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Editorial Note

Rethinking Resources: The Critical Role of Recycling in the Mining Industry

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In an era of increasing environmental awareness, the mining industry—often criticized for its significant contributions to global greenhouse gas emissions and other ecological impacts—faces growing pressure to innovate and reform (Dunlap and Laratte, 2022). Nonetheless, despite these obstacles exists a promising option that might revolutionize the business and significantly diminish its environmental impact: the recycling and repurposing of essential resources, especially from electronic waste (Primc et al., 2024; Qing et al., 2022).

The escalating demand for critical resources such as lithium and cobalt, propelled by the expanding electric vehicle and renewable energy industries, perpetuates environmental and social issues associated with conventional extraction methods (Dunlap, 2023). The industry, responsible for a large portion of global waste, is scrutinized for its practices that endanger both the climate and local communities. Yet, the shift towards a greener mining approach is marred by accusations of greenwashing, with claims of sustainability often falling short of substantial environmental benefits (Zhang et al., 2023; Zharfpeykan, 2021).

The Royal Society of Chemistry promotes a shift towards the recovery of valuable metals from electronic trash to address these challenges (Serpe et al., 2025). This initiative represents a dual opportunity: mitigating the growing problem of e-waste— which saw nearly 57 million tonnes discarded in 2021 alone—and providing a source of critical materials without the extensive damage associated with traditional mining methods (Gulliani et al., 2023). Electronic devices like phones, laptops, and tablets contain valuable materials that, if recycled, could significantly lessen the need for fresh mining operations (Liu et al., 2023).

The process, however, is not without its challenges. The recovery of materials from e-waste is complex due to their dispersion in small volumes and intricate designs that complicate disassembly. The solution begins with rethinking product design towards easier disassembly and recycling, ensuring that end-of-life products can be efficiently broken down and their materials recovered (Murthy and Ramakrishna, 2022; Zhang et al., 2022). Furthermore, there is a persuasive argument for enterprises to adopt industrial symbiosis—repurposing waste from one sector as raw material for another. This strategy fosters a circular economy and corresponds with rising consumer and regulatory expectations for sustainable behaviors. This transition necessitates strong coordination

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among companies and may need the redefinition of intellectual property boundaries to enhance recycling and recovery processes.

The emphasis on using secondary materials—those recovered from products at the end of their life cycle—offers a path towards a more sustainable mining industry that reduces environmental impact and dependency on raw material extraction (Ramprasad et al., 2022; Kusrini et al., 2020). Mining, extraction, and production of criticial minerals that involving 41 elements such as rare earth elements (REEs), lithium (Li), nickel (Ni) and others are challenging, and need multi-steps processes (Kusrini et al., 2020). One of example process such as adsorption that reported showed environmentally friendly process, higher efficiency, and lower cost (Kusrini et al., 2018). This strategy is not merely about compliance with environmental standards but about reshaping the industry into a more sustainable and responsible entity.

The mining industry's contribution to the worldwide challenges of climate change is unequivocal. Transitioning towards a model that emphasizes recycling and responsible material recovery could prove critical. This approach not only addresses environmental concerns but also ensures a sustainable supply of the metals crucial for the green technologies that underpin our collective move towards a more sustainable future.

This issue

Documentation of the inquiry of human well-being in relation to technology, energy, and the environment is provided in this volume. A proof of concept that involved the maritime and industrial sectors was also the subject of research that was conducted.

The first paper is authored by Hadi, I, Yola, L, Hanifa, AS & Muzhaffar, MH. It explores a novel initiative for collaborative decarbonization strategies within the Indonesian maritime sector, aiming to develop comprehensive measures to mitigate carbon emissions from international shipping routes through Indonesian Archipelago Sea Lanes. The study applies both qualitative and quantitative research methodologies, collecting data through interviews and direct observations to assess the environmental impact of shipping activities. A significant finding is that approximately 3,110,023 tons of CO_2 are emitted annually by vessels passing through these sea lanes, highlighting the urgent need for effective decarbonization frameworks.

The second paper is authored by Madyshev, I, Kharkov, V, Vakhitov, M & Kuznetsov, M. It focuses on the thermal performance analysis of the dry unit of a hybrid closed cooling tower, proposing an innovative design that includes a fill unit composed of a finned pipe coil and inclined corrugated plates. Through both experimental and mathematical modeling approaches, the study demonstrates significant enhancements in heat transfer efficiency and overall thermal performance of the cooling unit. These results support the potential for substantial improvements in industrial cooling applications, emphasizing sustainability and efficiency.

