

Nuklear Malaysia R&D and Potential Collaboration: A Brief Note

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DDG (RTD)

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Contents

- Some Insight about Top Down Projects
- NPP Green Tech and Environment Related Projects
- Agriculture Related Projects
- Industrial Application Related Projects
- Medical Related Projects
- Conclusions

ROADMAP FOR RESEARCH & DEVELOPMENT (R&D)

Short Term

Medium Term

Long Term

ENERGY & ENVIRONMENT

EPP 11: Deploying Nuclear Energy for Power Generation

- Development of Nuclear Fuel Cycle , including nuclear waste management
- Material and Structural Integrity Evaluation
- Nuclear Impact Assessment
- Reactor Technology and Nuclear Safety
- Nuclear Knowledge Management
- Green Energy and Technology

AGRICULTURE

EPP8: Strengthening the export capability of the processed food industry through an integrated processed food park

- Food Irradiation

EPP11: Scaling up and strengthening productivity of paddy farming in other irrigated areas

- Enhancement of yield and insect resistant paddy in climate change constraint through nuclear and related technology

MEDICAL

EPP 2: Creating a supportive ecosystem to grow clinical research

- Cyclotron Based Research

INDUSTRY

EPP 2 (Business Opportunity) : Building globally competitive outsourcers

- Localization - Development of Accelerator-based Radiation Source
- Localization – Development Nuclear Industrial and Medical Devices



Nuclear Power and Research Reactor

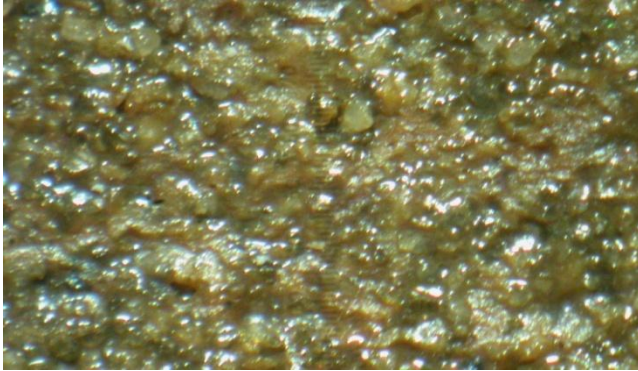
- Research Reactor Technology
 - Upgrading of RR Instrumentation and Controls (NM-KAERI)
 - RR Power Upgrade
- Research Reactor Utilization
 - Neutron Scattering and Radiography/Tomography (Neutron Beam Application)
 - Education and Training



Fuel and Waste Management

- Proposing a new project to address the issue of NORM in Rare Earth Processing
 - Lynas case
 - ARE experience
 - Prior U extraction fundamentals studies from local resources

Vitrified low radioactivity brick from NORM waste



Vitrified surface of brick



Drums of local oil sludge waste

- Cheap brick formulation made from local red clay
- Brick can be used in outdoor such as pavers, walls, garden, etc
- Possible NORM waste that can be used includes radioactive oil sludge waste from oil and gas industry, radioactive iron gypsum waste from Lynas, etc.
- Lynas had expressed interest in using this technology for their radioactive waste
- Properties of this brick includes:
 - a. Reduction of waste radioactivity to acceptable level
 - b. Leaching test using ISO 6961 method shows no radionuclide leach out after 2 years of leaching
 - c. Compress strength of 4 times that of commercial clay brick

Waste Management and Green Technology

- MSW Processing and Management
 - RDF Technology
 - Landfill Pollution Studies using Nuclear Techniques
 - Thermal/Gasification technology
- Radioactive Seal Sources Borehole Disposal Technology
- Conversion of Biomass into Bio-fuel using Radiation Grafting Technology
- Vulcanization of Rubber Latex

MSW and Green Technology



Green Technology, Products and Facilities

- Radiation Processing of Natural Polymers
 - Radiation Modification of Polymers
 - Polymer Blend and Composites
 - Radiation Curing and Synthesis
 - Radiation Conservation

