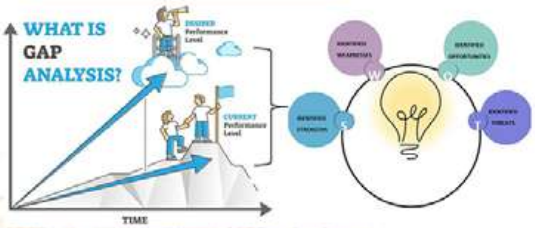
Rozilawati Mohd Japar, Bashillah Baharuddin, Nor Dalila Desa

N.U.R NUKLEAR UNTUK RAKYAT

INTRODUCTION

National Data Centers (NDCs) are essential for monitoring and verifying nuclear tests. Their main function is to analyze and report nuclear explosions, ensuring compliance with international treaties like the Comprehensive Nuclear-Test-Ban Treaty (CTBT). NDCs contribute to global security by providing crucial data and expertise. Malaysia, through its membership and commitment to the CTBT, has shown a strong commitment preventing nuclear proliferation and promoting international peace. The establishment and ongoing enhancement of My-NDC highlight Malaysia's proactive role in the global non-proliferation regime.

METHODOLOGY



DISCUSSION/RESULT

The analysis revealed several My-NDC's challenges, including:

i. Limitation of technical know-how
ii. Shortage of staff
iii. Resource constraints [including financial]
iv. Sustainability of knowledge and insufficiency of national experts

ACKNOWLEDGEMENT

1. Government of Malaysia [MOSTI, Malaysian Nuclear Agency]
2. Government of Australia [ASNO, Geoscience Australia (GA), ARPANSA]
3. CTBTO

SOLUTIONS

Partnership:
My-NDC's strategic partnerships with Geoscience Australia, ASNO, and ARPANSA have substantially enhanced its technical capabilities. Additionally, support from GA has strengthened My-NDC's expertise in waveform analysis, essential for Comprehensive Nuclear-Test-Ban Treaty (CTBT) verification.

Programs initiated under the bilateral cooperation:

- Expert training and capacity-building programs.
- Development of a train-the-trainers program.
- Scientific visits and colloquia.
- Outreach program.

CONCLUSION

Gap analysis helps My-NDC to identify and address discrepancies between current capabilities and desired goals. It enables targeted strategies to enhance operations, improve decision-making, mitigate risks, optimize performance, and ensure compliance with best practices. Collaboration with experienced nations in nuclear monitoring is crucial for My-NDC's development under the CTBT, with ongoing opportunities for improvement and strategic alignment among signatory states.

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NUKLEAR MALAYSIA

HARI BERSAMA ICT 2024 (HBICT2024)

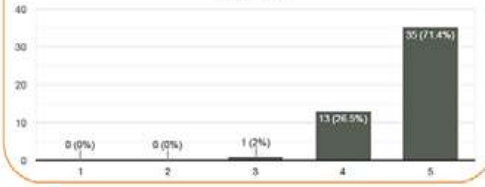
PUSAT TEKNOLOGI MAKLUMAT (PTM)

N.U.R NUKLEAR UNTUK RAKYAT

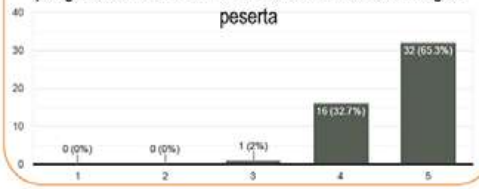
PENGENALAN

Tarikh Program: 26 Jun 2024
Tempat dan Mod: Dewan Tun Dr. Ismail secara Hibrid
Tema: AI Dalam Kehidupan
Jumlah Kehadiran Keseluruhan Peserta: 236 orang

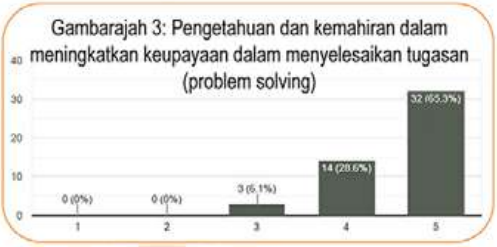
Gambarajah 1: Tahap pengetahuan dan kemahiran baru dalam AI



Gambarajah 2: Tahap peningkatan program terhadap pengetahuan dan kemahiran sedia ada berkaitan tugas peserta

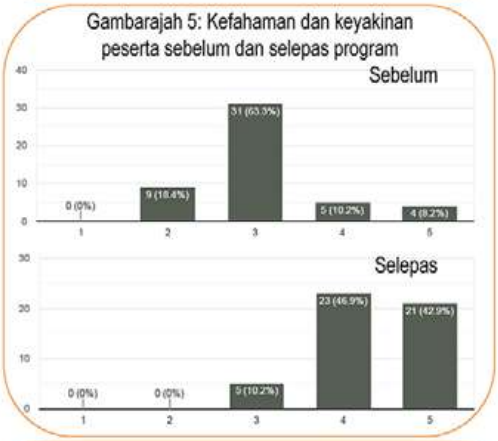


Gambarajah 3: Pengetahuan dan kemahiran dalam meningkatkan keupayaan dalam menyelesaikan tugasan (problem solving)

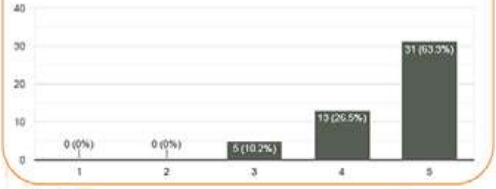


Gambarajah 4: Kemahiran dalam meningkatkan keyakinan dan keupayaan diri untuk melaksanakan tugas dengan lebih cekap

Gambarajah 5: Kefahaman dan keyakinan peserta sebelum dan selepas program



Gambarajah 6: Pencapaian objektif program



CADANGAN

- Menawarkan tajaan dari individu atau syarikat luar untuk menaja hadiah untuk program ini bagi sesi kuiz
- Menyediakan ruangan gerai atau booth untuk penaja-penaja dan penceramah jemputan untuk mempromosikan produk atau perkhidmatan yang berkaitan
- Melanjutkan lagi tempoh masa program
- Tambahan pembiayaan program

KESIMPULAN

Kehadiran peserta HBICT 2024 yang telah direkodkan secara hibrid buat pertama kali membuktikan sambutan di luar jangkaan iaitu seramai 236 orang peserta secara keseluruhan merangkumi kehadiran fizikal dan secara atas talian. Kehadiran seramai ini mungkin tidak akan tercapai tanpa usaha dan iltizam yang padu daripada semua warga PTM khususnya dan warga Nuklear Malaysia amnya.

SEMINAR R&D

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MALAYSIA: ADVANCING RESEARCH AND DEVELOPMENT ON NUCLEAR SCIENCE AND TECHNOLOGY THROUGH IAEA TECHNICAL COOPERATION PROGRAM

Hazmimi Kasim, Siti Syarina Mat Sali, Syahril

N.U.R NUKLEAR UNTUK RAKYAT

ABSTRACT

Malaysia has been an IAEA Member State since 1969 and has made significant achievements in nuclear science and technology. Recent milestones include the extension of Nuklear Malaysia's designation as an IAEA Collaborating Centre until 2027, recognition for contributions to regional cooperation and awards for plant mutation breeding. Malaysia's current priorities on the development of nuclear science and technology focus on radiation safety, industrial applications, human health, food and agriculture, and environmental management were aligned with the United Nation Sustainable Development Goal (UNSDG).The country has developed capabilities in areas such as non-destructive testing, mutation breeding, food irradiation, and addressing plastic pollution through nuclear techniques trough technical cooperation program with IAEA. Malaysia is actively involved in IAEA initiatives such as NUTEC Plastics, Rays of Hope, ZODIAC, Atoms4Food and has incorporated nuclear science into secondary school curricula. The country continues serves as an important centre for nuclear expertise in Southeast Asia. In recent years, Malaysia has also made progress in using isotope techniques for greenhouse gas evaluation and sterile insect technology for pest control. Malaysia continues to advance and strengthen its nuclear infrastructure, research and development; and expand applications of nuclear technology across various sectors, in alignment with National Nuclear Technology Policy and cooperation with the IAEA and regional partners.

MALAYSIA TC PROGRAM

Malaysia signed its CPF for 2022-2027 on 29 September 2022

- Improving the human health infrastructure
- Supporting the food and agriculture sector
- Protecting water and the environment
- Enhancing the industrial sector
- Strengthening nuclear safety and security
- Improving radioactive waste management

IAEA SUPPORT IN THE 21ST CENTURY

Per instance, not per individual

- ***57*** *national TC projects implemented.*
- ***632*** *fellows and SVs.*
- ***1357*** *training participants*
- ***1736*** *meeting participants*
- ***299*** *Expert missions received*

Source of data : IAEA Technical Cooperation (TC) Department, 2024

CONCLUSION

Malaysia continues to advanced and strengthened its nuclear infrastructure, research and development; and expand applications of nuclear technology through IAEA TC Program in alignment with National Nuclear Technology Policy (DTNN 2030) and UN SDG

MAJOR ACHIEVEMENTS

2022: Malaysia receives RCA Regional Cooperation Award and Project Award for its active involvement in 141 RCA projects, organising more than 68 RCA activities that benefited more than 1,200 personnel, as well as providing 41 technical experts to the region.

2023: The Nuklear Malaysia's designation as an IAEA Collaborating Centre in Radiation Processing, Advanced Non-Destructive Testing and Plant Mutation Breeding is extended until 2027.

2021:Malaysia receives an FAO-IAEA Outstanding Achievement Award in Plant Mutation Breeding in recognition of its major achievement in plant mutation breeding and associated biotechnologies to increase the nation's self sufficiency level and food security, by using radiation to breed better crop varieties, which new breed of rice NMR 152 has significantly increased farmer's income by at least 40%.

SUCCESS STORY

RAS 1024/MAL1017 – "Enhancing Capabilities in Nuclear and Related Technologies for Reliable and Sustainable Industries", Malaysia is developing R&D capacity in the utilization of irradiation technology to address plastic waste pollutions and is making significant progress in the recycling of PTFE through irradiation processes. This innovative approach reflects Malaysia's commitment to advancing sustainable solutions in managing plastic waste, showcasing the nation's dedication to technological excellence and environment. Malaysia is one the pilot countries in the IAEA NUTEC Plastic Initiative to address plastic pollutions.

Expert Mission on laboratory methods for extraction of NH_4+ and NO_3- contents in the treated plots in Malaysia

MAL5033, "Strengthening Analytical Capabilities for Food Safety and Food Security', Malaysia has developed a capacity for the use of isotope techniques for greenhouse gases evaluation and mitigation. This technique has been used to quantify the pathways of GHG emissions from agriculture, e.g., nitrification and or denitrification process leading to the emission of N_2O. Applications of the measurement of GHG emissions in arable and grassland systems, leading to improving rice production, maintaining soil health and reducing greenhouse gas emissions. Advanced capacity in using cosmic rays is to measure moisture levels in soils, help farmers in efficiently use water to ensure their crops thrive even in harsh climate conditions.

SEMINAR R&D NUKLEAR MALAYSIA 2024

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ANALISA PROGRAM PEMASARAN BAHAGIAN PENGKOMERSILAN TEKNOLOGI

Mohamed Zaffar Ali Bin Mohamed Amiroudine, Robiatul Adawiyah Ahmad Tajuddin, Halit Alias, Noor Hayati Abdul Rahman, Dr. Rasif Mohd Zain, Norasiah Ab Kasim, Ir. Ts. Dr. Mohamad Azman Che Mat Isa

N.U.R NUKLEAR UNTUK RAKYAT

ABSTRAK

Program pemasaran memberi penekanan kepada Bahagian Pengkomersilan Teknologi dalam mengenalpasti kaedah, aplikasi komunikasi dan strategi promosi dalam mengetengahkan produk dan perkhidmatan Agensi Nuklear Malaysia (Nuklear Malaysia) kepada pasaran/pelanggan. Berdasarkan kaji selidik yang dijalankan pada tahun 2023, 40% pengunjung masih belum mengetahui berkaitan produk dan khidmat yang ditawarkan oleh Nuklear Malaysia. Cabaran terbesar dalam pemasaran ialah menyusun program promosi yang kreatif dan efektif bagi menghasilkan impak yang lebih tinggi, agar teknologi nuklear dapat dimanfaatkan oleh rakyat serta menyumbang kepada peningkatan pendapatan negara.

OBJEKTIF

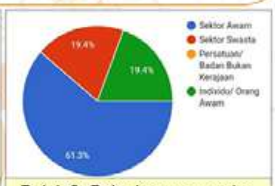
Analisis ini bertujuan untuk melihat strategi pemasaran yang berkesan untuk mencari penyelesaian kepada permasalahan yang dihadapi oleh pihak industri dengan menemukan warga Nuklear Malaysia terus kepada kumpulan sasaran.