The third paper is authored by Matar, M, Hassan, ME, Bukharin, N, Sakout, A, Hammoud, A & Assoum. It provides a comprehensive review of heat transfer enhancement techniques using passive, active, and hybrid impinging jets. Highlighting their efficacy in cooling electronic components and other applications requiring efficient heat management, the study explores experimental and numerical methods to improve the understanding and performance of these jet systems. Various configurations and innovations in jet impingement, such as the use of synthetic jets and pulsated jets, are evaluated for their potential to significantly enhance heat transfer efficiencies.

The fourth paper is authored by Paroka, D, Muhammad, AH & Rachman, S. It focuses on assessing the vulnerability of Indonesian Roll-On/Roll-Off (Ro-Ro) ferries to excessive acceleration failure modes through model experiments. The study demonstrates that Indonesian Ro-Ro ferries, characterized by large breadth-to-draught ratios and high metacentric heights, may face challenges meeting international stability criteria without modifications such as bilge keels. Through model experiments, the authors derive damping factors and apply these to evaluate the ferries' compliance

with international safety standards, providing crucial insights into the design and operation of these vessels.

The fifth paper is authored by Alwan, HM, Nikolavich, VA, Shbani, A & Vladmirovna, KO. It discusses the development of a new method for motion control and obstacle avoidance in mobile robots equipped with Mecanum wheels, focusing on both static and moving obstacles. The study introduces an innovative algorithm that utilizes ultrasonic sensors for detecting obstacles and adjusting the robot's path accordingly. The effectiveness of the approach is demonstrated through simulations in MATLAB, showing improved performance in navigating around obstacles compared to previous methods.

The sixth paper is authored by Effendi, MK, Soepangkat, BOP, Harnany, D & Norcahyo, R. It discusses the challenges and solutions in end-milling of glass-fiber-reinforced polymer composites (GFRP), focusing on optimizing cutting force, surface roughness, and delamination factor through a hybrid method combining genetic algorithms, simulated annealing, and backpropagation neural networks. This method aimed to optimize the end-milling parameters to improve the quality of machining GFRP composites, which are notoriously difficult to machine due to their abrasive nature and propensity for causing tool wear.

The seventh paper is authored by Kadir, AM, Setyawan, A, Purnamastuti, FN, Pramana, N, Muhammad, Satriya, IAA & Wirawan, R & Sampurno, B. It explores the design and analysis of floater structures for a 19-seater amphibious aircraft using composite materials to enhance performance while reducing weight. The study utilizes Vacuum-Assisted Resin Infusion for manufacturing carbon composite floaters, with finite element analysis predicting strength and weight outcomes effectively. Results indicate a significant weight reduction compared to traditional materials without compromising structural integrity, making it a viable option for aircraft design.

The eight paper is authored by Ginting, R, Silalahi, R & Marunduri, MA. It explores the integration of Quality Function Deployment (QFD) and Value Engineering (VE) for product development, specifically applied to redesigning a water dispenser. By analyzing customer needs and technical requirements through QFD, and then applying VE to enhance product value and reduce costs, the study successfully demonstrated a cost-effective improvement in water dispenser design. The integration of these methodologies led to material substitution in the water dispenser's hose and thermostat, resulting in significant cost savings and potentially increased customer satisfaction.

The ninth paper is authored by Setyaningrum, R, Auralita, V, Izzhati, D, Arsiwi, P & Thalitha, T. It discusses the application of dynamic system simulation to enhance the effectiveness and efficiency of supply chain performance at Waste Bank Resik Becik. By integrating SCOR 11.0 and dynamic system simulations, the study identifies critical aspects of the supply chain that could be improved to enhance overall operational efficiency. The simulation results offer insights into alternative scenarios for cost reduction and improved supply chain management, highlighting the potential for significant savings and more effective resource allocation.

The tenth paper is authored by Navea, RF, Talde, VM, Armintia, FL, Cruz, SMD, Medina, G & Decena, A. It explores the use of gamification and virtual reality (VR) for shoulder rehabilitation in mild-stroke patients. The study introduces "i-Suksok," a VR-based rehabilitation game developed on the Unity platform, designed to improve engagement and motivation through gamified tasks focused on shoulder mobility. Initial testing shows promising feedback from participants, suggesting that VR gamification could effectively enhance rehabilitation engagement and outcomes.

The next paper is authored by Dao, H-D, Nguyen, T-T, Vu, N-K, Hoang, V-T & Nguyen, H-Q. It introduces the Mixed Balanced Truncation (MBT) algorithm, aimed at enhancing the efficiency and effectiveness of large-scale electrical and electronic system simulations by reducing model complexity while preserving essential system characteristics such as stability and passivity. The MBT algorithm incorporates elements from both Balanced Truncation (BT) and Positive-Real

Balanced Truncation (PRBT) methods, addressing their individual limitations and offering a robust solution for practical applications in circuit simulations.