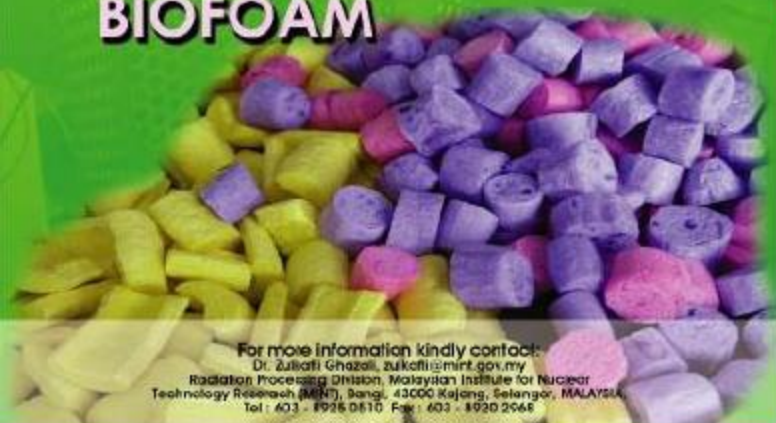
Biodegradable Packaging



BIOFOAM INNOVATION & PROCESS



BIOFOAM



For more information kindly contact:
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BIO-FILM INNOVATION & PROCESS



BIO-FILM MARKET



BIO-FILM



Ministry of Science, Technology and Innovation

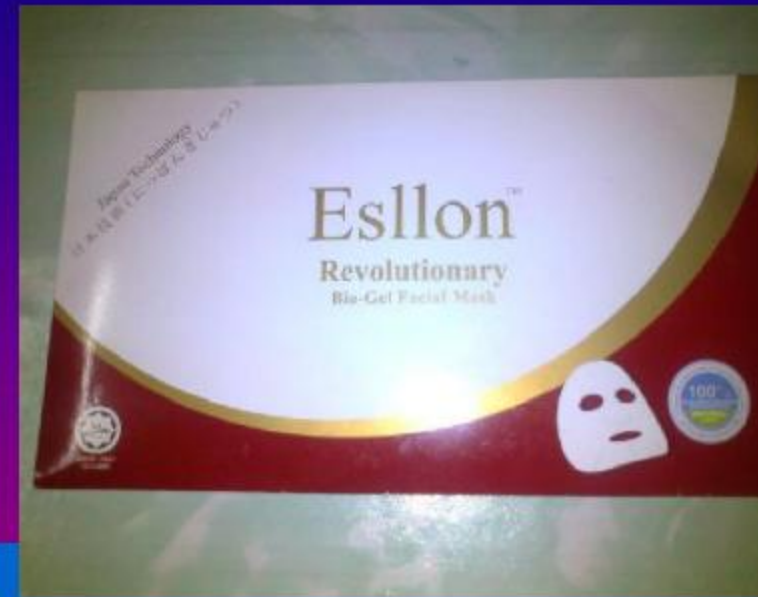
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Biodegradable Films



Product Sago Starch Hydrogel



Current Status - Product in Market



Radiation Crosslinking of PE and PVC



Heat shrinkable tube, hot water tube and flame retardant wire insulation

Radiation resistant PVC compounds for medical tubes



Pilot Scale Facilities

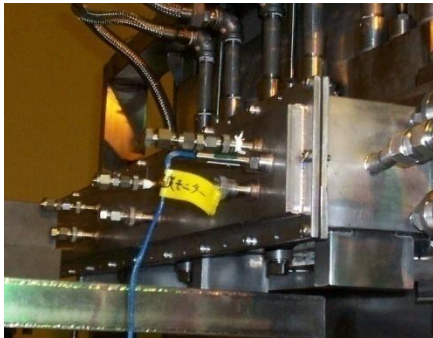
Palm oil acrylate resin synthesis plant





ODOUR TREATMENT AND CONTROL

- chemical treatment (waste water absorption, combustion)
- physical treatment (deodorization)
- biological treatment (biofiltration)
- Irradiation (electron beam and UV)



