INTERNATIONAL EXHIBITION & SYMPOSIUM ON PRODUCTIVITY, INNOVATION, KNOWLEDGE & EDUCATION

E-PROCEEDING

EXTENDED ABSTRACT

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EXTENDED ABSTRACT

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Welcome Message

RECTOR, UITM KEDAH BRANCH

Assalamualaikum warahmatullahi wabarakatuh,

First and foremost, I would like to extend my deepest appreciation to the organising committee of i-SPiKE 2025 for their steadfast dedication and commitment in making this prestigious event a reality. My heartfelt congratulations to the committee for their tireless efforts in ensuring that i-SPiKE continues to grow as a meaningful and impactful platform for academics, researchers, students, and industry players worldwide.

The theme for this year, "Empowering Minds: Bridging Innovation, Knowledge and Education for a Sustainable Future," is both timely and significant. It reflects our shared responsibility to not only embrace creativity and technological advancement, but also to ensure that innovation directly contributes to sustainable development, equitable education, and the well-being of future generations.

i-SPiKE 2025 provides a dynamic platform for showcasing innovations that address real-world challenges while opening new avenues for collaboration, engagement, and inclusivity. By bridging knowledge, innovation, and education, this symposium strengthens our collective capacity to design solutions that empower communities and inspire positive change.
I am truly impressed by the diversity and calibre of participants in this year's event. The projects and ideas presented highlight the extraordinary creativity and determination of our innovators. I am confident that the insights and solutions shared here will pave the way for continuous advancement in teaching, learning, and innovation.

It is my sincere hope that you will find i-SPiKE 2025 an enriching experience, one that sparks new ideas, builds lasting collaborations, and strengthens our shared vision for a sustainable future. To all participants, I wish you every success, and to the winners, my warmest congratulations.
Once again, I thank the organising committee, partners, and contributors for their invaluable support. May i-SPiKE 2025 continue to inspire and empower minds for many years to come.

Professor Dr. Roshima Haji Said
Acting Rector
Universiti Teknologi MARA (UiTM) Kedah Branch

Welcome Message
(i-SPiKE 2025 CHAIR)

It is my great pleasure to welcome you to the 4th International Exhibition & Symposium on Productivity, Innovation, Knowledge, and Education 2025 (i-SPiKE 2025). This year's theme, "Empowering Minds: Bridging Innovation, Knowledge, and Education for a Sustainable Future," reflects our collective commitment to advancing innovation and fostering meaningful collaboration across academia, industry, and communities.

i-SPiKE 2025 provides a platform for scholars, researchers, students, and practitioners from diverse fields to showcase their ideas, share knowledge, and inspire new solutions to global challenges. We extend our sincere appreciation to all participants and contributors whose efforts and dedication have made this symposium possible.
We hope that this e-proceedings serves not only as a record of the innovations presented but also as a valuable resource that continues to inspire long after the event.

Thank you.

Dr Junaida Ismail
Chair
4th International Exhibition & Symposium on Productivity, Innovation, Knowledge, and Education 2025 (i-SPiKE 2025)

PREFACE

The 4th International Exhibition & Symposium on Productivity, Innovation, Knowledge, and Education (i-SPiKE 2025) marks yet another milestone in our ongoing commitment to fostering innovation, creativity, and collaboration across disciplines. Guided by this year's theme, "Empowering Minds: Bridging Innovation, Knowledge and Education for a Sustainable Future," the event provides a dynamic platform for students, educators, researchers, and professionals to share their ideas, showcase their innovations, and engage in meaningful knowledge exchange.

This year, we are pleased to report that i-SPiKE 2025 received approximately 50 initial submissions, with more than 35 projects successfully advancing to final presentation and exhibition. These projects reflect a rich diversity of innovation, ranging from educational technologies, digital applications, and gamified learning tools to sustainable materials, cultural heritage preservation, and community-focused solutions. Collectively, they embody the spirit of bridging innovation and education to address pressing societal and global challenges.

We sincerely thank all participants, reviewers, and committee members for their invaluable contributions in making i-SPiKE 2025 a success. It is our hope that this e-proceedings will not only serve as a record of the ideas and innovations presented, but also as an inspiration for future collaborations and advancements in the pursuit of sustainable knowledge and innovation.