KAEDAH KAJIAN

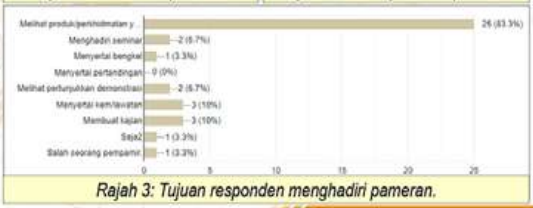
1. Pameran ITEX, KLCC
2. Pameran Hari Muzium Antarabangsa
3. Pameran MCY Summit, Bangsar (Kuala Lumpur)
4. Pameran 60 tahun Muzium Negara, Kuala Lumpur
5. Pameran Program DTEN, Putrajaya
6. Pameran sempena Hari Sungai Sedunia, Perlis
7. Pameran sempena persidangan MEXCO-STI, MYSA
8. Pameran sempena INUSTEC, UNITEN
9. Pameran sempena 4th SRIE, KLCC
10. Pameran MADANI Rakyat Zon Utara
11. Program TPS

ANALISIS SOAL SELIDIK

Rajah 1: Umur responden.



Rajah 2: Pekerjaan responden.



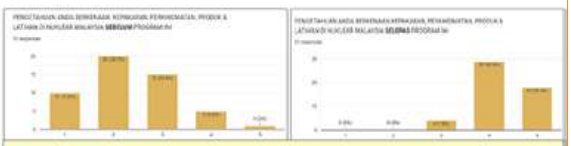
Rajah 3: Tujuan responden menghadiri pameran.

AKTIVITI PEMASARAN (2023-2024)

Jadual 1: Rumusan Aktiviti Pemasaran BKT 2023

Bil.	Aktiviti	Sasaran (2023)	Pencapaian (2023)
1.	Pameran	5	14
2.	Program TPS	3	3
3.	Promosi Sosmed	5	8
4.	Libat urus	1	11
5.	Penerbitan Katalog	1	1

Secara keseluruhannya pada tahun 2023, aktiviti pemasaran yang dijalankan oleh BKT memenuhi objektif dan sasaran. Promosi pada tahun 2024 dan seterusnya akan dijalankan dengan menggunakan medium sedia ada dengan menekankan era pendigitalan bagi memenuhi kehendak pelanggan dan masyarakat serta meningkatkan pendapatan Akaun Amanah Agensi Nuklear Malaysia.



Rajah 4: Maklumbalas responden terhadap program promosi bersasar.

KESIMPULAN

Pameran, program promosi bersasar dan hebahan media sosial merupakan strategi berkesan yang perlu diteruskan. Walaubagaimanapun, penambahbaikan perlu dilakukan dari masa ke semasa supaya ianya kekal relevan. Sebarang cadangan/aktiviti pemasaran boleh dikemukan dengan mengimbas kod QR.

PENGHARGAAN

Setinggi-tinggi penghargaan dan terima kasih kepada semua pihak yang terlibat secara langsung dan/atau tidak langsung dalam menjayakan aktiviti pemasaran Agensi Nuklear Malaysia.

SEMINAR R&D NUKLEAR MALAYSIA 2024

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THE EFFECT OF RAW MATERIAL HANDLING CONDITIONS ON THE STANNOUS (II) CHLORIDE CONTENT OF STERILE AND PYROGEN FREE DMSA LYOPHILISED COLD KIT

Saifullizan Mohamad, Wan Hamirul Bahrin Wan Kamal, Anee Suryani Sued, Ng. Yen, Siti Aminah Muhamad, Manisah Saedon, Muhammad Ridzuan Rosdi and Muhammad Fathurrahman Faizul Akhmal

N.U.R NUKLEAR UNTUK RAKYAT

INTRODUCTION

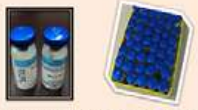
- A sterile and pyrogen free dimercaptosuccinic acid (DMSA) lyophilized cold kit is formulated for kidney imaging in nuclear medicine by radio-labelling with radioactive material called technetium-99m.
- This kit contains a single important raw material that is called stannous (II) chloride.
- Stannous (II) chloride contents in every lyophilized kit should be tested by a polarography technique.
- In this study, the effect of raw material handling conditions on the stannous (II) chloride content of sterile and pyrogen free DMSA lyophilized cold kit will be determined.

OBJECTIVES

- To evaluate the percentage of stannous (II) chloride content of sterile and pyrogen free DMSA lyophilized cold kit.
- To determine the effect of raw material handling conditions on the stannous (II) chloride content of sterile and pyrogen free DMSA lyophilized cold kit.

METHODOLOGY

FORMULATION OF DMSA KIT



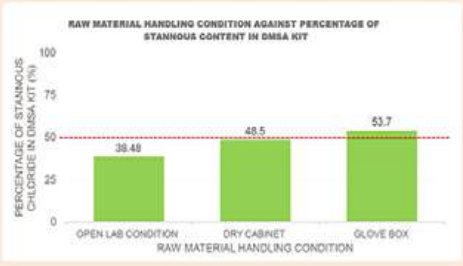
50 vials of lyophilized DMSA cold kit

RAW MATERIAL HANDLING CONDITION

Dry cabinet | Open laboratory | Laboratory glove box

STANNOUS CONTENT ANALYSIS BY POLAROGRAPHY

RESULTS AND DISCUSSION



Graph shows that the percentage of stannous (II) chloride content in DMSA lyophilized cold kit were 38.48%, 48.50% and 53.70% at which the raw material handling condition in open lab, dry cabinet and laboratory glove box respectively. The percentage of stannous (II) chloride content in the DMSA kit was calculated by polarography instrument (884 Professional VA, Metrohm, Switzerland) using the following equation;

$$\text{Percentage of stannous (II) chloride (\%)} = \frac{\text{stannous (II) chloride (µg/vial)} \times 100}{400\ (\mu g/vial)}$$

The raw material, stannous (II) chloride tends to be oxidized when is exposed to the atmospheric oxygen. The inert condition in the laboratory glove box contains less oxygen to oxidize the stannous (II) chloride when is compared to open laboratory and dry cabinet. Thus, the percentage of stannous (II) chloride content was higher when it is handled in laboratory glove box.

CONCLUSION

In conclusion, the content of stannous (II) chloride in DMSA kit was affected by the way raw materials are handled. The stannous (II) chloride contents that were handled in a laboratory glove box was found to be higher compared to handling in a dry cabinet followed by an open laboratory environment.

REFERENCES

1. Zeki Dostbil, Necmettin Pembegül, Mehmet Küçüköner, Yaar Bozkurt, Ahmet Ali Sancaktutar, smail Yldz and Güven Tekba, Comparison of split renal function measured by 99mTc-DTPA, 99mTc-MAG3 and 99mTc DMSA renal scintigraphies in paediatric age groups. 2011 *Clinical Reviews and Opinions* Vol. 3(2), 20-25.
2. IAEA TECHNICAL REPORTS SERIES No. 466. Technetium-99m radiopharmaceuticals: Manufacture of Kits. *International Atomic Energy Agency, IAEA Vienna, Austria* 2008, 86-89.
3. EUROPEAN DIRECTORATE FOR THE QUALITY OF MEDICINES, Technetium (^{99m}Tc) succimer injection, *European Pharmacopoeia, 5th edition,EDQM, Council of Europe, Strasbourg* (2005) 865.

Acknowledgement: Medical Technology Division, Malaysian Nuclear Agency, Bangi.

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KEMENTERIAN SAINS, TEKNOLOGI DAN INOVASI

NUKLEAR MALAYSIA

STRUCTURE, MORPHOLOGY AND HYDROGEN STORAGE PROPERTIES OF TIMN ALLOY SYNTHESIZED BY MECHANICAL ALLOYING TECHNIQUE

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N.U.R NUKLEAR UNTUK RAKYAT

INTRODUCTION

Much research has been undertaken to investigate the hydrogen storage properties of various types of metal hydride families such as Mg-based systems, BCC alloys and intermetallic systems (AB, AB_2 (Laves phase), AB_3 and AB_5) (Nobuko et. al 2017; Nivedhitha et. al 2024; Lototskyy et. al 2015). At the present time AB_5 intermetallic compounds do not satisfy the requirements for mobile storage due to low gravimetric storage capacities (< 2 wt.%) and often high material cost. An inexpensive intermetallic system with the requisite sorption pressure at a desired temperature with adequate kinetics has the potential to be a hydrogen storage material for these markets.

OBJECTIVE

To synthesize and to investigate the properties of intermetallic compounds (TiMn alloys) as a suitable candidates for material-based hydrogen (hydride materials).

EXPERIMENTAL

- All starting materials were prepared in a mBraun, argon glove box. The glove box function is to minimise oxygen (O_2 <5 ppm) and moisture (H_2O <1 ppm) contamination of samples.
- Alloys were prepared by mechanical alloying the starting materials with toluene using a Glen Mills Turbula T2C shaker-mixer with a ball-to-powder (mass) ratio of 12:1 and milling time of 40 h. Then the as milled samples were put into the 316 stainless steel sample cell and annealed at 800°C under vacuum for 3h.

CHARACTERIZATION

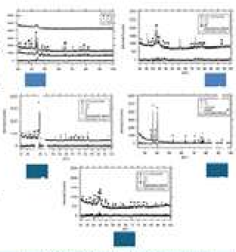
- The lattice parameter of the alloys were determined by Bruker D8 Advance diffractometer (CuKα radiation) with a 2θ range of 30 - 100° using 0.02° steps and a 0.8 s count time per step with operating conditions of 40 kV and 40 mA.

- Microstructural observations were conducted on a Philips XL-30 Scanning Electron Microscopy (SEM) using a secondary electron detector operating at 15 keV. The microscope was coupled with an Oxford Instruments energy dispersive X-Ray spectrometer (EDS) for elemental analysis.

- The hydrogen sorption properties were determined using a custom-made automatic rig. It consist of valve 1, valve 2, valve 3, valve 4 and valve 5.

RESULT & DISCUSSIONS

- Fig. 1A. XRD pattern of as-milled $TiMn_2$ powders using BPR of 12:1 at (a) 2 h, (b) 12 h and (c) 40 h milling times.
- Fig. 1B. XRD pattern of as-milled $TiMn_2$ powders using BPR of 12:1 at 40 h milling times and annealed at 800°C.
- Fig. 1C. XRD pattern of $Ti_{0.97}Zr_{0.019}Mn_{1.5}Cr_{0.57}$
- Fig. 1D. XRD pattern of(left) and $Ti_{0.7875}Zr_{0.2625}Mn_{0.8}Cr_{1.2}$.
- Fig. 1E. XRD pattern of starting powder Ti.



Alloys	Annealed (wt.%)		Lattice parameters		
			a (nm)	c(nm)	V(nm³)
$TiMn_2$ (BPR 12:1)	C14 TiO/TiC Mn	37.24±0.5 22.16±0.3 40.59±0.5	0.4821	0.7856	0.1581
$Ti_{0.97}Zr_{0.019}Mn_{1.5}Cr_{0.57}$	C14 TiO/TiC Mn	31.5±1.2 10.35±0.8 58.19±1.6	[illegible]	0.7892	0.1600
$Ti_{0.7875}Zr_{0.2625}Mn_{0.8}Cr_{1.2}$	C14 TiO/TiC Cr Zr	32.81±0.5 16.45±0.7 39.98±0.5 10.79±0.5	0.4859	0.7940	0.1623
$TiMn_2$ C14 Laves phase PDF No. 07-0133	-	-	0.4825	0.7917	0.1596

Table 1. Rietveld analysis for phase composition and lattice parameter calculated from XRD patterns in Fig. 1A till 1D. Mathematical fitting uncertainties are provided (2 standard deviations).

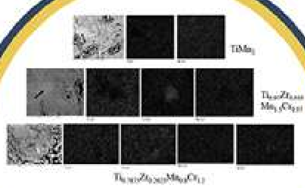


Fig. 2. BF image and the corresponding EDS elemental mapping of $TiMn_2$, $Ti_{0.97}Zr_{0.019}Mn_{1.5}Cr_{0.57}$ and $Ti_{0.7875}Zr_{0.2625}Mn_{0.8}Cr_{1.2}$ (bright region is shown by the black arrow)

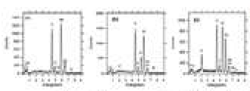


Fig. 3.EDS spectra of (a) $TiMn_2$, (b) $Ti_{0.97}Zr_{0.019}Mn_{1.5}Cr_{0.57}$ and (c) $Ti_{0.7875}Zr_{0.2625}Mn_{0.8}Cr_{1.2}$.

