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INTERNATIONAL TINKER INNOVATION & ENTREPRENEURSHIP CHALLENGE (i-TIEC 2025)

"Fostering a Culture of Innovation and Entrepreneurial Excellence"



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23 January 2025
PTDI, UiTM Cawangan Johor
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Electrical Engineering Studies, College of Engineering
Universiti Teknologi MARA (UiTM) Cawangan Johor
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PREFACE

It is with great pleasure that we present the e-proceedings of International Tinker Innovation & Entrepreneurship Challenge (i-TIEC 2025), which compiles the extended abstracts submitted to the International Tinker Innovation & Entrepreneurship Challenge (i-TIEC 2025), held on 23 January 2025 at **PTDI, Universiti Teknologi MARA (UiTM) Cawangan Johor, Kampus Pasir Gudang**. This publication serves as a valuable resource, showcasing the intellectual contributions on the invention and innovation among students, academics, researchers, and professionals.

The International Tinker Innovation & Entrepreneurship Challenge (i-TIEC 2025), organized under the theme "Fostering a Culture of Innovation and Entrepreneurial Excellence," is designed to inspire participants at various academic levels, from secondary students to higher education students and professionals. The competition emphasizes both innovation and entrepreneurship, encouraging the development of product prototypes that address real-world problems and have clear commercialization potential. By focusing on technological and social innovations, i-TIEC 2025 highlights the importance of turning creative ideas into viable, market-ready solutions that can benefit users and society. The extended abstracts in this e-proceedings book showcase the diverse perspectives and depth of research presented during the event, reflecting the strong entrepreneurial element at its core.

We extend our sincere gratitude to the contributors for their dedication in sharing their innovation and the organizing committee for their hard work in ensuring the success of the event and this publication. We also appreciate the support of our collaborators; Mass Rapid Transit Corporation Sdn. Bhd. (MRT Corp), Universitas Labuhanbatu, Indonesia (ULB), Universitas Riau Kepulauan, Indonesia (UNRIKA) and IEEE Young Professionals Malaysia, whose contributions have been instrumental in making this event and publication possible.

We hope that this e-proceedings book will serve as a valuable reference for researchers, educators, and practitioners, inspiring further studies and collaborations in both innovation and entrepreneurship. May the knowledge shared here continue to spark new ideas and market-ready solutions, advancing our collective expertise and fostering the growth of entrepreneurial ventures.

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B-ST016: WASTE TO WEALTH UV LED ACRYLATED CURABLE COATING: A WASTE PALM COOKING OIL INNOVATION

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ABSTRACT

This study introduces a UV-curable coating derived from acrylated waste palm cooking oil (AWPCO), transforming a common environmental pollutant into a high-value, sustainable material. Waste palm cooking oil (WPCO), if improperly disposed of, causes significant environmental damage. To address this, WPCO was modified using Cis-9-octadecenoic acid and enzymatic catalysis to enhance double bonds, enabling acrylation and UV crosslinking. The resulting AWPCO was blended with reactive monomers and cured using UV LED technology, a green and energy-efficient method that reduces power consumption and volatile organic compound (VOC) emissions. The optimized coating, particularly with Trimethylolpropane triacrylate (TMPTA) and a cationic photoinitiator, demonstrated exceptional properties, including high gel content (88.90%), improved hydrophobicity (contact angle 86°), and enhanced solvent resistance. The use of UV LED curing ensures faster processing, lower costs, and environmental friendliness, making this technology highly competitive. This innovation offers a “waste-to-wealth” solution with significant socio-environmental impact by reducing pollution and promoting sustainability. Its commercial potential is substantial, catering to industries seeking eco-friendly, high-performance coatings, and aligning with global green technology trends. AWPCO-based coatings provide a scalable, cost-effective alternative to conventional materials, driving a positive shift toward circular economic practices.

Keywords: UV LED, Curable Coating, Waste Palm Cooking Oil (WPCO), Acrylation, Green Technology

1. Product Description

This research focuses on developing UV LED-curable acrylic resin coatings from high oleic waste palm cooking oil (WPCO), a sustainable and renewable resource widely available in Malaysia. By incorporating cis-9-octadecenoic acid through enzymatic acidolysis, the functionality of WPCO is enhanced, introducing additional double bonds for acrylation polymerization. The resulting acrylated WPCO (AWPCO) blends with reactive monomers and photoinitiators, making it a green, reactive photopolymer that efficiently cures under UV LED light. The UV LED curing technology requires low energy, is less expensive, and emits

minimal volatile organic compounds (VOCs) compared to conventional curing methods, ensuring environmental safety. This study explores the effects of varying reactive monomers (di-, tri-, and tetra-functionality), photoinitiators (cationic and free radical), and curing times on AWPCO's surface morphology, mechanical, thermal, and chemical properties. Compared to petroleum-based coatings, AWPCO offers superior elasticity, reduced surface free energy, and sustainability, positioning it as an eco-friendly solution for industries like automotive, packaging, and wood coatings.