The twelfth paper is authored by Khan, A, Thirunavakkarasu, PM & Waqas, N. It examines the performance enhancements in a half-duplex wireless sensor network (WSN) through the integration of cooperative non-orthogonal multiple access (NOMA) with simultaneous wireless information and power transfer (SWIPT). This approach aims to improve spectrum efficiency and network lifetime while extending coverage for both far users and cognitive users through more efficient power and spectrum utilization. The study introduces a novel cooperative NOMA based SWIPT cognitive relay protocol and provides simulation results to demonstrate significant reductions in outage probabilities and improvements in data rates for far users, contributing to more balanced network performance across various user proximities.

The thirteenth paper is authored by Zahra, I, Neo, M & Hew, SH. It explores the innovative educational approach of the Collaborative and Interactive Game-Based Learning Environment (CIGLE) framework. This study aims to enhance learning through game-based collaboration, integrating artificial intelligence (AI) and other digital tools to foster engaging and effective problem-solving experiences in educational settings. The research findings indicate significant improvements in student engagement, collaboration, critical thinking, and problem-solving skills through the adoption of the CIGLE framework, thus providing a dynamic and interactive educational experience.

The fourteenth paper is authored by Nugrahaningtyas, KD, Kusrini, E, Salsabila, S, Fitriana, D, Usman, A, Kusumaningsih, T & Santoso, SJ. It delves into the synthesis, characterization, and antibacterial applications of transition metal-nanochitosan composites (TM-NCs) utilizing Ni, Cu, Zn, and Ag as transition metals. This research showcases how TM-NCs were synthesized using a precipitation method with sodium tripolyphosphate as a cross-linking agent, characterized by various spectroscopy and microscopy techniques, and tested for antibacterial efficacy. The study highlights that Ni-NCs demonstrated superior antibacterial activity against gram-positive bacteria compared to other TM-NCs.

The fifteenth paper is authored by Hendrarsakti, J, Yuwazama, Z, Kolala, PA, Prahmana, RA, Alfaridzi, Khotimah, KFN & Gili, MBD. It focuses on the effects of adding micro additives—specifically zinc oxide and graphite powder—to biodiesel in order to reduce pressure drops within microchannels. The study evaluates the performance improvements and flow characteristics within the fuel and injector channels of diesel engines, demonstrating that these additives can significantly decrease the pressure drop, enhancing overall engine efficiency.

The sixteenth paper is authored by Sambudi, NS, Mulia, MG, Khayrani, AC, Isnaeni, Raviadaran, R, Aziz, F & Permana, DD, Suwandi, R & Lischer, K. It focuses on the synthesis of carbon quantum dots (CQDs) using oil palm fronds as a carbon source for detecting polyethylene and polyethylene terephthalate microplastics. This study highlights the potential of CQDs, produced through the hydrothermal method, as a promising tool for environmental monitoring, particularly for detecting microplastic pollution due to their photoluminescence properties.

The seventeenth paper is authored by Anggerta, LA, Kurniawansyah, F, Tetrisyanda, R & Wibawa, G. It examines the catalytic synthesis of diethyl carbonate (DEC) from carbon dioxide using a combination of potassium iodide (KI) and sodium ethoxide (EtONa) catalysts with propylene oxide as the dehydration agent. This study employs a Box-Behnken Design for process optimization, which successfully enhances the DEC yield up to 24.07%. The synthesis was carried out in a stainless steel reactor under batch conditions, demonstrating that optimized process parameters are critical for achieving high DEC yield.

The eighteenth paper is authored by Tan, YH, Chai, MK, Wong, LS, Ong, MY and Rajamani, R. It examines the optimization of microwave-assisted extraction (MAE) for carbohydrates from Scenedesmus sp. cultivated in domestic wastewater using response surface methodology (RSM) coupled with a Box-Behnken design. The study identifies the optimal conditions for the MAE process, leading to a significant increase in carbohydrate extraction efficiency compared to

conventional methods. This optimized process highlights MAE's potential as a rapid, environmentally friendly, and effective method for extracting valuable compounds from microalgae, which could be scaled up for industrial applications.