Assoc. Prof. Dr. Azlyn Ahmad Zawawi
Editor-in-Chief, i-SPiKE 2025 Proceedings

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CATEGORY 1

S&T (YOUNG)

ELECTROCOAGULATION CLEANUP WITH RECYCLED CANS

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ABSTRACT

Microplastic pollution has become a pressing environmental issue, raising concerns not only for aquatic life but also for human health. These tiny plastic fragments, often smaller than 5 mm can easily bypass conventional filtration systems and contaminate our water sources. In this study, we explore a simple yet innovative solution: using electrocoagulation (EC) with recycled aluminium cans to remove microplastics from water. By repurposing waste materials as electrodes, this method offers an affordable, eco-friendly alternative to traditional approaches, making sustainability part of the solution itself. Aluminium cans were chosen for their high conductivity, lightweight properties, and wide availability as everyday waste. The experiment focused on three key variables: voltage (5 V, 10 V, 15 V), supporting electrolyte concentration (0.01 M and 0.1 M), and PET microplastic levels (0.3, 0.7, 1.0 g/L). The EC process ran for 60 minutes, with microplastic removal measured using both FTIR spectroscopy and gravimetric analysis. Our results were promising. The best performance was seen at a PET concentration of 0.3 g/L, achieving removal rates of 76.33% (gravimetric) and 85.82% (FTIR). A voltage of 15 V yielded up to 76.53% and 72.73% removal, while a 0.1 M electrolyte concentration reached 71.73% and 50.90%, respectively. Beyond its effectiveness, this method stands out for its practicality especially in areas without access to advanced water treatment facilities. By turning everyday waste into a valuable resource, we not only clean our water but also take a step toward a more sustainable future.

Keywords: electrocoagulation, microplastics, aluminium cans, wastewater treatment, sustainability

INTRODUCTION, PROBLEM STATEMENT AND OBJECTIVES

Every year, billions of aluminium cans are thrown away despite being fully recyclable (Tan et al., 2024). In Malaysia, only 10% of aluminium waste is recycled, leading to overflowing landfills and wasted resources (Randhawa, 2024). At the same time, polyethylene terephthalate (PET) microplastics particles smaller than 5 mm can easily bypass standard water filtration systems and pollute aquatic environments (Vaverková, 2019). Traditional microplastic removal methods are often costly, inefficient, or environmentally unfriendly. Hence, the objective of this study is to investigate a dual-purpose solution: using recycled aluminium cans as electrodes in an electrocoagulation (EC) process to remove microplastics from water. It also aims to determine the optimal operating conditions in three parameters namely voltage, electrolyte concentration, and microplastic levels for maximum removal efficiency. This sustainable approach tackles two environmental issues at once: plastic pollution and solid waste.

METHODOLOGY

The electrocoagulation experiment used recycled aluminium cans, cut into 4 cm × 6 cm electrodes, which were cleaned with sandpaper, rinsed with distilled water, soaked in 1.0 M HCl, and dried at 100 °C for 12 hours. PET microplastics, sieved to 150 µm, were dispersed in distilled water at concentrations of 0.3, 0.7, and 1.0 g/L, with 20 mg of SDS surfactant added to improve dispersion. The experimental setup consisted of a beaker containing the microplastic solution and Na_2SO_4 as the supporting electrolyte (Luo et al., 2022). Aluminium electrodes were positioned 2 cm apart and connected to a DC power supply set at 5 V, 10 V, or 15 V. The solution was stirred continuously at 200 rpm under neutral pH (pH 7) for 60 minutes. Samples were collected every 10 minutes. Microplastic removal was analysed using gravimetric analysis (by filtering and drying samples to measure mass loss) and FTIR spectroscopy, focusing on the characteristic PET absorption peak around 1713 cm^{-1} to determine removal efficiency. Figure 1 illustrates the overall flow of this electrocoagulation process.

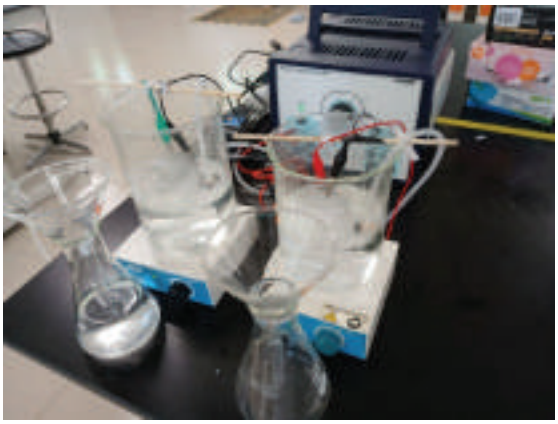


Figure 1. The actual electrocoagulation process experimental set-up

FINDINGS

Microplastic removal efficiency improved with increasing voltage, with 15 V yielding the highest removal rates: 76.53% (gravimetric) and 72.73% (FTIR). Higher voltage accelerated the dissolution of aluminium electrodes, enhancing the release of coagulant species such as Al^{3+}, which facilitated floc formation and microplastic capture. Electrolyte concentration also influenced performance where 0.1 M Na_2SO_4 improved conductivity, promoted aluminium oxidation, and boosted removal efficiency. PET concentration played a role as well: lower microplastic levels (0.3 g/L) resulted in the highest removal rates, reaching 76.33% (gravimetric) and 85.82% (FTIR), likely due to more available active sites on the electrode surface and less particle crowding.