Extrusion machine for profile and wire coating



A twin-screw compounder for polymer blend/composites processing



EB Processing: crosslinking and sterilization

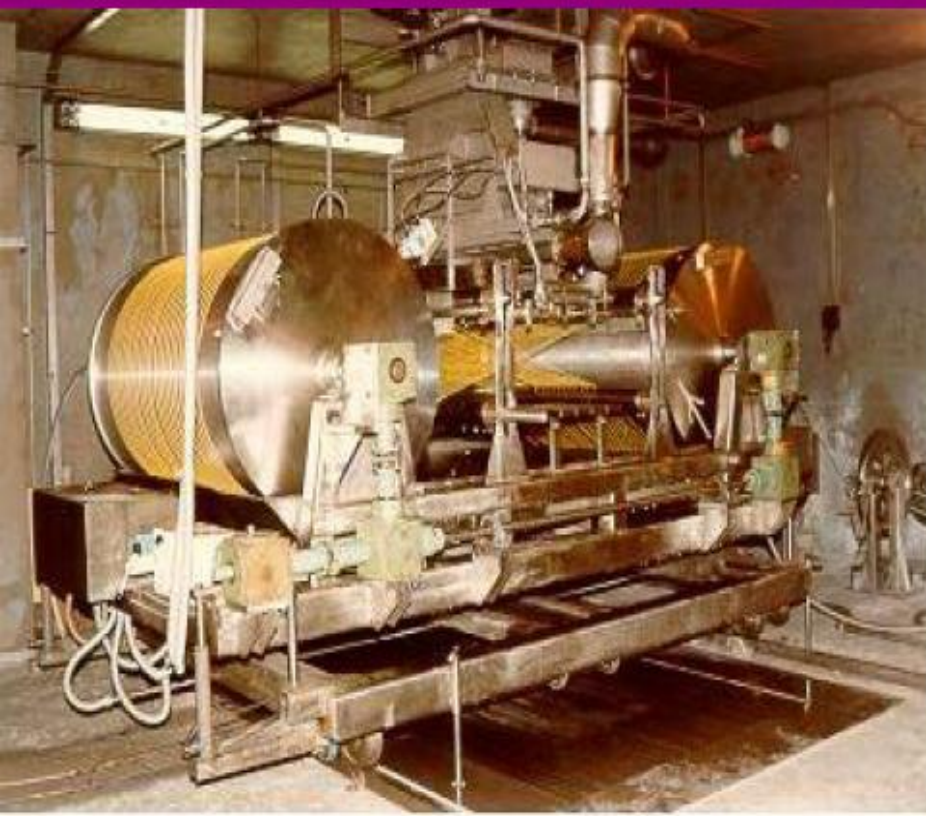


Passing through electron beam for 25 kGy dose.



Products outside irradiation room

ALURTRON: Electron beam accelerator, 3.0 MeV, 90kW
with handling facility for research and continuous
irradiation of wire and tubes





UTAMAKAN

LATEX FORMUL

PREIRR

ER

SINAGAMA



Gamma irradiation sterilization
plant of ~ 1.0 MCi Co-60
strength

RAYMINTEX



Radiation plant for prevulcanization
of natural rubber latex, 100 kCi.

Polymer testing laboratory

- tensile machine, impact tester, hardness tester, scratch and abrasion tester, tackiness tester, etc.



Analytical Equipments:

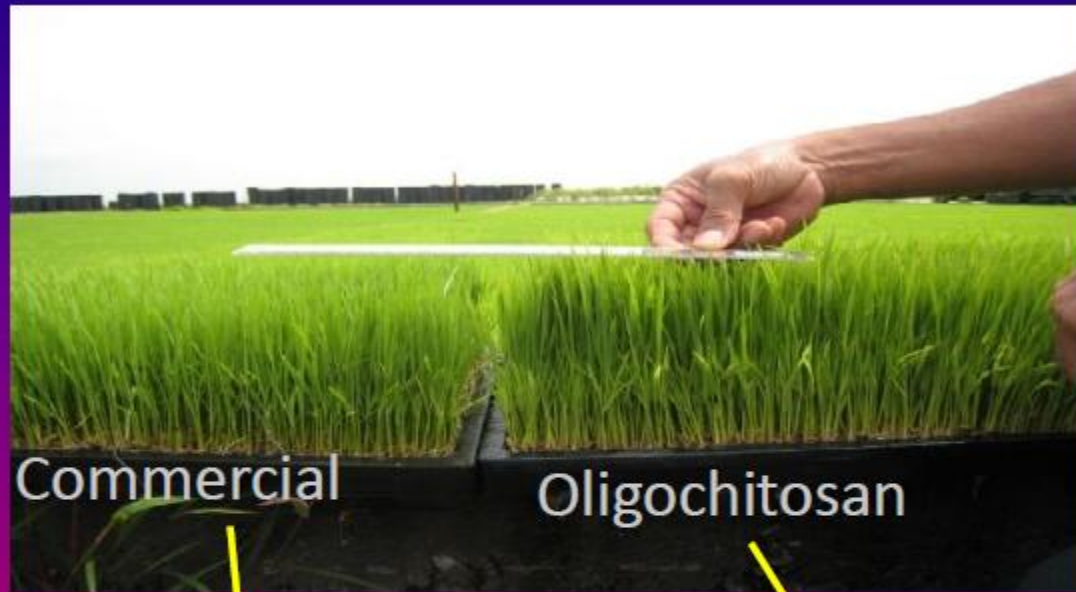
- DSC, DMTA, TGA
- FTIR, Real Time FTIR
- GPC, HPLC, SLS
- SEM, TEM
- Nanophox
- Zeta potential

Polymer processing laboratory



➤ Melt blend mixers, hot & cold press, melt flow indexer, temp controlled two roll mill, three roll mill, injection molding machine – table top, rheometer, etc