Cycle	Hydrogen Absorption in $TiMn_2$	Absorbed hydrogen (wt.%)
1	Initial pressure of [illegible] bar was applied at RT for 1 h and the final pressure was [illegible] bar.	[illegible]
2	Initial pressure of [illegible] bar was applied at RT for 1 h and the final pressure was [illegible] bar.	[illegible]
3	Initial pressure of [illegible] bar was applied at RT for 1 h and the final pressure was [illegible] bar.	[illegible]
Cycle	Hydrogen content in $Ti_{0.97}Zr_{0.019}Mn_{1.5}Cr_{0.57}$	Absorbed hydrogen (wt.%)
1	Initial pressure of [illegible] bar was applied at RT for 1 h and the final pressure was [illegible] bar.	[illegible]
2	Initial pressure of [illegible] bar was applied at RT for 1 h and the final pressure was [illegible] bar.	[illegible]
3	Initial pressure of [illegible] bar was applied at RT for 1 h and the final pressure was [illegible] bar.	[illegible]
Cycle	Hydrogen content in $Ti_{0.7875}Zr_{0.2625}Mn_{0.8}Cr_{1.2}$	Absorbed hydrogen (wt.%)
1	Initial pressure of [illegible] bar was applied at RT for 1 h and the final pressure was [illegible] bar.	[illegible]
2	Initial pressure of [illegible] bar was applied at RT for 1 h and the final pressure was [illegible] bar.	[illegible]
3	Initial pressure of [illegible] bar was applied at RT for 1 h and the final pressure was [illegible] bar.	[illegible]

Table 2: Hydrogen contents in $TiMn_2$, $Ti_{0.97}Zr_{0.019}Mn_{1.5}Cr_{0.57}$ and $Ti_{0.7875}Zr_{0.2625}Mn_{0.8}Cr_{1.2}$ samples.

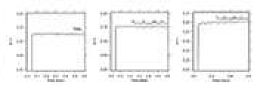


Fig. 4. Hydrogenation kinetics on absorption at room temperature for $TiMn_2$, $Ti_{0.7875}Zr_{0.2625}Mn_{0.8}Cr_{1.2}$ and $Ti_{0.97}Zr_{0.019}Mn_{1.5}Cr_{0.57}$ samples after three activation cycles.

CONCLUSION

Ti-Mn alloy compounds with the composition $TiMn_2$, $Ti_{0.97}Zr_{0.019}Mn_{1.5}Cr_{0.57}$ and $Ti_{0.7875}Zr_{0.2625}Mn_{0.8}Cr_{1.2}$ have been synthesised. A nanocrystalline Ti-Mn alloy was formed when the starting reagents were mechanical alloying for 40 h, using a ball-to-powder (mass) ratio of 12:1 and annealed at 800°C. The addition of PCA leads to the formation of carbide phase (TiC) in the samples. The presence of impurity, carbide (TiC) and oxide (TiO) phases resulted a decrease in C14 laves phase wt.% in the synthesised samples. Only 37.24, 31.5 and 32.81 wt.% C14 phase were formed in $TiMn_2$, $Ti_{0.97}Zr_{0.019}Mn_{1.5}Cr_{0.57}$ and $Ti_{0.7875}Zr_{0.2625}Mn_{0.8}Cr_{1.2}$ respectively. The result also showed that the theoretical value of 1.9 hydrogen wt.% could not be reached by these samples. Therefore, for future work, samples with an oxygen scavenger and an effective PCA that will not react with the starting reagents should be studied.

ACKNOWLEDGEMENTS

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NEW TRIGGERING UNIT OF MNA-PF

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ABSTRACT

A new triggering unit has been developed to operate Malaysian Nuclear Agency Plasma Focus (MNA-PF) device at voltage up to 6.0 kV. The performance of the new triggering unit was tested in the MNA-PF device and the result are reported in this paper.

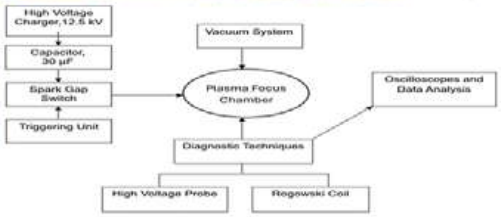
INTRODUCTION

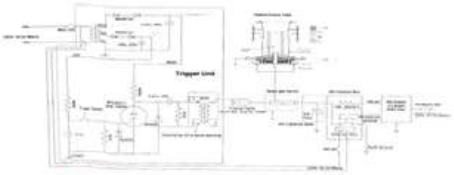
Nuclear Agency's Plasma Focus (MNA-PF) is a simplified version of the device where it is a Mather type that can operate maximum at 12.5 kV, 30 µF with a low development cost and is effective for producing neutron radiation, x-rays, ions and is good for learning and understanding of the fundamentals of physics in the field of education and teaching. MNA-PF device design based on UNU / ICTP PFF (The United Nation University / International Center For Theoretical Physics Plasma Focus Facility) in the Asia-Africa Association for Plasma Training Network (AAAPT) program.

Malaysian Nuclear Agency Plasma Focus (MNA-PF)

The triggering unit is an electrical circuit system used as a trigger for the discharge spark gap that acts as a switch to transfer energy from the capacitor to the electrode in the vacuum chamber. It is required to generate a pulse with a very sharp rise and fall time to trigger the spark gap switch for the best switching performance.
In order to ensure that the MNA-PF works properly, one of the main components which is a new trigger unit has been built to replace the existing trigger system which has been damaged.

TRIGGERING UNIT





DISCUSSION

Key Components and Functionality

- ✓ Capacitor Bank: The energy source for the plasma focus, which stores electrical energy that will be released during the discharge.
- ✓ Triggering Mechanism: A reliable triggering unit, such as a spark gap, is used to initiate the discharge. This mechanism must operate at high voltages (up to 15 kV).
- ✓ Discharge Process: When the triggering unit activates, it allows the stored electrical energy to flow through the plasma focus tube. This results in the formation of a current sheet that accelerates down the tube, leading to a pinch effect where the plasma is compressed and heated to high temperatures.
- ✓ Operational Characteristics: The efficiency and reliability of the triggering unit directly influences the performance of the plasma focus device.

RESULT

A new trigger unit was developed and tested. Experiments were only conducted up to 6.0 kV. The plasma focus system was found to be self-discharged, and no focus (pinch) was produced.
Setting up a new triggering unit to achieve plasma pinching in a plasma focus device can be challenging due to several factors that can prevent effective operation.
Achieving a pinch of plasma in a plasma focus device is highly dependent on the interplay of voltage, trigger reliability, spark gap, gas conditions, electrode design, circuit configuration and diagnostic capabilities. Addressing these factors is essential for effective operations.

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DEPTH DOSE PROFILE OF EPS 3000 ELECTRON ACCELERATOR USING RADIOCHROMIC FILMS B3 AND CELLULOSE TRIACETATE (CTA) FILM FOR FOOD IRRADIATION

Shalina Sheik Muhamad, Ahmad Zainuri Mohd Dzomir, Muhd Izham Ahmad, Mohamad Hakiman Mohamad Yusoff
Azmi Ali, Hasan Sham, Ruzalina Baharin, Siti Zulaiha Hairaldin, Ros Anita Ahmad Ramli

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ABSTRACT

The effectiveness of radiation processing depends on reliable measurement and accepted delivery of the absorbed dose. The characteristics of the beam, which are the electron energy, beam spot profile, scan width and scan uniformity, are factors that ensure that the dose is delivered uniformly on the product surface. The electron's penetration depends on the beam energy. It is measured by determining the depth–dose distribution along the beam axis with reference material, usually water or polystyrene. Experimental evaluation of the depth dose profile of an electron beam accelerator (EPS 3000) was carried out to study the characteristics of the beam required for the irradiation of various products. The measurement of the dose profile used two dosimeter systems: Radiochromic films B3 and Cellulose Triacetate (CTA) film strip in the dynamic mode of operation. This study was pursued following the recommendations of the International Atomic Energy Agency (IAEA) reports and protocols of the International Code of Practice ISO/ASTM 51649. The obtained results showed the depth dose distribution in unit density material of a 3 MeV beam.

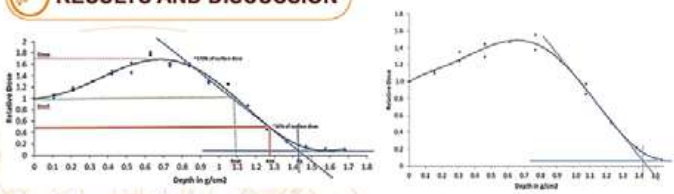
METHODOLOGY

(a) (b)

Figure 1. The setup for depth–dose profile tests (a) the assembly of polystyrene, (b) the assembly of cardboard during the irradiation.

Irradiation Parameters	
Energy	3 MeV
Current	2 mA
Conveyor speed	0.89 m/min

RESULTS AND DISCUSSION



(a) (b)

Figure 2. Depth dose profile without Copper foil for (a) polystyrene and (b) cardboard

For a 3.0 MeV energy on polystyrene with density of 1.05 g/cm3, the characteristic depth-dose profile has been shown in Figure 2 (a). Using this characteristic depth-dose profile, several electron ranges and depth have been defined.

- Optimum thickness (Ropt) = 1.1 g/cm2
- Half-value depth (R50) = 1.275 g/cm2.
- Practical range (Rp) = 1.425 g/cm²

Depth dose profile in cardboard has been defined in Figure 2 (b), the Practical range (Rp) = 1.43 g/cm².

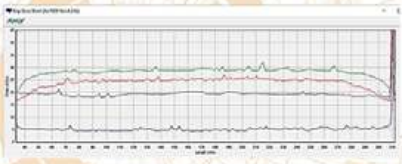


Figure 3. Dose profiles measured with the 4 CTA strips.

Figure 3 shows the dose profiles measured using CTA at different depths of cardboard.

- The surface dose in a brown curve demonstrating that dose distribution averaging about 20 kGy, on the surface of the cardboard sample was very homogeneous.
- After 0.46 g/cm2 (green curve) the average dose was increased to about 29 kGy.
- At a depth of 0.92 g/cm2 (red curve) the average dose reduced again but edge effects were still visible, albeit at a minor amplitude.
- At the very end of the electron range at 1.38 g/cm2 (blue curve) the dose was becoming very low, as the scattered electrons from the neighbouring air were slightly increasing the dose at the product edges.

CONCLUSION

- The Rp (practical range) was almost the same for both reference products (polystyrene was 1.425 g/cm³ and cardboard was 1.43 g/cm³).
- For the energies (up to 3.0 MeV) used in our facility, electron beam irradiations were limited to thin samples.
- Though the homogenous density assumption is rarely true in practice, it provides a good basis for understanding beam penetration performance.
- Nevertheless, proper dose mapping study is important to achieve on depth-dose performance. The dose mapping process is a conclusive test to determine where the minimum and maximum points are in the product, and the ratio of dose between the two.

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ASSESSMENT OF STRUCTURAL INTEGRITY OF BIOLOGICAL SHIELDING STRUCTURE AT RTP

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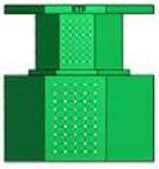
Abstract

Over its operational lifetime, Reaktor TRIGA PUSPATI (RTP) has undergone several aging processes, which may impact the structural integrity of the biological shielding. To ensure ongoing safety, the RTP needs regular inspections, including tests for concrete strength and overall structural health. The rebound hammer is a tool used to quickly estimate concrete strength. This research aims to assess the RTP's structural health by considering factors like material condition and the effects of aging.

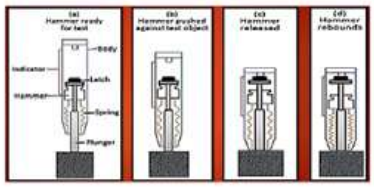
Introduction

Over its operational lifetime, Reaktor TRIGA PUSPATI (RTP) has undergone several aging processes, which may impact the structural integrity of the biological shielding. To ensure the continued safety and reliability of the RTP, comprehensive monitoring and inspection assessment are essential involving regular assessments of the biological shield's structural integrity, including concrete strength testing, reinforcement condition evaluation, and overall structural analysis. The rebound hammer is a non-destructive testing tool commonly to estimate concrete compressive strength in-situ. It operates by measuring the rebound distance of a spring-loaded mass after impact with the concrete surface. To effectively utilize the rebound hammer for assessing the RTP biological shielding, a detailed test protocol, including test locations, number of readings, and data recording, has be established. Thus, this research aims to assess the structural integrity of the biological shielding at RTP by considering factors such as material properties, loading conditions, and aging effects.

Methodology



The testing process involves pressing the rebound hammer at 40cm intervals on the selected biological shielding surface.



(a) The hammer is held perpendicular to the concrete surface (b) The spring is compressed fully (c) The spring is released, propelling the mass towards the concrete (d) The mass rebounds due to concrete resistance. A slide indicator measures the rebound distance.

Average Rebound Number	Quality of Concrete
>40	Very Good Hard Layer
30 to 40	Good Layer
20 to 30	Fair
<20	Poor Concrete
0	Delaminated

Quality of the concrete was evaluated by referring to this table.