The use of recycled aluminium cans proved effective, though some surface degradation was observed due to continuous oxidation at higher voltages. Despite visible wear and thinning, the cans-maintained conductivity and electrode function throughout the process, validating their potential for reuse in short-term or batch EC applications. FTIR analysis showed a reduction in the PET C=O peak at 1713 cm^{-1}, confirming physical removal without chemical breakdown. Kinetic data fit best with a second-order model, indicating concentration-dependent removal. Gravimetric analysis consistently outperformed FTIR in detecting changes, particularly at higher microplastic loads. Overall, this study demonstrated that recycled aluminium cans can serve effective, low-cost EC electrodes, and offer strong removal efficiency while contributing to waste reduction and sustainable water treatment practices (Lu et al., 2023).

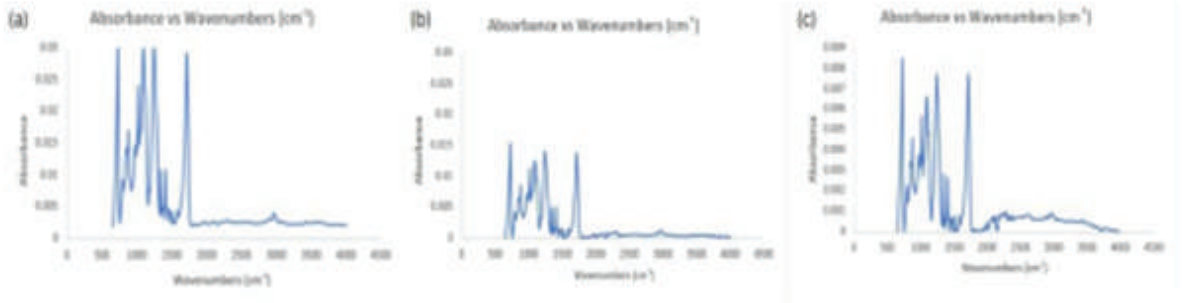
Table 1. Removal efficiency of PET microplastics at optimum conditions using the FTIR and gravitational methods.

Parameters	Optimal conditions	Gravitational method Removal efficiency (%)	FTIR method Removal efficiency (%)
Electrolytes concentrations (M)	0.1	71.73	50.90
Voltages (V)	15	76.53	72.73
Microplastics concentrations (g/L)	0.3	76.33	85.82

NOVELTY AND UNIQUENESS

This research is novel in its dual repurposing approach, transforming aluminium waste into functional EC electrodes while simultaneously addressing microplastic water contamination. Unlike previous studies that use expensive commercial electrodes, this method leverages discarded beverage cans, reducing both material cost and environmental impact. The use of both FTIR and gravimetric analysis enhances accuracy and robustness in microplastic quantification (Kandaiah et al., 2023). Furthermore, the project demonstrates a strong interdisciplinary linkage between environmental engineering, green chemistry, and circular economy models, marking it as a practical and replicable innovation for resource-limited settings.

Figure 2. FTIR of PET peaks (a) 0.1 M (b) 15V (c) 0.3 g/L



BENEFITS TO MANKIND

This project offers a low-cost and scalable method to remove microplastics from wastewater, crucial for human health, as microplastics are linked to endocrine disruption and bioaccumulation in the body. Using recycled materials as electrodes reduces solid waste disposal in landfills. Communities with limited access to advanced treatment facilities can adopt this method for decentralized water treatment. Industries can implement it to comply with wastewater discharge standards while reducing operational costs. It empowers communities to create sustainable solutions using readily available waste materials. Additionally, reducing microplastic pollution improves aquatic ecosystem health and food security. This innovation also educates society on circular economy practices for environmental conservation.

INNOVATION AND ENTREPRENEURIAL

The study opens up opportunities for green entrepreneurship, especially in waste management and clean water sectors. The design is simple, allowing the creation of modular EC units that can be scaled up or down based on need. Start-ups could integrate the technology into affordable home or village-scale water filters. Innovators can patent portable EC kits that use discarded cans, offering a unique value proposition. By encouraging public-private partnerships with recycling companies and water utilities, this innovation bridges academic research and industrial applicability. It supports Malaysia's push towards a circular economy and green technology leadership.

POTENTIAL COMMERCIALIZATION

The system's low production cost, modularity, and recyclability make it ideal for commercial development. Municipal wastewater plants, rural communities, environmental NGOs, and educational institutions represent viable target markets. The use of recycled cans as electrodes offers a clear sustainability narrative, appealing to ESG-conscious investors and customers. Technology can be adapted into portable units for disaster relief or field operations, and licensing opportunities can arise from scaling this into larger treatment systems. The feasibility of sourcing aluminium locally ensures scalability and alignment with global microplastic removal regulations

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