Oligochitosan Growth Promoter



Pineapple Tissue Culture



Agriculture

- Food Security Enhancement
- Biofertilizer
- Food Preservation
- Food and Crop Propagation
- Product, Services and Facilities

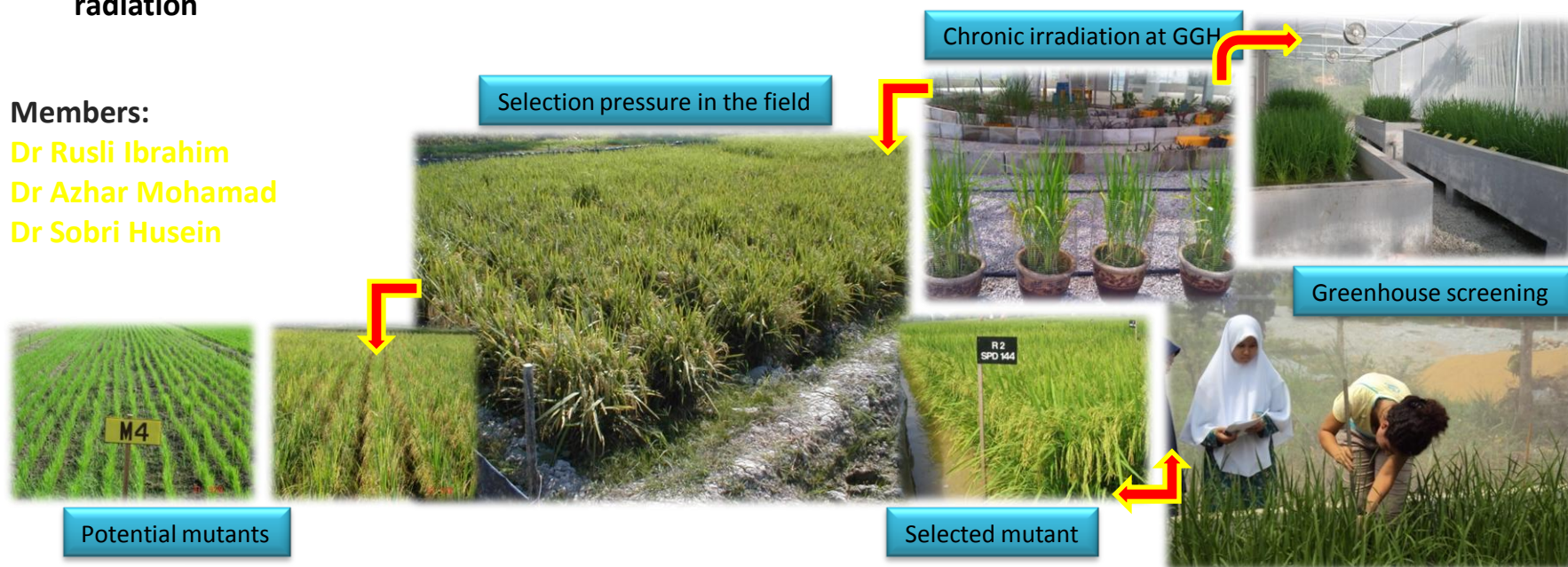
Mutagenesis of Rice for Good Agronomic and Quality Traits

Related Project:

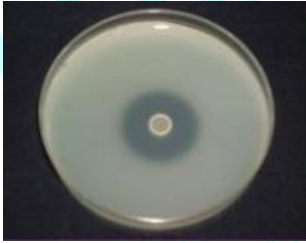
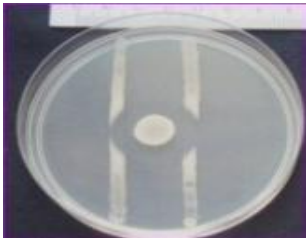
- 1) Improvement of crop quality and stress tolerance for sustainable crop production using mutation techniques and biotechnology (RAS/5/045)
- 2) Mutation breeding approaches to develop new crop varieties adaptable to social development and climate changes (IAEA/RCA)
- 3) Mutation breeding for varietal improvement of irrigated rice under minimal water conditions and amylose content using gamma irradiation (FNCA)
- 4) Improvement of rice varieties/breeding lines for low water availability in South and Southeast Asia – Global Partnership Initiative for Plant Breeding Capacity (GIPB) /GCP-GSS Project (GS09037/GS07001)
- 5) Molecular markers for abiotic and biotic stress of rice mutant lines derived from mutagenesis by ionising radiation

Members:

Dr Rusli Ibrahim
Dr Azhar Mohamad
Dr Sobri Husein



Multifunctional Bioorganic Fertilizers



- to reduce dependency on chemical fertilizer for crop production.
- use **100% natural products**, with no added chemicals.
- **'Green Products'** - environmental friendly,
- **optimising the bioresources**,
- **pathogen-free**,
- **suitable for many crops**, including vegetables, fruits trees and ornamentals,
- Suitable for **different farming systems** – plantation, orchards, greenhouses, fertigation and nurseries.