Results and Discussion

Test Location	Average Rebound Number	Quality of Concrete
Ground Level		
Beam Port 1	43.6	Very Good Hard Layer
Beam Port 2	44.2	Very Good Hard Layer
Beam Port 3	42.9	Very Good Hard Layer
Beam Port 4	42.2	Very Good Hard Layer
Sample Storage	42.0	Very Good Hard Layer
Level 1		
Beam Port 1	37.8	Good Layer
Beam Port 2	32.7	Good Layer
Beam Port 3	34.3	Good Layer
Beam Port 4	34.1	Good Layer
Sample Storage	33.0	Good Layer
Thermal Coloum	33.0	Good Layer

- The RTP's concrete surface was evaluated using a rebound hammer at 344 points.
- Ground Level concrete showed very good hardness (rebound values 42.0-44.2).
- Concrete variations were observed, with Beam Port 2 and Sample Storage areas showing the highest and lowest rebound values.
- The average rebound value for the entire RTP wall was 39.2, indicating high durability.
- This value is higher than that of the Dhruva research reactor.

Conclusion

This investigation assessed the condition of the RTP wall primarily through rebound hammer testing. Results indicate that the concrete generally meets or exceeds required standards for its role as a biological shield within the TRIGA PUSPATI reactor.

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ANALYSIS THE PARAMETER OUTPUT OF CHARGE SENSITIVE PRE-AMPLIFIER THROUGH GENERATED PULSE SIGNAL BY USING MULTISIM SOFTWARE

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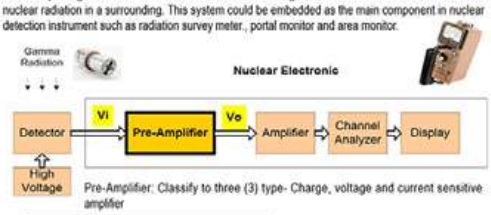
INTRODUCTION

Pre-amplifier in nuclear counting system is purposely to receive and filter undesireble line noise of electrical pulse generated from nuclear detector such as Geiger Muller Tube when the detector detect nuclear radiation in a surrounding. This system could be embedded as the main component in nuclear detection instrument such as radiation survey meter., portal monitor and area monitor.



Pre-Amplifier: Classify to three (3) type- Charge, voltage and current sensitive amplifier

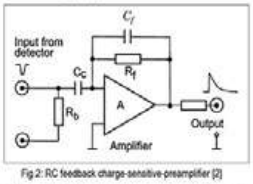


Fig.2: RC feedback charge-sensitive-preamplifier [2]

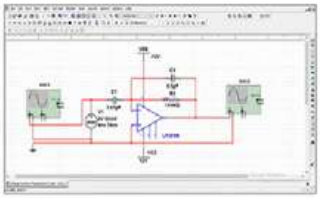
1. 1. Charge accumulates on the feedback capacitor, integrating the detector's current pulse

2. As charge collects on the feedback capacitor, it causes a step change in voltage.

3. The output voltage is thus proportional to the total integrated charge on the capacitor, and the height of the output voltage pulse corresponds to the energy deposited by radiation interaction.

4. The output pulse height of the charge preamplifier is characterized by a short rise time

METHODOLOGY



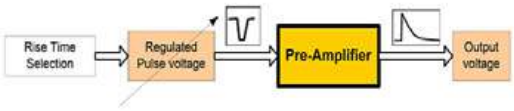
1. Develop CSPA circuit using Multisim Software

2. Generate pulse voltage using Pulse Generator for Input of CSPA

3. Feedback resistor and capacitor are fixed at value 100MΩ and 0.5pF respectively.

4. Variable parameter are rise time and pulse voltage

5. The circuit utilized an LF351 operational amplifier, a high-speed JFET input single operational amplifier



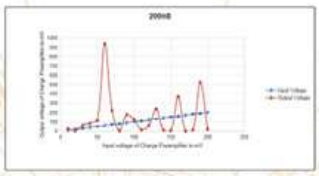
1. Short Rise Time of generated pulse voltage are **200ns**, **350ns** and **500ns**

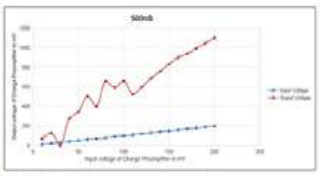
2. The regulated pulse voltage voltage are varies starting from **10mV** up to **200mV** based on **10mV** voltage interval

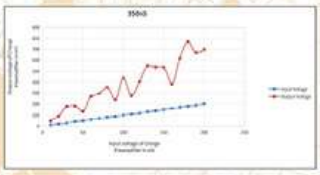
3. Output voltage of CSPA is measured based on amplitude voltage value.

4. Characterizing CSPA based on correlation between output and input voltage based on a particular rise time.

RESULT & DISCUSSION







1. At 200ns Rise Time, the output voltage shows significant fluctuations and peaks, especially around 50 mV and 150 mV input voltage. This indicates a highly sensitive response of the preamplifier at this time constant, with the output voltage not following a smooth trend.

2. At 350ns Rise Time, the output voltage shows a more consistent trend compared to the 200nS time constant, but still exhibits some fluctuations. The output voltage increases with the input voltage, but with noticeable peaks and troughs, indicating some instability in the response.

3. At 500ns Rise Time, the output voltage follows a more linear and smooth trend compared to the other two time constants. There are fewer fluctuations, and the output voltage steadily increases with the input voltage, indicating a more stable response of the preamplifier at this time constant.

CONCLUSION

1. Higher rise time lead consistency amplification voltage signal

2. Higher pulse voltage at input of CSPA at higher rise time lead high uniformity correlation between input and output voltage of CSPA

3. In general, percentage gain of output voltage uniformly increase as increasing input voltage of CSPA especially starting at high input voltage value

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ANALYSIS THE PARAMETER OUTPUT THROUGH CONFIGURATION THE DESIGN PARAMETER OF CHARGE SENSITIVE PRE-AMPLIFIER BY USING TAGUCHI METHOD

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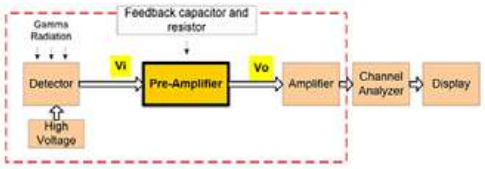
INTRODUCTION

This study delves into an in-depth analysis of CSPA output parameters by configuring design parameters using the Taguchi method.



1. The primary objective is to enhance gain performance by systematically varying key design factors, including capacitor and resistor values
2. Through the implementation of the Taguchi method, the research identifies optimal configurations that significantly improve CSPA performance.

RESULT & DISCUSSION

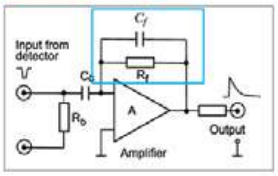
25 experiments varying the feedback capacitor and resistor values in a charge-sensitive pre-amplifier (CSPA) to optimize its performance based on input voltage of 60mV.

No of Experiment	Feedback Capacitor	Feedback Resistor	Vout (mV)	Gain Percentage (%)
1	0.05	10	-0.05194	-0.09%
2	0.05	50	-0.00429	-0.01%
3	0.05	100	0.039666	0.07%
4	0.05	200	0.793274	1.32%
5	0.05	500	4.452	7.42%
6	0.1	10	16.225	27.04%
7	0.1	50	19.888	33.15%
8	0.1	100	19.981	33.30%
9	0.1	200	34.969	58.28%
10	0.1	500	36.51	60.85%
11	0.5	10	36.692	61.15%
12	0.5	50	36.895	61.49%
13	0.5	100	36.896	61.49%
14	0.5	200	36.904	61.51%
15	0.5	500	36.911	61.52%
16	5	10	36.957	61.60%
17	5	50	37.023	61.71%
18	5	100	37.113	61.86%
19	5	200	37.181	61.97%
20	5	500	37.473	62.46%
21	50	10	38.535	64.23%
22	50	50	38.566	64.28%
23	50	100	38.606	64.34%
24	50	200	70.991	118.32%
25	50	500	73.191	121.99%
	Maximum Gain		73.191	121.99%

The output voltage (Vout) varies significantly across the experiments, with the lowest value being -0.05194 mV (Experiment 1) and the highest value being 73.191 mV (Experiment 25).

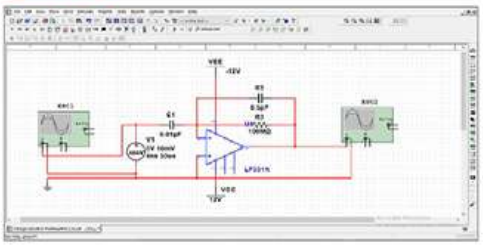
METHODOLOGY

Selection of Design Parameter



Regulate Feedback capacitor and resistor value based on DoE of Taguchi Method

Experimental Setup



Configuring Parameter Variation

Parameter	Name	Level Value				
		1	2	3	4	5
A	Feedback Capacitor	0.05	0.1	0.5	5	50
B	Feedback Resistor	10	50	100	200	500

CONCLUSION

1. The new higher value feedback capacitor consistenly define the new higher gain percentage of voltage output when pairing design with any value of feedback resistor.

2.Increasing value of feedback resistor at any feedback resistor value lead increasing gain percentage of output voltage

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Study of Existing Shielding for Malaysian Nuclear Agency - Dense Plasma Focus (MNA-PF) using Monte Carlo PHITS

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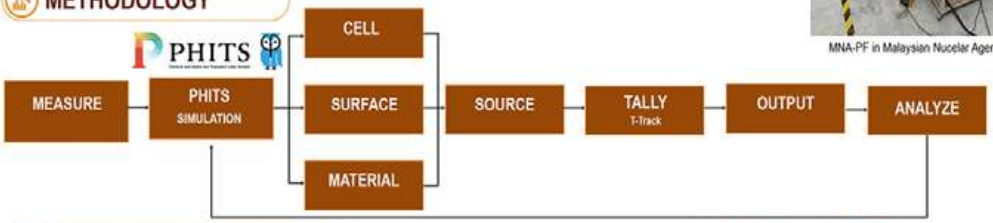
INTRODUCTION

The Dense Plasma Focus (DPF) device at the Malaysian Nuclear Agency (MNA-PF) is a Mather type device that generates significant neutron radiation as part of its operation. Ensuring adequate shielding is crucial for protecting personnel and maintaining a safe operational environment. This study utilizes the Monte Carlo PHITS (Particle and Heavy Ion Transport code System) to **evaluate the effectiveness of the existing shielding configuration at the MNA-PF facility**. The existing shielding is being made of Paraffin. By simulating neutron transport and interactions within the current shielding setup, we aim to ensure optimal protection against neutron exposure.

MNA-PF in Malaysian Nucelar Agency

METHODOLOGY



RESULTS AND DISCUSSION

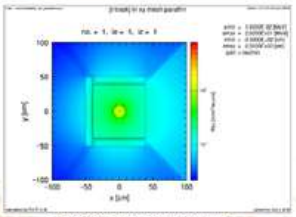


Fig 1 Neutron distribution of top view top-view for paraffin shield

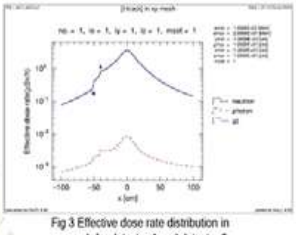


Fig 3 Effective dose rate distribution in xy-mesh for detector 1 and detector 3

Paraffin shielding used in MNA-PF

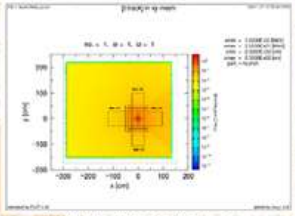


Fig 2 Neutron distribution of top view top-view for PF lab

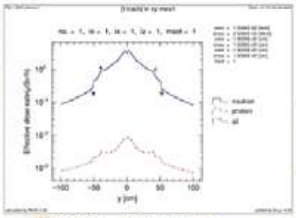


Fig 4 Effective dose rate distribution in xy-mesh for detector 2 and detector 4

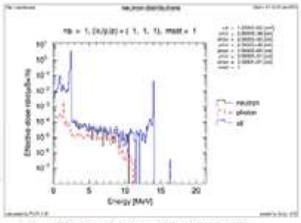


Fig 5 Effective dose rate as a function of energy

CONCLUSION

The analysis of the effective dose rate distribution for the Dense Plasma Focus (DPF) device at the Malaysian Nuclear Agency (MNA-PF) indicates that the current shielding configuration is highly effective in mitigating neutron and photon radiation. The data shows that the highest observed total dose rate is approximately 1 μSv/hr at the center, which is well within the regulatory safety limits for occupational exposure. From the calculation, the effective dose rate after passing the existing paraffin shield is 1.03×10^{-3} μSv/shot. Therefore, it required around 6 million shots to meet the occupational safety limit which is 20mSv/yr.

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BREAKTHROUGH CANCER THERAPY: LEVERAGING OF ^{68}Ga -NOTA-RITUXIMAB IN RADIOIMMUNOTHERAPY (RIT)

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ABSTRACT

Introduction: Radioimmunotherapy (RIT) is a novel technique to treating non-Hodgkin lymphoma (NHL) that combines the targeting precision of monoclonal antibodies with the radioactive nucleotide. **Method:** Rituximab was conjugated with p-SCN-Bn-NOTA at ratios of 1:10 and 1:50. The conjugated rituximab was purified using prep-HPLC and were radiolabelled with ^{68}Ga and further purified using a PD-10 column. **Result:** The radiochemical purity (RCP) of ^{68}Ga-NOTA-Rituximab for 1:10 and 1:50 were 97.34 ± 0.16% and 89.02 ± 2.24% before purification, and increase to 99.63 ± 0.16% and 99.06 ± 0.01% post-purification. **Conclusion:** The study successfully made a radioactive version of rituximab. It remained stable in tests and needs further research for potential use in PET imaging for NHL.