2. Pictures/ Schematic diagrams/ Flow Charts/Screenshots/Graphs/Table and etc .

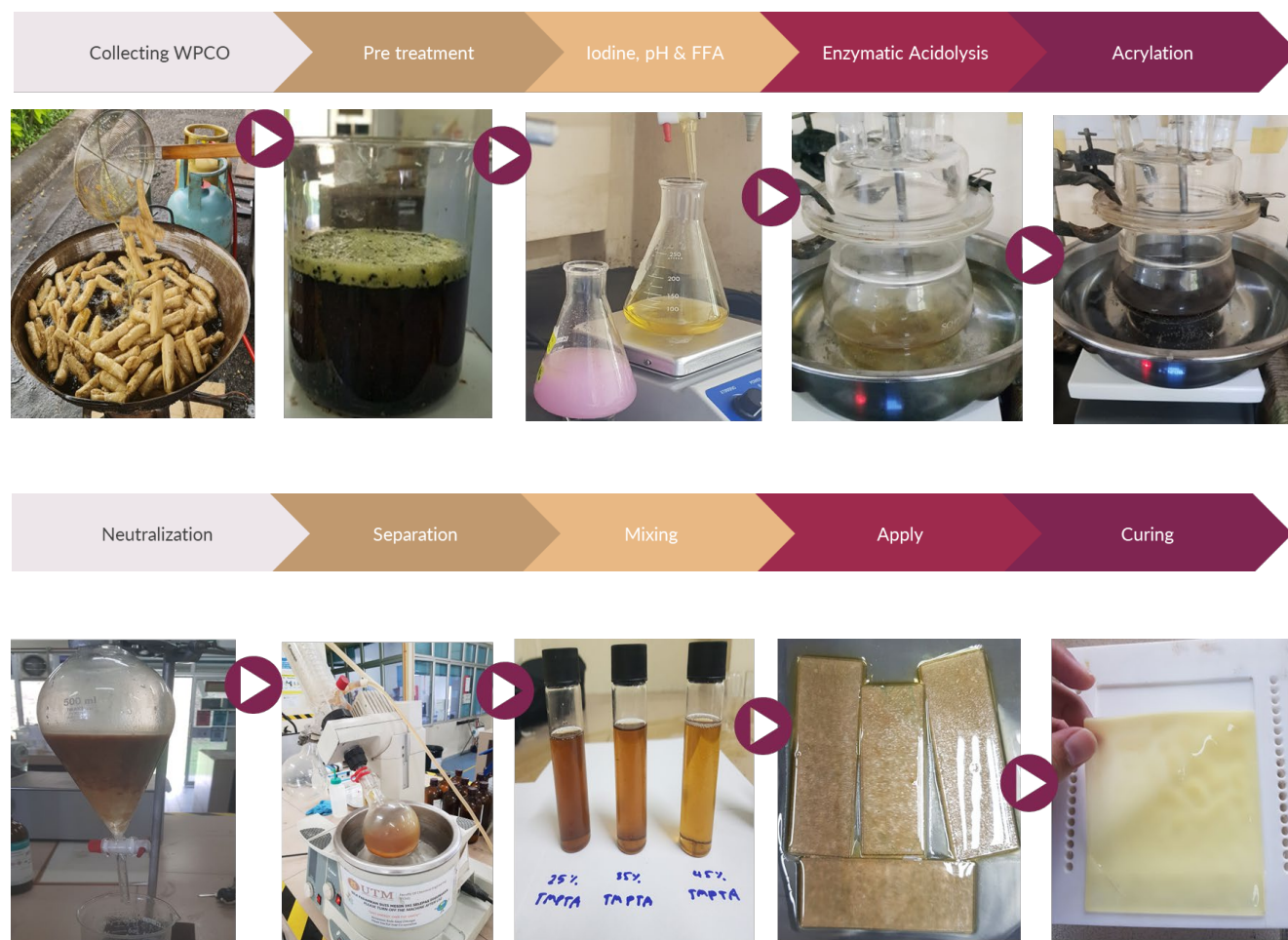


Figure 1. Schematic diagrams on producing UV LED cured AWPCO coating from WPCO

3. Novelty and uniqueness

This project transforms waste palm cooking oil (WPCO), a major environmental pollutant, into high-value UV LED-curable acrylic coatings. The novelty lies in combining enzymatic acidolysis with acrylation polymerization, enhancing the reactivity and functionality of triglyceride oils, which are typically underutilized in high-performance coatings. Unlike

conventional petroleum-based coatings, this research utilizes UV LED curing technology, which requires low energy, is cost-effective, and emits minimal VOCs, offering an environmentally friendly and energy-efficient alternative. Additionally, the investigation of varying reactive monomers (di-, tri-, tetra-functionality) and photoinitiators enables the optimization of coating properties, such as high hydrophobicity, enhanced adhesion, and superior solvent resistance. The uniqueness of this innovation lies in its dual benefits: addressing environmental issues caused by WPCO disposal and offering a renewable, sustainable alternative for high-performance coatings, aligning with the global push toward green and circular economies.