PROJECTS:

- 1) Evaluation effectiveness of fertilizer for fertigation on herbs, tomato and chili plants through isotopic tracer technique
- 2) Multifunctional biofertilizer for different cultivation systems - biofertigation and ornamental plant



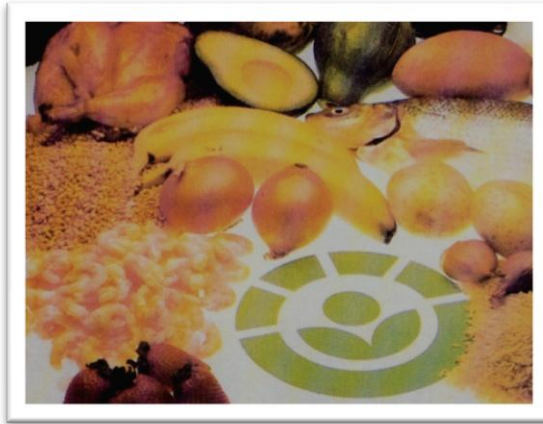
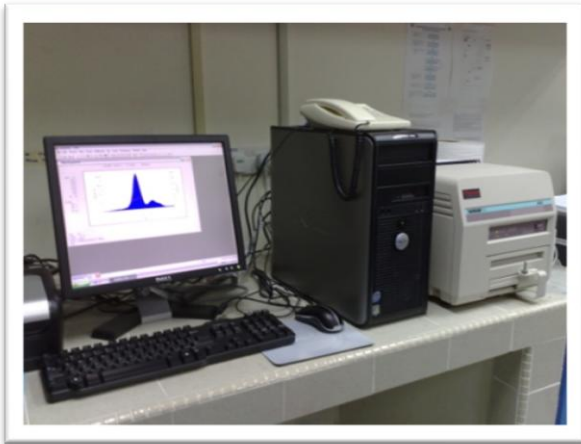
Advanced Bioreactor System for the Secondary Metabolites in Herbs



Food Irradiation

Projects:

- Enhancing sanitary and phytosanitary treatment of regional products for export by irradiation (RAS5050)



- Detection of irradiated food using thermoluminescence technique

- Irradiation as a phytosanitary treatment for the export of Malaysian fruits (rambutan, papaya, pineapple, carambola and jackfruit) to USA

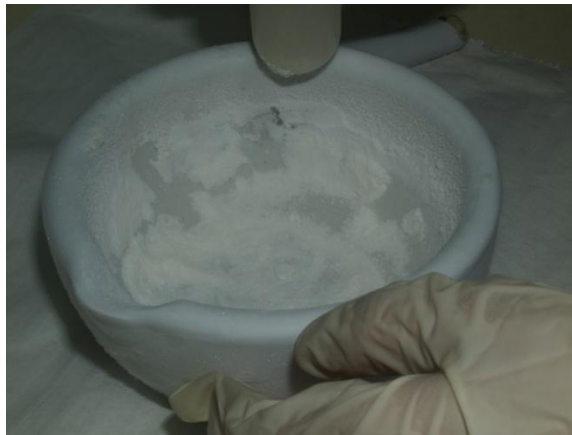


Mutagenesis of Mushroom

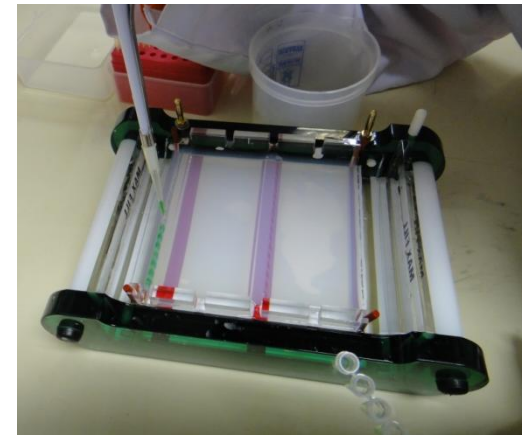
- 1) Mutagenesis of mushrooms for high glucan content
- 2) Identification of *Pleurotus sajor caju* using molecular marker technique