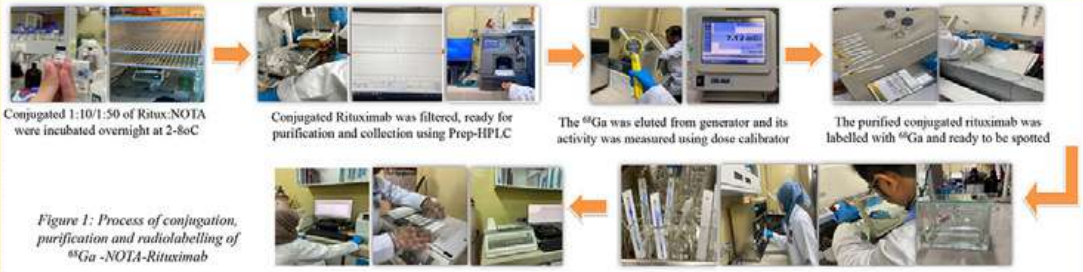
INTRODUCTION

- RIT using suitable therapeutic radionuclides linked to target-specific mAb has regained importance in nuclear medicine
- An mAb labelled with gamma and beta emitting radionuclide makes the diagnosis and treatment more effective
- Delivering synergistic effect of cytotoxicity with cell killing on tumor cells

OBJECTIVES

1. To conjugate Rituximab mAb with the p-SCN-Bn-NOTA
2. To purify the conjugated mAb (p-SCN-Bn-NOTA- Rituximab) using Prep-HPLC
3. To radiolabel p-SCN-Bn-NOTA - Rituximab with Ga-68, and analyzed by U-HPLC and ITLC scanner [radiochemical purity (RCP %)].

METHODOLOGY



Conjugated 1:10/1:50 of Ritux:NOTA were incubated overnight at 2-8oC

Conjugated Rituximab was filtered, ready for purification and collection using Prep-HPLC

The ^{68}Ga was eluted from generator and its activity was measured using dose calibrator

The purified conjugated rituximab was labelled with ^{68}Ga and ready to be spotted

After spotted, the ITLC strips were placed in solvents (0.02M citric acid: 10% acetonitrile) and dried in oven for 6 minutes

The strips were placed on TLC scanner and RCP readings (>95%) were evaluated

Figure 1: Process of conjugation, purification and radiolabelling of ^{68}Ga -NOTA-Rituximab

RESULTS & DISCUSSIONS

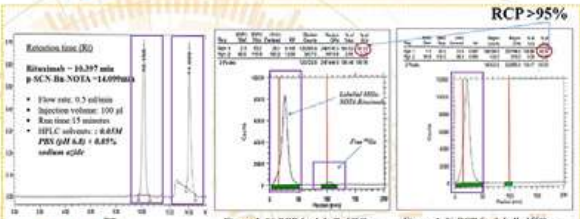


Figure 2: Retention time of 1mg/ml Rituximab and 5mg/ml p-SCN-Bn-NOTA

Figure 3: % RCP for labelled ^{68}Ga - NOTA-Rituximab (1:10) (w/out purification).

Figure 4: % RCP for labelled ^{68}Ga - NOTA-Rituximab (1:10) (with purification:PD-10 Column)

RCP >95%

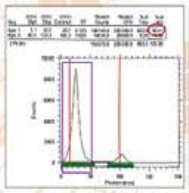


Figure 5: % RCP for labelled ^{68}Ga NOTA- Rituximab (1:50) (w/out purification)

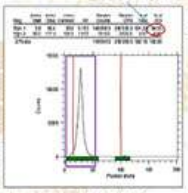


Figure 6: %RCP for labelled ^{68}Ga - NOTA- Rituximab (1:50) (with purification: PD-10 Column)

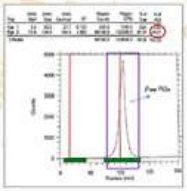


Figure 7: % RCP for free ^{68}Ga

CONCLUSION

- ✓Collection of pure conjugated NOTA-Rituximab (1:10 and 1:50) has been done.
- ✓Purification of labelled NOTA-Rituximab by PD-10 column has increased the % RCP compared to unpurified.
- ✓Hence, NOTA-rituximab has been successfully labelled with ^{68}Ga with %RCP >95% (**PROOFING CONCEPT**)
- ✓Thus, ^{68}Ga -NOTA-Rituximab can be further testing as a RIT kit and used in-vivo study.

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PRELIMINARY STUDY OF THERAPEUTIC RADIONUCLIDES PRODUCTION, HOLMIUM-166 (Ho-166)

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Abstract

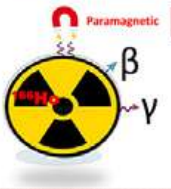
Cancer is a major health concern in Malaysia, with liver cancer ranking as the fifth most commonly diagnosed cancer for both sexes. The use of targeted therapy using emitting radiopharmaceuticals has become increasingly popular in the fields of oncology, endocrinology, and rheumatology. Holmium-166 (Ho-166) is a radionuclide suitable for treating and imaging target tissues. This study aims to optimize production protocols and quality control procedures for the routine production of Ho-166. Ho-166 is produced at the research reactor TRIGA PUSPATI from holmium nitrate, 165-$Ho(NO_3)_3$. Five (5) milligrams of 165-$Ho(NO_3)_3.5H_2O$ were weighed and sealed in a double polyethylene capsule. Heat was applied to the top of the capsule for sealing purposes, and irradiated in the reactor for 24 hours. After 24 hours of cooling, the irradiated target was dissolved in 1 mL of HCl solution. A gamma spectrometer was used to detect and analyse the presence of radionuclide impurities. The radioactivity of the irradiated target was measured using a calibrated dose calibrator. Ho-166 chloride (166-$HoCl_3$) was produced successfully and a protocol for the production of Ho-166 radionuclides has been developed.

Keywords: Holmium-166, production, research reactor, liver cancer

Introduction

1 in 4 Malaysians are at risk of cancer

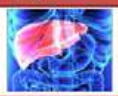
Top 10 cancer categories



Holmium-166 (Ho-166)

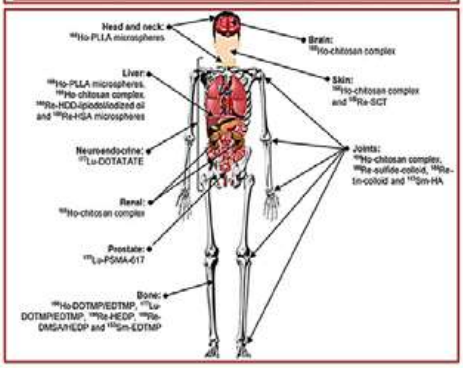
- Half-life 26.6 hour
- Natural abundance of 100 %
- Highly paramagnetic and can be visualized with high-resolution MRI
- Decays under emission of beta radiation (1854 keV and 1744 keV) and a primary gamma photon (81 keV).
- Decay product stable Erbium-166 (Er-166)

The liver is a vital organ responsible for digestion, metabolism, immunity, and nutrient storage. Its capacity to regenerate dead or damaged tissue allows it to rapidly grow and restore normal function.

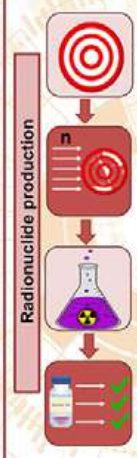


Objectives

This research aims to investigate the feasibility and capability of producing high radioactivity Holmium-166 radionuclides at Reactor TRIGA PUSPATI, focusing on achieving optimal yields, determining purity, and evaluating sterility and pyrogenicity.



Materials and Methods



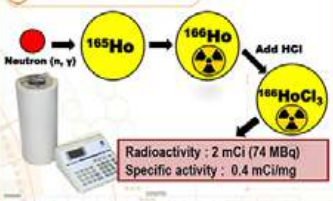
Target preparation
- 5 mg Holmium Nitrate ($^{165}Ho(NO_3)_3$) in PE tube
- Dissolved in acid
- Overnight drying in oven
- Seal PE tube

Irradiation
- Reactor TRIGA Mark II PUSPATI
- Rotary rack 500 kW
- Neutron flux 1 X10^{13} n cm^{-2} s^{-1}
- 5 hour irradiation time
- Cooling 6 hour

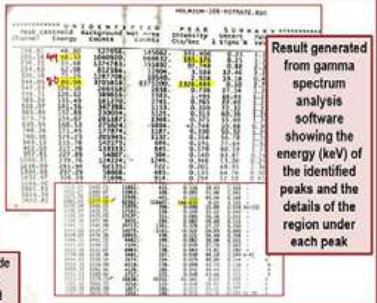
Radionuclide Processing
- Sterile environment
- Add 1M Acid Hydrochloric
- Filter solution with 0.22 µm filter
- Solution transfer into sterile vial
- Measure radioactivity

Quality Control
- Measure radioactivity
- Radionuclidic purity : Detect presence of other radionuclides

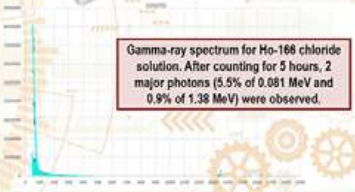
Results



Radioactivity : 2 mCi (74 MBq)
Specific activity : 0.4 mCi/mg



Result generated from gamma spectrum analysis software showing the energy (keV) of the identified peaks and the details of the region under each peak



Gamma-ray spectrum for Ho-166 chloride solution. After counting for 5 hours, 2 major photons (5.5% of 0.081 MeV and 0.9% of 1.38 MeV) were observed.

Specific activity using different type of Holmium	
$^{165}Ho_2O_2$	0.33 mCi/mg
$^{165}HoCl_3$	0.20 mCi/mg
$^{165}Ho(NO_3)_3$	0.40 mCi/mg

Conclusion

- Feasible to produce high radioactivity Ho-166 radionuclides at Reactor TRIGA PUSPATI
- Specific activity of Ho-166 is not significantly difference using different type of Ho-165 starting materials

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STUDY ON THE IMPACT OF RESIDUAL MOISTURE ON STANNOUS CHLORIDE CONTENT ($SnCl_2$) IN TECHNETIUM-99m (^{99m}Tc) BASED PHARMACEUTICAL COLD KIT

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ABSTRACT

Background: The components in a pharmaceutical cold kit and the process of freeze-drying used determine its stability. The stability of the freeze-dried pharmaceutical cold kits is mostly dependent on the residual moisture content. Therefore, residual moisture is one important quality characteristic that must be monitored post lyophilization cycle. Residual moisture may affect the stannous ion stability, hence results in loss of stannous chloride ($SnCl_2$) content throughout period of time. As a strong reducing agent, stannous [Sn (II)] chloride is readily oxidized to Sn(IV) by oxygen dissolved in solution or in air. The primary problem is the incomplete reduction of pertechnetate caused by the loss of Sn(II) chloride content in the ^{99m}Tc based pharmaceutical cold kit.

Objective: This study to analyze the relationship between residual moisture and stannous chloride content in ^{99m}Tc based pharmaceutical cold kit.

Methodology: The pharmaceutical cold kit formulated by Bahagian Teknologi Perubatan (BTP) are being used in this study which include Dimercaptosuccinic acid (DMSA) and Diethylenetriaminepentaaceticacid (DTPA) kits. Both kits are intended to be labelled with ^{99m}Tc radioisotope and to be applied for renal imaging. Non-destructive headspace moisture and pressure analyzer is used to measure the moisture content by measuring moisture partial pressure in the headspace of sealed container pharmaceutical cold kit. Polarographic technique utilizing polarography is used to determine the concentration of stannous chloride content in both DMSA and DTPA kits by measuring the current flowing through an electrode immersed in the pharmaceutical cold kit solution.

Conclusion: Based on the findings, the stannous chloride concentration showing correlation with the residual moisture in the pharmaceutical cold kit. However, more study with a greater number of cold kits need to be tested to get better view of the result.

INTRODUCTION

- Residual moisture is a crucial parameter for stability of the Active Pharmaceutical Ingredients (API) in lyophilized drug formulation and its effectiveness including pharmaceutical cold kit.
- Residual moisture may affect the stannous ion stability, hence results in loss of stannous chloride ($SnCl_2$) content throughout period of time.
- Headspace moisture analyzer measures the headspace water vapor pressure inside a sealed vial by passing laser light through the headspace of the vial, adjusting the laser to the water molecule's absorption wavelength and evaluating the absorption signal.
- Voltammetry analyzer or Polarography using mercury drop to measure the current flowing through an electrode immersed in the cold kit solution.