The nineteenth paper is authored by Rahayu, DS, Husodo, ZA, Pidanic, J, Li, X & Suhartanto, H. It presents a novel bankruptcy prediction technique that leverages ultimate ownership networks of executives, directors, and shareholders as key indicators. The study employs network analysis and machine learning models, particularly Random Forest and XGBoost, achieving an accuracy of 86% in predicting financial distress. Key findings highlight that the degree of centrality of directors and the direct bankruptcy rates of executives and directors significantly influence bankruptcy likelihood, offering an alternative approach to traditional financial indicators for risk assessment.

The twentieth paper is authored by Pham, HV, Chu, T, Le, TM, Tran, HM, Tran, HTK, Yen, KN, & Dao, SVT. It presents a comprehensive evaluation of bankruptcy prediction in Taiwanese firms using multiple machine learning models, including Support Vector Machines (SVM), Random Forest (RF), and Artificial Neural Networks (ANN). The study integrates advanced techniques such as Synthetic Minority Oversampling Technique with Edited Nearest Neighbor (SMOTE-ENN), Binary Particle Swarm Optimization (BPSO) for feature selection, and hyperparameter tuning to enhance model accuracy. The proposed ANN model with SMOTE-ENN achieved the highest accuracy of 98.6%, demonstrating the effectiveness of hybrid predictive models for financial risk assessment.

The twenty-first paper is authored by Yunus, AL, Syahputra, AR, Fitriana, R, Deswita, Saputro, B, Yunus, MY, Yasmine, H, Tetriana, D, Sugoro, I & Darwis, D. It investigates the performance of reused N95 face masks sterilized via gamma irradiation to assess its impact on residual bioburden and the material's functional resistance. The study concludes that gamma irradiation is an effective sterilization method, which at a dose of 23.2 kGy, does not significantly alter the chemical and mechanical properties of the mask, allowing for safe reuse without compromising protection against COVID-19.

The next paper is authored by Lischer, K, Hayati, K, Fabian, MH, Laksmi, FA, Nugraha, Y, Rizqi, HD, Fauziyya, R, Sarmoko & Ali, MSM. It examines the interaction between CRISPR-associated protein 9 (Cas9) and different single-guide RNA (sgRNA) constructs through in-silico molecular docking, focusing on halothermophilic applications. The study aims to identify the optimal sgRNA structure that offers the best binding energy with Cas9, contributing to the precise and efficient genetic editing in halothermophilic bacteria which could enhance their industrial applications, particularly in producing biosurfactants.

The twenty-third paper is authored by Fadhillah, MR, Arozal, W, Habiburrahman, M, Arumugam, S, Wibowo, H, Primadhani, SW, Tedjo, A, Dwira, S & Khatimah, NG. It investigates the potential of bioactive compounds from Indonesian medicinal herbs as apelin receptor agonists for heart failure therapy through in-silico methods. Molecular docking and bioactivity predictions revealed Gambogic acid and Procyanidin B2 as promising candidates with stronger binding affinities than the standard agonist Azelaprag. Gambogic acid also exhibited favorable pharmacokinetic properties, suggesting its potential for further development in preclinical studies.

The twenty-fourth paper is authored by Hardianingtyas, L, Lestari, SL, Pratama, G & Kusmardi, K. It evaluates the impact of adding Vitamin C, Alpha Lipoic Acid (ALA), and Pentoxifylline to the cryopreservation medium on sperm parameters, cryosurvival rate, and malondialdehyde (MDA) concentration post-thaw. The study found that Pentoxifylline significantly improved sperm motility and cryosurvival rates, particularly in normozoospermic samples, while Alpha Lipoic Acid and Vitamin C effectively reduced MDA concentrations, indicating a decrease in oxidative stress. This research highlights the potential of these antioxidants to enhance sperm quality and viability post-cryopreservation, contributing to the success of Assisted Reproductive Technology (ART) treatments.

The twenty-fifth paper is authored by Zuwanna, I, Riza, M, Aprilia, S, Syamsuddin, Y, Said, SD & Dewi, R. It investigates the characteristics of biocomposite films made from whey protein isolate

(WPI), chitosan, and silica (SiO_2) as potential environmentally friendly packaging materials. The study found that incorporating SiO2 significantly improved the thermal and mechanical properties of the films, with tensile strength increasing to 28.83 MPa at 5% SiO_2 concentration. Additionally, the films demonstrated decreased swelling and transparency, highlighting their suitability as sustainable alternatives to synthetic polymers for packaging applications.

The integration of contemporary technologies and recent breakthroughs has created new opportunities for tackling complex difficulties across several domains. As scientific knowledge advances, it is quite likely that innovation will assume a more pivotal role in shaping our future. Ijtech cordially invites you to submit your articles and willingly accepts them, aiming to disseminate your research endeavors to our readership.

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Greetings from Jakarta,

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