Pleurotus sajor caju



DNA extraction

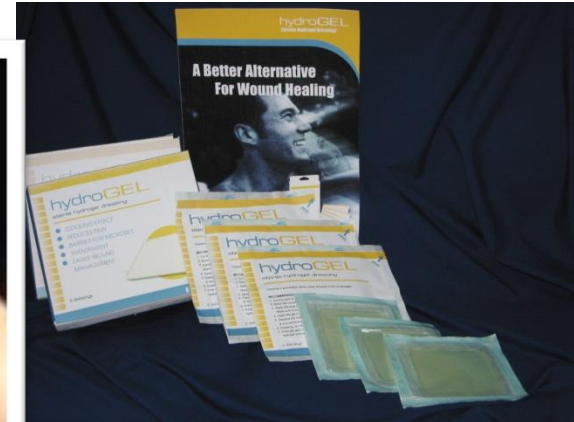


Gel electrophoresis

Production of hydrogel-based products from radiation cross-linking of biopolymers (chitosan, sago starch)



Eye Fresh



Hydrogel Dressing (Sheet)



*Chitosan paste
for wound dressing*

BioDesign Facility (Transgenic Greenhouse)



Plant Containment Level 2



**Automated Control
Environment System**



Gamma Green House



N-15, C-14, P-32 Analysis

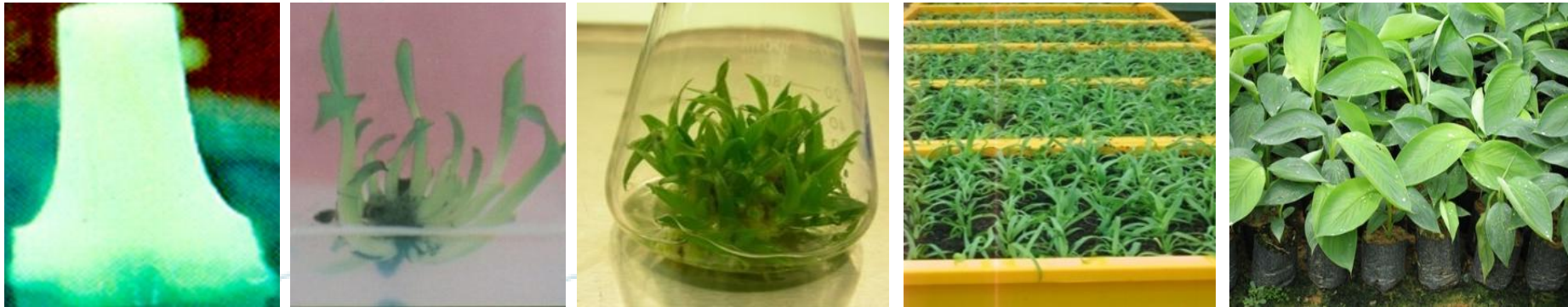


P-32 tracer technique for root activity and fertilizer efficiency studies on sago palms, Sarawak

P-32 analysis in Nuclear Malaysia

PRODUCTS AND PROCESSES FOR TECHNOLOGY TRANSFER

In Vitro Mutagenesis and Micropropagation of Fruit Trees



Somatic Embryogenesis for the Production of Tissue Culture Plantlets



Micropropagation using Bioreactor Technology

SERVICES

- Temporary immersion bioreactor system
- Technical guidelines for assembly, sterilisation and equipment handling
- Training of bioreactor technicians
- Diagnostic and recommendation for technology adaption
- Mass propagation protocols
 - ✓ Protocols for preparation and sterilization of large volumes of culture media
- Multiplication protocols for banana, pineapple, orchid, chrysanthemum,
- Gaharu, tongkat ali, kacip patimah and other herbal plants.

Consultancy/training

- Development of multiplication protocols and bioreactor system for new crops
- Recommendations on tissue culture laboratory on space, lightings, ventilation and lab equipment distribution
- Training of tissue culture technicians for mass propagation of selected crops:

- ✓ Banana
- ✓ Pineapple
- ✓ Orchids
- ✓ Chrysanthemums

- ✓ Tongkat Ali
- ✓ Kacip Patimah
- ✓ Gaharu
- ✓ Vanilla
- ✓ Other herbal plants

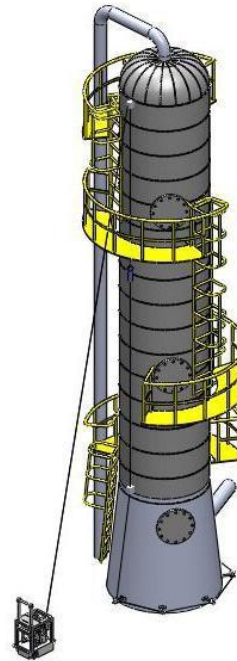


Industrial Nuclear Technology Application

- Products Localization
 - Scorpion
 - Gammakite
 - Neutron Backscatter
 - Mobile Digital NDT System
 - Eddy Current Probe
 - UT Sensors
- Various Nanotechnology Products