METHODOLOGY

Headspace Moisture/Pressure Analyzer

Stabilized moisture/pressure analyzer: 30 minutes (3 LPM)

Calibration : 2 calibration vials

Measure 5 standard vial (1, 2, 3, 4, 5 torr)

Measure sample : moisture partial pressure in headspace vial

Place sample in sample chamber and enter label in Label textbox

Repeat measurement 3 times

Moisture partial pressure will be analysed

Voltammetry Analyzer : Polarography

Stabilized system: electrode, mercury drop

Add 5mL oxygen-free of diluted nitric acid (HNO_3) into measuring vessel, purged for 5 minutes

Prepare sample (last 2 mins) of purging: insert 2mL oxygen-free of diluted HNO_3, gently swirl

Add 25mg/L standard stannous and purge 20 seconds. Repeat 3 times.

Purge for another 20 seconds

After purging, pipette 0.135mL sample into measuring vessel

Polarogram of sample and standard will be constructed.

Stannous chloride concentration per vial (2mL) will be calculated through software.

OBJECTIVES

A. To measure partial pressure of moisture content in headspace sealed ^{99m}Tc based pharmaceutical kit (DMSA, DTPA) using moisture/pressure headspace analyzer.

B. To measure stannous concentration in ^{99m}Tc based pharmaceutical cold kit (DMSA, DTPA) using polarography.

C. To determine the relationship between moisture partial pressure of sealed ^{99m}Tc based pharmaceutical kit (DMSA, DTPA) and stannous chloride ($SnCl_2$) concentration.

RESULTS AND DISCUSSION

- The partial pressure of moisture content in the headspace of the vials are higher in each batch of Dimercaptosuccinic acid (DMSA) cold kits formulation compared to Diethylenetriaminepentaceticacid (DTPA) cold kits formulation. This result may due to production year in which all batches DMSA were produced on year 2022 while all batches DTPA were produced on year 2023 and 2024, hence giving higher partial pressure of moisture content in all batches DMSA cold kits with longer formulation duration.
- For DMSA cold kits, in figure 1, results show the higher the partial pressure of moisture content, the lower the $SnCl_2$ concentration. However, results DTPA cold kits in figure 2 shows lower partial pressure of moisture content in the headspace of the vial, but not resulting in higher $SnCl_2$ concentration of the formulation. The results were not consistent may due to inconsistent $SnCl_2$ left and loss in the formulation after freeze-drying process.

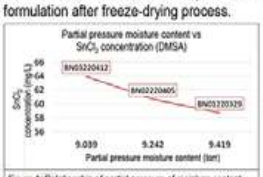

Figure 1: Relationship of partial pressure of moisture content and stannous chloride ($SnCl_2$) concentration of Dimercaptosuccinic acid (DMSA) cold kits.

Figure 2: Relationship of partial pressure of moisture content and stannous chloride ($SnCl_2$) concentration of Diethylenetriaminepentaaceticacid (DTPA) cold kits.

CONCLUSION

- ✓ $SnCl_2$ concentrations in DMSA formulation were affected by the moisture content in the headspace of DMSA cold kits.
- ✓ $SnCl_2$ concentrations in DTPA formulation were inconsistent despite lower partial pressure of moisture content may due to loss of $SnCl_2$ in the formulation each batch of DTPA cold kits after freeze-drying process.
- ✓ More samples of pharmaceutical cold kits with initial data starting from initial formulation are needed to get better view of the results.

ACKNOWLEDGMENT

The author would like to acknowledge Radiopharmaceutical Technology group for providing samples in this study and Quality Control & Biodosimetry group for providing support in technical works. Besides that, acknowledgment to Medical Technology Division for the facility provided during this study.

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CYTOTOXICITY EFFECT AND MORPHOLOGICAL STUDY OF CHALCONE DERIVATIVES TOWARDS HUMAN COLORECTAL ADENOCARCINOMA CELLS LINE (HT-29)

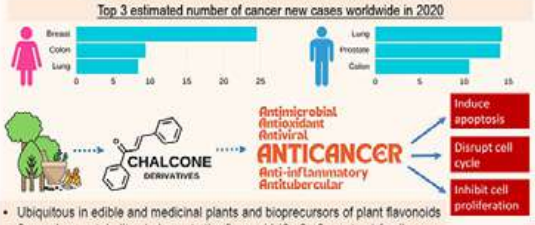
Rosniza Razali, Veshalini Kasiraja, Zainah Adam, Daryl Jesus Arapoc, Nurmaziah Mohammad Shafie, Fazliana Mohd Saaya, Abang Abdul Rahim Ossen and Nurul Akmarina Mohd Abdul Kamal

ABSTRACT

Chalcones, a group of natural compounds with a characteristic 1,3-diphenyl-2-propene-1-one scaffold, have garnered interest in anticancer studies due to their diverse biological activities. This study investigates the cytotoxic effects and morphological changes induced by four chalcone derivatives which are 4-nitrochalcone, 4-hydroxychalcone, 3-(4-methylphenyl)-1-phenyl-2-propen-1-one, and 1-(3-methylphenyl)-3-(4-methylphenyl)-2-propen-1-one on human colorectal adenocarcinoma cells (HT-29). The HT-29 cells were treated with varying concentrations of each derivative to assess their cytotoxicity using MTT assays as per IC_{50} values. Morphological changes were observed under an inverted microscope. The results revealed that all chalcone derivatives exhibited dose-dependent cytotoxic effects. However, the 3-(4-methylphenyl)-1-phenyl-2-propen-1-one treatment showed a significantly higher cytotoxic effect compared to other chalcone derivatives. Morphological analysis demonstrated significant apoptotic features such as cell shrinkage, rounding and partial detachment, floating of cell and lobulated appearance. These findings suggest that chalcone derivatives, particularly 3-(4-methylphenyl)-1-phenyl-2-propen-1-one, have potential as therapeutic agents for colorectal cancer, warranting further investigation into their mechanisms of action and in vivo efficacy.

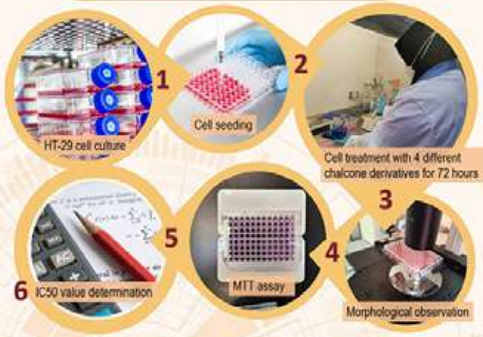
INTRODUCTION

Top 3 estimated number of cancer new cases worldwide in 2020



- Ubiquitous in edible and medicinal plants and bioprecursors of plant flavonoids
- Secondary metabolites belongs to the flavonoid (C_6-C_3-C_6 system) family

METHODOLOGY



CONCLUSION

Chalcone derivatives exhibit significant cytotoxic effects and induce apoptotic morphological changes in HT-29 human colorectal adenocarcinoma cells. These findings suggest that chalcone derivatives hold promise as potential therapeutic agents for colorectal cancer treatment. Further research is warranted to explore their clinical applications and to develop more potent derivatives.

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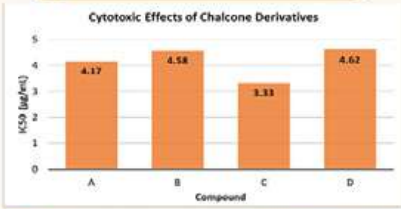
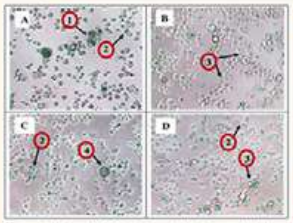
3. Kumar Vishal, Dhawan Sanjeev, Grace Pankaj S., Awolade Paul, Shinde Suraj Raosaheb, Kanjeomath Rajshekhar and Singh Parvesh. 2021. Recent Advances in Chalcone-Based Anticancer Heterocycle: A Structural and Molecular Target Perspective. Current Medicinal Chemistry, Vol 28, No 33, pp. 6805-6845(41)

OBJECTIVES

- To evaluate the cytotoxic effect of chalcone derivatives on the human colorectal adenocarcinoma cell line HT-29
- To investigate the morphological changes associated with the treatment.

RESULTS





Cell morphology of HT-29 cells treated with chalcone derivatives at IC_{50} value for 72 hours at 20x Magnification using inverted light microscope (Olympus CKX41).

COMPOUND NAMES

- A 4-nitrochalcone
- B 4-hydroxychalcone
- C 3-(4-methylphenyl)-1-phenyl-2-propen-1-one
- D 1-(3-methylphenyl)-3-(4-methylphenyl)-2-propen-1-one

CELL MORPHOLOGY LABEL

1. Membrane blebbing
2. Cell shrinkage
3. Rounded cells
4. Floating with lobulated appearance

DISCUSSION

- The observed morphological changes showed potent cytotoxic effects of chalcone derivatives against HT-29 human colorectal adenocarcinoma cell, further confirm the induction of apoptosis
- These findings align with previous studies highlighting the anticancer potential of chalcones
- Further studies are needed to elucidate the exact molecular mechanisms and to evaluate the in vivo efficacy of chalcone derivatives

ACKNOWLEDGMENT

This research was supported by Dana Dalaman Nuklear Malaysia (NM-R&D-20-08). We would like to convey our highest gratitude to Malaysia Nuclear Agency for funding our project and giving us the opportunity to deliver this project successfully.

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PRESERVATION OF BLOOD SAMPLES FOR CYTOGENETIC TESTS: A COMPARATIVE STUDY

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N.U.R NUKLEAR UNTUK RAKYAT

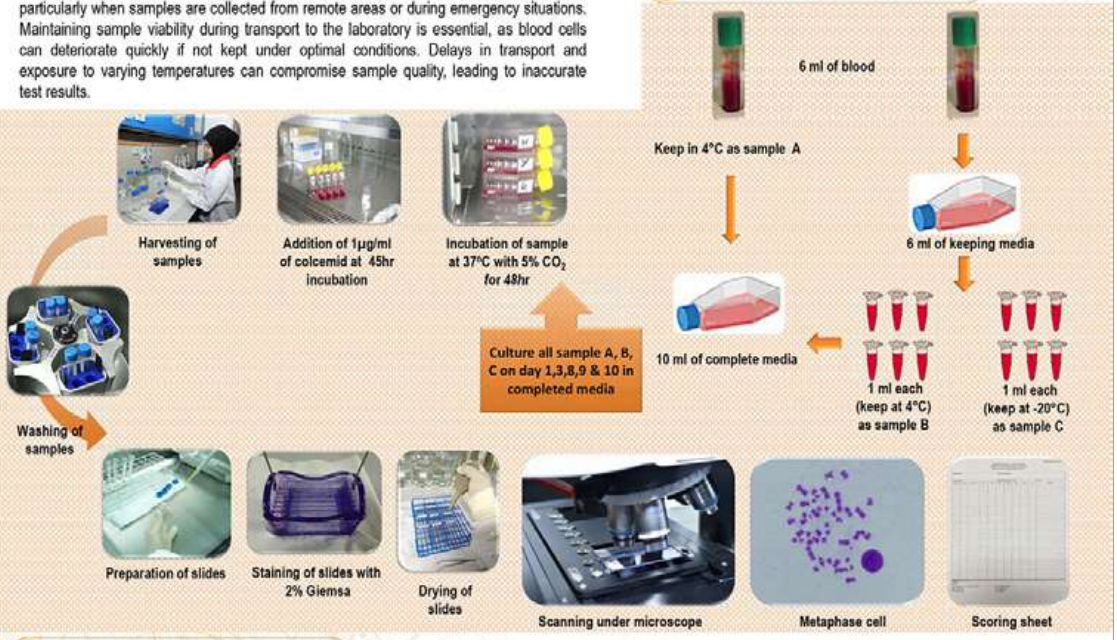
INTRODUCTION

Blood is a vital fluid in the human body, consisting of various cells suspended in plasma. It performs essential functions such as transporting oxygen and nutrients, removing waste products, and playing a crucial role in the immune response. Cytogenetic tests are crucial diagnostic tools used to identify genetic disorders, cancers, and to monitor radiation exposure. These tests rely heavily on the analysis of lymphocytes, which are abundant in blood samples. The integrity and viability of these samples are critical for accurate cytogenetic analysis. However, preserving blood samples poses significant challenges, particularly when samples are collected from remote areas or during emergency situations. Maintaining sample viability during transport to the laboratory is essential, as blood cells can deteriorate quickly if not kept under optimal conditions. Delays in transport and exposure to varying temperatures can compromise sample quality, leading to inaccurate test results.

OBJECTIVE

The objective of this research is to determine the optimal storage conditions for blood samples used in cytogenetic testing by evaluating the viability of lymphocyte-containing blood cells under different storage durations and temperatures.

METHODOLOGY



RESULTS

Sample treatment	No. of Cell/Metaphase									
	Day 1		Day 3		Day 8		Day 9		Day 10	
Normal at 4°C, A	677	692	574	636	654	782	633	561	753	749
4°C with keeping medium, B	-	-	12	23	5	28	15	18	21	7
-20°C with keeping medium, C	-	-	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil

The study shows that blood samples stored at 4°C without any additional medium retained viable cells for up to 10 days. In contrast, samples stored at 4°C with the keeping medium declined in viability after 3 days, and those stored at -20°C had no viable cells after the first day. Therefore, 4°C is effective for short-term storage, while -20°C is unsuitable.