4. Benefit to mankind

This innovation provides a sustainable solution to the environmental challenges caused by improper disposal of waste palm cooking oil (WPCO). By converting WPCO into UV LED-curable coatings, this research reduces pollution while creating valuable products for industrial use. The UV LED curing technology requires low energy, is less expensive, and emits minimal VOCs, making it environmentally friendly and energy-efficient. Industries adopting this solution benefit from a cost-effective, high-performance alternative to petroleum-based coatings. Furthermore, this innovation promotes resource efficiency by upcycling waste into valuable coatings, encouraging sustainable manufacturing practices. Overall, this project addresses critical environmental concerns while providing economic opportunities, contributing to cleaner air, healthier ecosystems, and improved quality of life.

5. Innovation and Entrepreneurial Impact

This project promotes a culture of innovation and entrepreneurship by transforming waste into high-value products, aligning with global trends in green technology and circular economies. Unlike conventional acrylic coatings, which are primarily derived from fossil fuels, this research uses waste palm cooking oil (WPCO) as a sustainable and renewable feedstock, reducing dependency on non-renewable resources. By upcycling WPCO into UV LED-curable coatings, it addresses environmental challenges while creating new commercial opportunities in the coatings industry. The UV LED curing process, which requires low energy, reduces costs, and emits minimal VOCs, provides a competitive advantage in sustainable manufacturing. This project fosters entrepreneurial growth by offering a scalable, eco-friendly solution for industries like automotive, wood, and packaging, inspiring sustainable businesses. It encourages research and development within institutions, demonstrating how scientific innovations can create economic value and reduce environmental footprints, fostering a culture of entrepreneurship driven by sustainability.

6. Potential commercialization

This UV LED-curable coating technology has significant commercial potential in industries seeking sustainable alternatives to petroleum-based coating, such as automotive, packaging, construction, and furniture sectors. The use of waste palm cooking oil (WPCO) as a feedstock provides a low-cost and renewable resource, ensuring profitability and scalability for commercialization. The UV LED curing process requires low energy, is less expensive, and emits minimal VOCs, making it an attractive solution for manufacturers looking to reduce

production costs and comply with environmental regulations. With Malaysia's abundant WPCO supply, this innovation has the potential to disrupt the coatings market by offering an eco-friendly, high-performance alternative. By partnering with coating manufacturers, this technology can be scaled up for mass production, creating economic opportunities and driving the adoption of sustainable materials worldwide.

7. Acknowledgment

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8. Authors' Biography



Munirah Onn is a full time PhD student at Faculty of Chemical and Energy Engineering, Universiti Teknologi Malaysia (UTM). She is also work as Senior Lecturer at Universiti Teknologi MARA (UiTM), Kampus Pasir Gudang which receives a Science Degree from Universiti Teknologi MARA (UiTM) and Science Master's Degree from UTM. During the study she received a Best Degree Student, Best Thesis Writing and Vice Chancellor Award from UiTM and Best Student for Master Programme from UTM. She has industrial work experience as a Production Engineer, Research Officers and Executive Chemist for 4 years. Her current research interest is in renewable and advanced materials.



Prof. Dr. Mat Uzir Wahit is a distinguished scholar specializing in polymer and composite materials, particularly in the areas of natural fiber composites, polymer nanocomposites, and biodegradable materials. Prof. Wahit is currently a Professor in the Faculty of Chemical and Energy Engineering at UTM, where he also serves as Deputy Dean (Research, Innovation and Development). Prof. Wahit's research emphasizes sustainable materials and innovative composite technologies, including natural and silk fiber-reinforced epoxy composites, and cellulose nanocomposites. He is also affiliated with Advanced Composite Materials (CACM), where he contributes extensively to the centre. His extensive publication record includes over 100 peer-reviewed papers and conference proceedings, reflecting his contributions to advancing material science.



Aznilinda Zainuddin obtained both her bachelor's degree and master's degree in electrical engineering from Universiti Teknologi MARA (UiTM), Shah Alam, Malaysia. Her research activities are centered on engineering education, inventive problem-solving, and space weather. Currently, she is a senior lecturer at the Electrical Engineering Studies, UiTM Johor Branch, Pasir Gudang Campus and her current research focuses on the development of prediction models for geomagnetically induced current.



Mazleenda Mazni is currently pursuing a full-time Ph.D. at Universiti Teknologi Malaysia (UTM), focusing on deep learning models for structural health monitoring, particularly in surface crack classification and measurement. She holds a Master of Engineering in Mechatronics and Automatic Control from UTM. Prior to her academic career, she gained industry experience as an engineer in manufacturing companies. Currently, she serves as a Senior Lecturer at Universiti Teknologi MARA (UiTM), Pasir Gudang Campus. Her research expertise encompasses control applications in dynamic systems, network control systems, mechatronic and artificial intelligence.