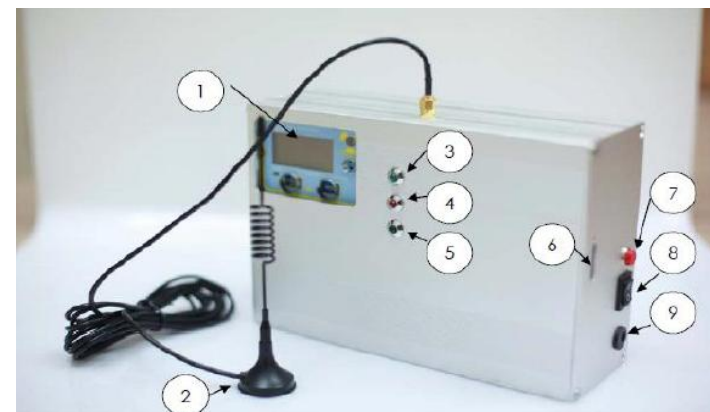
Nuclear Technology for Industrial Application

- Non-Invasive Method and Apparatus Using Ionising Radiation for Early Detection of Basal Stem Rot of Oil Palms Caused by *Ganoderma Boninense* Disease
- GammaKite : A Novel Gamma-Ray Scanning System for On-line Diagnostic Inspection of Industrial Process Columns
- Low-Cost X-Ray Computed Tomography System



Nuclear Technology for Industrial Application

- Neutron backscattering technique
- Pipe scanning system
- Smart Alert Radiation Detection (SARD) System
- Portable Gamma Tomography Corrosion Scanner



NDT Mobile Digital Radioscopy System

The System was designed to accommodate the needs of low cost, mobile, high speed and real time inspection using Radiography Technique (RT). Currently the system has been used in field services provided by Nuclear Malaysia



The MDRS offers:

- Image reusability
- No film processing
- No chemical usage
- Digital image formation
- Post image processing freedom
- Direct and dynamic visualization
- Ability for automatic defect recognition
- Qualified for Class A radiographic test in accordance to ISO/DIS 17632-2
- Reduce the risk of high radiation exposure dose towards radiation workers





APPLICATIONS

EDDYPROBE uses in rough environment for heat exchanger or boiler to detect any flaw in tube inspection

Tubes

- Different material – non ferrous
- Varying Diameter

Tubes Duties

- Refineries
- Power Plants

Flaws Found

- External Corrosion & Defects
- Internal corrosion & Defects
- Environmental cracking

For further enquires:

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EDDYPROBE
Low Cost Eddy Current Probe
For Tube Inspection

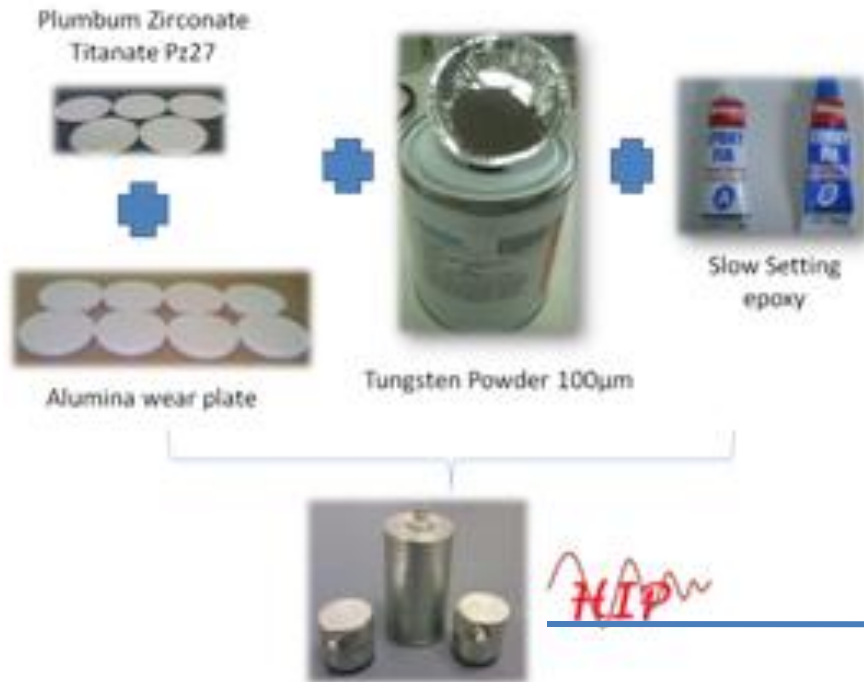
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Eddy probe is a sensor that is capable of detecting defects in tubes. It particularly useful for heat exchanger inspection. It has been successfully developed and tested with our collaborator INTESTMAL SDN BHD