CONCLUSION

The data clearly demonstrated that 4°C is a more effective storage temperature for maintaining cell viability compared to -20°C, and that the new keeping medium did not enhance cell survival under either temperature condition. The keeping medium did not improve cell preservation, indicating the need for further research into more effective storage solutions, such as using Leibovitz's L-15 medium.

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EFFECT OF DURATION ON THE ANTIOXIDANT PROPERTIES OF *CITRUS HYSTRIX* (KAFIR LIME) LEAVES WATER EXTRACT

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N.U.K.R
NUKLEAR UNTUK RAKYAT

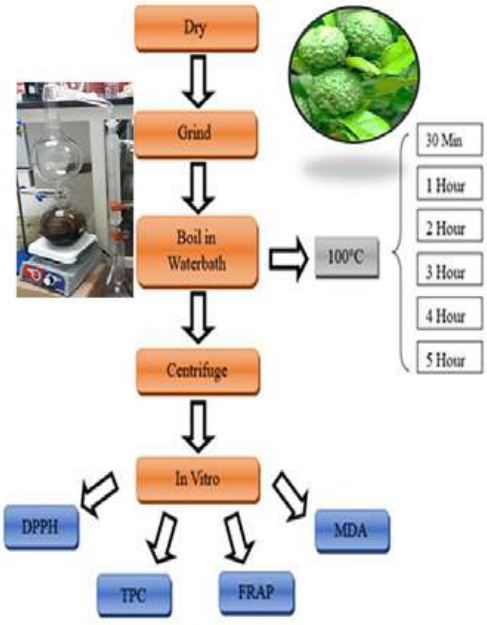
INTRODUCTION

C. hystrix: prominent compound in Asian cuisine andas traditional medicine → Distinct part of *C. hystrix*: Excellent source of chemical compound → Previous study: *C. hystrix leaves* rich in phytochemical compounds → However, extraction duration impacts quality and quantity of phytochemical compounds

OBJECTIVE

To identify ideal extraction duration at 100℃ for obtaining highest antioxidant and total phenolic content.

METHODOLOGY



RESULTS & DISCUSSION

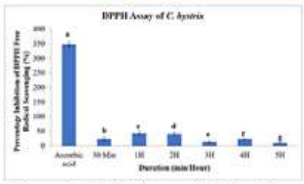


Figure 1: DPPH Assay of *C. hystrix*

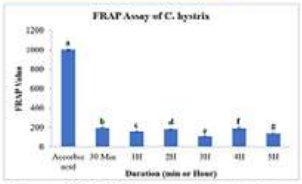


Figure 2: FRAP Assay of *C. hystrix*

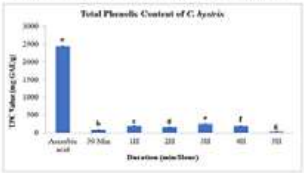


Figure 3: Total Phenolic Content of *C. hystrix*

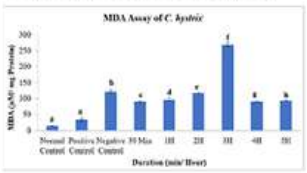


Figure 4: MDA Assay of *C. hystrix*

Suitable extraction procedures - yield extracts and fractions high in bioactive components from plants.

Antioxidant activity of plant extract and its phenolic content are positively correlated.

Previous findings: depending on the species, phenolic chemicals in plants should be present in various bound states. Therefore, the most efficient processing techniques for extracting phenolic chemicals from distinct plants may vary.

CONCLUSION

-Extraction for 30 minutes at 100 ℃: Highest antioxidant properties and total antioxidant content.

-Potential for development into herbal medicine.

Further study required: Designed and focused on its biological activities in combating chronic illness with its suggested mechanisms of action.

ACKNOWLEDGEMENT

Sincere gratitude to the Malaysian Nuclear Agency and the Forest Research Institute Malaysia for generously providing access to their facilities in the successful completion of this research.

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PYRROLOQUINOLINE QUINONE (PQQ) GENES ISOLATION IN *ACINETOBACTER CALCOACETICUS*

Chong Saw Peng, Phua Choo Kwai Hoe, Ahmad Zainuri bin Mohd Dzomir, Norellia Bahari and Mariani Deraman

N.U.R NUKLEAR UNTUK RAKYAT

ABSTRACT

Phosphorus (P) is an essential nutrient for plant growth and development. However, many agricultural soils exhibit insufficient phosphorus levels, leading to suboptimal crop yields and threatening global food security. To overcome phosphorus deficiency, plant growth-promoting rhizobacteria (PGPR) offer a promising solution to this problem by enhancing phosphorus availability and uptake in plants. In this study, phosphate-solubilizing microorganisms, such as *Acinetobacter calcoaceticus* can make phosphorus more accessible to plants by solubilizing insoluble phosphate forms. Among these microorganisms, pyrroloquinoline quinone (PQQ) genes have been implicated in the phosphate solubilization process. Four PQQ genes were isolated from *A. calcoaceticus* including PQQ A, PQQ B, PQQ C, and PQQ D genes using heterologous primers designed from *Acinetobacter baumannii* sequences and amplified using polymerase chain reaction (PCR) method from the genomic DNA of *A. calcoaceticus*. The PQQ A, B, C, and D genes were then sequenced and the lengths obtained were 39, 843, 689, and 255 base pairs (bp) respectively. PQQ genes can offer insights into the genetic basis of phosphate solubilization and aid in developing targeted molecular tools, such as selective primers, for screening mutation sites associated with enhanced phosphate solubilization traits.

INTRODUCTION

The imbalanced use of fertilizers, specifically nitrogen and phosphorous, and indiscriminate use of chemical pesticides have led to depletion in soil fertility and environmental pollution. Biofertilizer technology is being developed to solve the problem of excessive use of chemicals and save our environment. In this study, phosphate solubilising bacteria, *A. calcoaceticus* will be investigated. Phosphate-solubilizing bacteria are a group of beneficial microorganisms that can solubilize inorganic phosphorus from insoluble forms in the soil, making it available for plant uptake. Gluconic acid production is considered the principal mechanism for phosphate solubilisation in bacteria (Dhangar and Farida 2018). One of the genes involved in gluconic acid production is the pyrroloquinoline quinone (PQQ) (Naveed et al. 2016). This study will identify and isolate PQQ A, B, C, and D from the phosphate solubilising bacteria, *A. calcoaceticus*. The objective of studying PQQ genes is because PQQ is a cofactor involved in the activity of certain specific enzymes and metabolic pathways responsible for phosphorus solubilization (Pan et al. 2023). Moreover, investigating PQQ genes helps in understanding the genetic regulation of phosphate solubilization in bacteria. This includes understanding the genetic mechanisms underlying phosphate solubilization can lead to the development of new strains through mutagenesis with enhanced solubilization capabilities (Bhanja et al. 2021). Therefore, PQQ genes can serve as targets for the selection of phosphate-solubilizing bacteria for use as biofertilizers.

MATERIALS & METHODS

I. Phosphate solubilising bacteria isolation

Bacterial strains were isolated from compost and soil. The bacterial strains were identified by using the 16S rRNA method.

II. PQQ gene-specific primer pairs design

The specific PQQ gene primers were designed using Primer-BLAST software from the NCBI. Primer pairs were outsourced and synthesized by the primer synthesis service provider.

III. Phosphate solubilising genes isolation

The synthesized PQQ gene-specific primer pairs were used to amplify the PQQ genes through PCR. The isolated PQQ genes were outsourced for sequencing through the sequencing service provider.

ACKNOWLEDGEMENT

This research was conducted under the Nuclear Malaysia internal project (R&D-NM-21-67) and supported by the Forum for Nuclear Cooperation in Asia (FNCA) under the project Radiation Processing and Polymer Modification for Agricultural, Environment, and Medical Application (RPPM)

RESULTS & DISCUSSION

Table 1. The M100 isolate species identification and Gen Bank accession number.

Isolates	Organism Identification	Gen Bank accession no. and reference strains	Similarity (%)
M100	*Acinetobacter calcoaceticus*	JF681282	97

Table 2. The PQQ gene heterologous primer sets were designed based on the sequence bioinformatics from *A. baumannii*.

Gene	Forward Primer	Reverse Primer
PQQ A	5' ATG CAA TGG ACA AAA CCA G 3'	5' TTA ACG TGC TTC AAA GTA CAT 3'
PQQ B	5' ATG CAT ATT TAT ATT TTA GGT TCA GC 3'	5' TTA GAG TTC AAT TTG CAT GCC 3'
PQQ C	5' TGA AAC ATG ACT CAA ACA CC 3'	5' TCA TTT AAA TAG TCC TTT GTG CC 3'
PQQ D	5' ATG AAT AAA GAA CAA TTT GAT GTA A 3'	5' TCA TAT TAA ATC AAT CCA GTG TTG T 3'

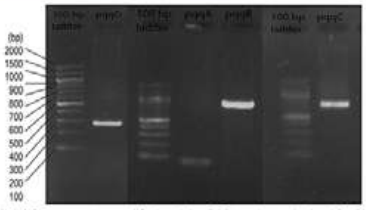

Figure 1. PQQ genes were amplified and the PCR products obtained for PQQ A, B, C, and D genes were compared to the 100 bp ladder marker.

Table 3. The protein coded for PQQ genes in *A. calcoaceticus*.

Gene	Coded Protein
PQQ A	Protein coenzyme PQQ precursor peptide PqqA
PQQ B	Protein pyrroloquinoline quinone biosynthesis protein PqqB
PQQ C	Protein pyrroloquinoline quinone synthase PqqC
PQQ D	Protein pyrroloquinoline quinone biosynthesis peptide chaperone PqqD

CONCLUSION

The isolation of PQQ genes in *A. calcoaceticus* through molecular techniques and bioinformatics tools helps to elucidate the genetic basis for PQQ biosynthesis in *A. calcoaceticus*, shedding light on its potential applications as a biofertilizer in environmental science

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Naveed, M. T., Kamal, S., Hakeema, A., Haroon, M.A., and Samad, (2016). The life history of Pyrroloquinoline quinone (PQQ): A versatile molecule with novel impacts on living systems. *Int J Mol Biol Open Access* 1:29-45.
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Forum Iklim Kebangsaan 2024

3 Oktober 2024

NUKLEAR MALAYSIA

FORUM IKLIM KEBANGSAAN 2024

Utilizing CTBT Data for Initial Information for Environmental Radiological Monitoring and to Understand Transportation behaviour of Anthropogenic Radionuclides: A Preliminary Study for Malaysia

INTRODUCTION

Many human activities in the Asia Pacific have posed a radiological contamination risk since 1946, including nuclear tests and major reactor accidents like Chernobyl in 1986 and the TEPCO Fukushima Nuclear Power accident in 2011. Understanding factors like atmospheric and hydrological processes is essential for assessing the pathways and impacts of these anthropogenic radionuclide transport and developing effective monitoring and mitigation strategies. Once released into the atmosphere or water bodies, natural processes such as wind patterns, precipitation, evaporation, and water currents can influence their transport over varying distances. This study is part of an initiative for environmental radiological monitoring and understanding anthropogenic radionuclide transportation using CTBTO database information

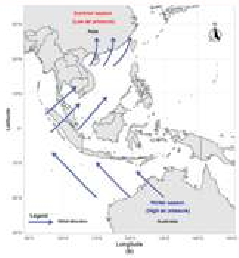
METHODOLOGY

In this study, the collected data is categorized as spatial data, focusing on anthropogenic radionuclides' types and their activity concentrations at various locations. The analysis is facilitated by Geographic Information System (GIS) software for mapping and in-depth examination. For the purpose of the study, Cs-137 data from 2011-2022 for stations retrieved from CTBT IMS located in Malaysia, Philippines, Japan, Russia, and Mongolia. Later these data were analyzed to study the pattern of Cs-137 concentration against meteorology data such as precipitation and wind direction. The mapping and the autocorrelation analysis were conducted with ArcGIS software 9 [version 10.2 ESRI Inc. Redlands]

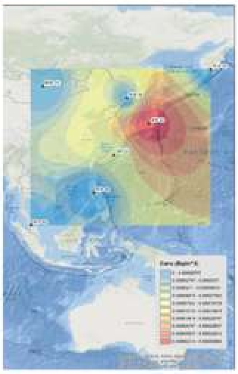
OBJECTIVES

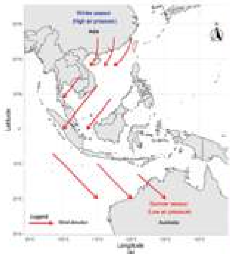
1. To explore CTBTO IMS data use for National Radiological Mapping and Database on Common Fission Products to support National Disaster Management
2. to investigate and discover scientific evidence whether fallout from the previous Asia Pacific nuclear incidents/disasters has reaches/spread out into Malaysia's environment and helps To develop National Radiological Database and Digital Map on anthropogenic radionuclides for East Coast of Peninsular Malaysia, Sabah and Sarawak

THE RESULTS

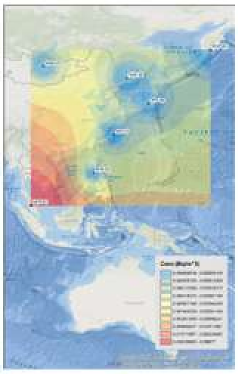


2014
South-West Monsoon Observation [Late May to September]





2014
North-East Monsoon Observation [November to March]

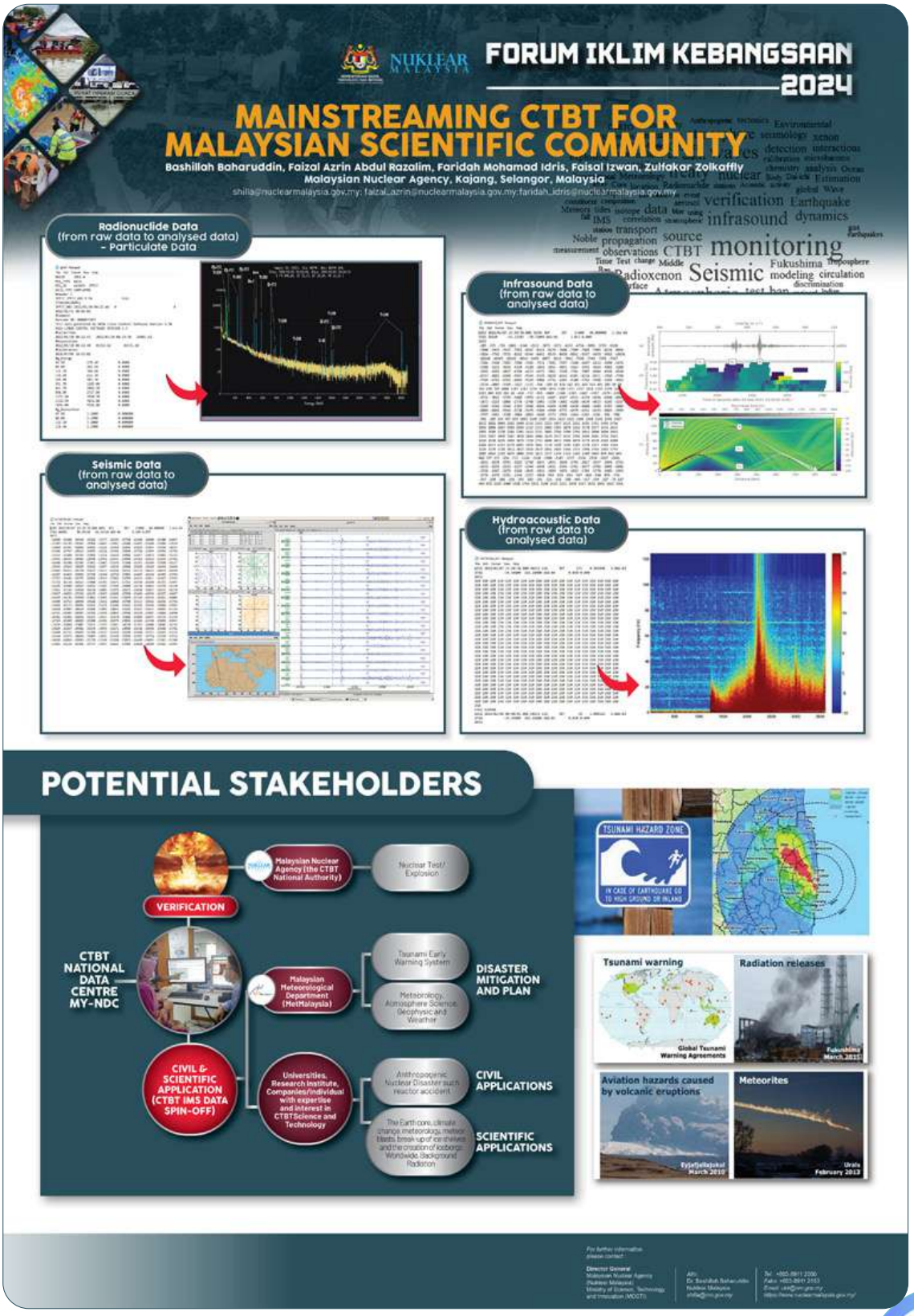


DISCUSSION

Preliminary findings indicate the presence of detected anthropogenic radionuclide Cesium-137 (137Cs) in Malaysia. When comparing radionuclide concentrations year 2014 during the Northeast Monsoon and the Southwest Monsoon, the pattern became evident that the Northeast Monsoon had slightly elevated Caesium -137 concentrations in the Malaysian environment, indicating its influence on radionuclide movement

Director General

Forum Iklim Kebangsaan 2024



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CLIMATE CHANGE STUDY USING THE CIVIL AND SCIENTIFIC APPLICATIONS OF CTBT DATA

About CTBT & IMS

Comprehensive Nuclear-Test-Ban Treaty (CTBT) is an international multilateral treaty banning all nuclear explosions – everywhere and by anyone

The International Monitoring System (IMS) is a global network of monitoring stations to detect events that might indicate violations of the CTBT. It consists of 337 monitoring facilities involving 4 monitoring technologies – **seismic, hydroacoustic, infrasound & radionuclide**. Start about 90 percent complete, with some 300 monitoring facilities installed and operational

Scientists and institutions in all 183 CTBTO Member States can also use the data for disaster warning and scientific studies including in the field of climate change. The data can also be accessed via the Virtual Data Exploitation Centre. Following the devastating 2004 Indian Ocean tsunami, Member States decided to make IMS data available to tsunami warning centres

The system's ability to monitor atmospheric disturbances, such as volcanic eruptions, severe storms, or other large-scale events, helps improve weather forecasts. Additionally, with almost two decades of data, it can be used to track climate change

CTBT Data for Climate Change Study

INFRASOUND	RADIONUCLIDE	HYDROACOUSTIC	SEISMIC
Signals generated by the calving of icebergs and movements of glaciers	Increase understanding of the long-range exchange of pollutants through tracking the transport of air masses or validating atmospheric transport models	Research on the calving of icebergs and ice shelf break-up as indicators of warming at the ice shelves	Serving as an additional source for studying the melting of glaciers, whose size and movements can affect seismic signals
Microbaroms (very low-frequency sound waves generated in marine storms), hurricanes and tornadoes to assess the intensification of storm activity	Monitor the stratosphere/ troposphere exchange and validate global climate models by using radionuclides as tracers	Improving weather prediction and estimates via the inference of ocean temperature	Study of the differences in wave travel time (acoustic impedance temporal variations) in the lower atmosphere using co-located seismic and infrasound stations
Signals generated by landslides and avalanches as indicators of climate change	Monitor seasonal and yearly variations of specific radionuclides which might be connected to climate variations	Support research on ocean processes and marine life, such as whale populations and migration patterns that might be affected by climate change	
Specific sources along a fixed source-to-station path to determine seasonal and yearly variations of some atmospheric properties	Determine the quantity of dust and pollens present over a certain period of time as well as the evolution of chemical contents in dust	Measuring water temperature by means of 'acoustic thermometry'	

Climate Studies and Monitoring:

- Meteorological phenomena study
- Signals generated by the calving of icebergs and movements of glaciers
- Microbaroms (very low-frequency sound waves generated in marine storms), hurricanes and tornadoes to assess the intensification of storm activity
- Signals generated by landslides and avalanches as indicators of climate change
- Specific sources along a fixed source-to-station path to determine seasonal and yearly variations of some atmospheric properties

Promoting Human Welfare

- Detecting volcanic explosions and the presence
- Of volcanic ash clouds to assist aviation safety, and help provide warnings in real-time.
- Detecting a range of man-made and natural events on the Earth's surface, including chemical explosions, meteoroids entering the atmosphere, severe storm systems and aurorae

Other Civil & Scientific Application

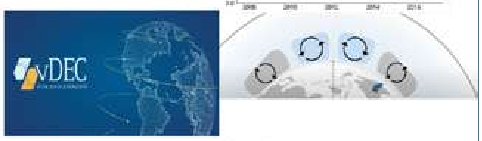
- Of the Earth middle atmosphere
- Tsunami early warning,
- Monitoring volcanic eruptions,
- Detecting Near-Earth Objects impacting the Earth atmosphere as well as for scientific studies such as better understanding the dynamic

Our Interest Radionuclide for Climate Change Study

Radionuclides can provide valuable insights into atmospheric processes, including monsoons, by tracing air masses and studying particle transport. Some radionuclides used in atmospheric studies that can help understand monsoon patterns include:

Beryllium-7 (^{7}Be):A cosmogenic radionuclide produced in the upper atmosphere by cosmic rays.It attaches to aerosols and can be used to track the movement of air masses, including those associated with monsoons

Cesium-137 (^{137}Cs): A man-made radionuclide from nuclear fallout, still present in trace amounts in the atmosphere. It can be used to study large-scale atmospheric circulation and deposition patterns, including monsoons. These radionuclides, especially ^{7}Be and ^{210}Pb, are often used to trace atmospheric aerosols and understand how monsoonal systems transport particles across region



- Virtual Data Exploitation Centre (vDEC) provides worldwide scientists and researchers to access IMS data to conduct research and to publish new findings
- Data are freely available
- A proposal must be submitted for approval prior access to the data
- Data are only provided within temporal and geographical boundaries as granted by CTBTO
- Requests for data can be made online via *https://www.ctbto.org/resources/for-researchers-experts/vdec/request-for-data*

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Unveiling the Northeast Monsoon's Influence Through Be-7 Concentration: A Study of Easterly and Meridional Surges

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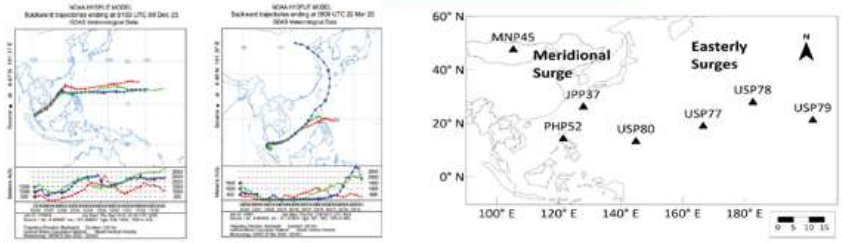
ABSTRACT

Establishing several radionuclide stations by the Comprehensive Nuclear Test-ban Treaty (CTBT) along wind pathways during the Northeast Monsoon season has provided a unique opportunity for this study to investigate and further utilize Be-7 concentration. Beryllium-7 (Be-7), a cosmogenic radionuclide also detected by these stations, serves as a tracer for atmospheric processes, particularly precipitation dynamics influenced by monsoonal patterns. This research explores the initial correlation between Be-7 concentration and the Northeast Monsoon Index (NEMI), encompassing Easterly and Meridional surges. The Northeast Monsoon, a significant climatic phenomenon in Southeast Asia, impacts regional weather patterns and precipitation levels. Understanding the correlation between Be-7 concentration and these two surges could provide insights into atmospheric transport mechanisms, rainfall variability, and potential implications for climate and environmental studies. Granger Causality tools is used for this purpose. Initial findings suggest a potential linkage between Be-7 concentration and the intensity or duration of the Northeast Monsoon, highlighting avenues for further research to elucidate these interactions more comprehensively.

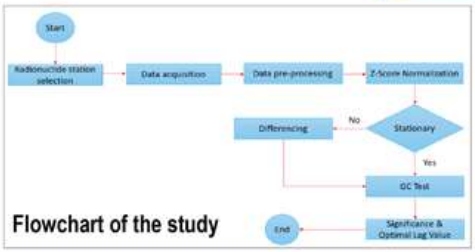
Keywords: Be-7 intensity, Granger causality test, Easterly surge, Meridional surge

INTRODUCTION



Wind path during NEM season in Malaysia and possible related radionuclide station

METHOD



Flowchart of the study

Table 2: Granger Causality test result

	Meridional Surge		Easterly Surge	
	P-value	Optimum lag value	P-value	Optimum lag value
JPP37	0.0008*	6	0.0001*	3
MNP45	0.0246*	11	0.1128	4
PHP52	0.0059*	11	0.0071*	4
USP77	0.7341	6	0.0069*	2
USP78	0.3800	6	0.0017*	4
USP79	0.4321	6	0.0920	3
USP80	0.7666	11	0.0306*	5

* Statistically significant, $p < 0.05$

CONCLUSION

Reference : Fakaruddin, F.J., W.S. Yip, J.Y. Dong, A. Dindang, N. K. Chang & M.H. Abdullah. 2020. "Occurrence of Meridional and Easterly Surges and Their Impact on Malaysian Rainfall during the Northeast Monsoon: A Climatology Study." Meteorological Applications. Vol. 27. (1): pp. 1–12. https://doi.org/10.1002/met.1836.

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