High Frequency Ultrasonic Sensor



UT sensor is capable of detecting defect in welds and castings. It is also applicable for measuring thickness in pipes, thus providing data for corrosion in pipelines. Our collaborator, MJ Inspection Sdn Bhd helped us a lot in testing the performance of this sensor



Nano-sized alumina powders from aluminium waste



Our nano-sized alumina products



Nano-sized alumina balls for oil and gas catalyst

- Nano-sized alumina powder from produced from aluminium waste such aluminium dross waste
- Green technology that helps both to give more value to waste as well as reduce industrial waste volume
- Application of nano-sized alumina powder includes oil and gas catalyst, heat insulator, thermal insulating paint, fillers for specialized aluminium, industrial ceramics, etc
- The nanotechnology product was included as part of the showcase in Malaysia Nano Summit and Expo 2011
- MIGHT has promoted the product to companies as part of the government offset program
- Companies that have expressed interest includes SCOMI, Baustead, Rakannusa, Innopeak, Protega and Reylon Products

Nano-sized anatase and rutile produced from Malaysian mineral resource



Our nano-sized anatase and rutile products



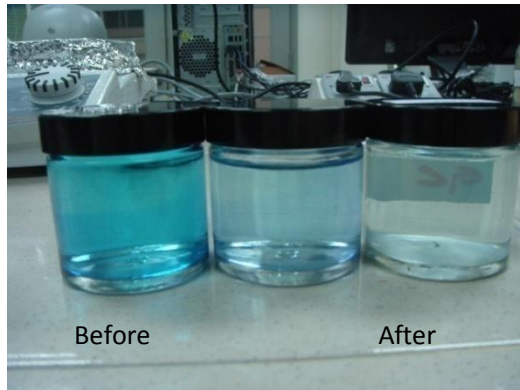
Malaysian titanium mineral used as starting material

- Green technology product produced at much lower cost than existing commercials using Malaysian titanium mineral as starting material
- Nano-sized ranging from 10 – 40 nm titania in anatase and rutile forms
- Both have good photocatalytic property as tested using standard ISO/CD 10678 method
- Can be used in applications for anti-microbes, anti-bacteria, neutralizing harmful and hazardous gases, waste water treatment, self cleaning property, UV blocker, cosmetics, hydrogen power cell, sensor, electrodes, etc
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UV and Visible light activated photocatalyst nano TiO₂ paint



Our nano TiO₂ paint products



Test on decolourization of blue dye

- Paint formulation using our nano-sized TiO₂ products
- Multi applications of paint that includes anti-microbes, anti-bacteria, neutralizing harmful and hazardous gases, waste water treatment and self cleaning property
- Amongst major advantages of the paint is the product effectiveness is both in-door and out-door
- The paint can also be produced in different colours unlike the whitish colour that is available in market at present

Kit for Photodegradation of hazardous air in automobile



Products design and colour can be modified according to needs of clients



Product features:

- Nano technology
- Green Technology
- Neutralize cigarette smoke and odour
- Neutralize hazardous gases such as formaldehyde, VOC, toluene, etc
- Does not use electricity

Geopolymer produced from silica sand for different applications



Our geopolymer incorporated with nano titania for water treatment

- Geopolymer produced from Nuklear Malaysia silica sand in Malim Nawar, Perak
- Geopolymer incorporated with nano titania for water treatment
- Geopolymer incorporated with nano alumina for heat insulator and fire proof materials
- Geopolymer incorporated with radioactive waste or industrial schedule waste for long term storage



Our geopolymer incorporated with nano alumina for heat insulator and fire proof materials



Our geopolymer undergoes leaching test for long term durability

MEDICAL

Production of radiopharmaceutical kits

Nuclear Medicine Centres

Artificial Bones (Bone Graft)

Monoclonal Antibody

Tissue Bank

Hydrogel for wound dressing



Conclusions

- NM achievements in nuclear technology has been very encouraging and wide ranging. However, R&D for NPP is about to begin
- Our Laboratories and Researchers Hosts and Co-Supervised many MSc and PhD students from Local Universities. These will continue and will be enhanced. Thus, a joint collaboration between NM and NUMC through this model is very much welcomed.
- However, this should not be the limit!