E-PROCEEDINGS

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

"Fostering a Culture of Innovation and Entrepreneurial Excellence"

23 January 2025
PTDI, UiTM Cawangan Johor
Kampus Pasir Gudang

ORGANIZED BY:

Electrical Engineering Studies, College of Engineering
Universiti Teknologi MARA (UiTM) Cawangan Johor
Kampus Pasir Gudang
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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.

B-ST010 - B-ST152

B-ST015: GEOPOBA AS A SOIL STABILIZATION MATERIAL

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ABSTRACT

This research-enhanced soil liners are used in modern landfills to contain waste and the study explores the use of green technology geopolymers as an additive. Geopolymer was used in this research in considering the main material that could enhance laterite's properties in the performance of hydraulic conductivity in soil liner application. This study uses palm oil boiler ash mixed with sodium hydroxide and sodium silicate to make geopolymer paste. Boiler ash is another industrial waste product from the combustion of coal. A boiler ash-based geopolymer was mixed with laterite mixed with different percentages (5,10,15, and 20%) to improve soil liner application properties. The objective of this research is to determine the optimum percentage of geopolymer mixed with laterite as an additive for reducing hydraulic conductivity. An empirical model has been developed based on the results of this study, showing that increases in geopolymer content result in a decrease in hydraulic conductivity. As an alternative to lengthy laboratory tests that take a long time, the empirical model is designed to predict hydraulic conductivity, k, for landfill soil liners without requiring long-term laboratory testing.

Keywords: Geopolymer, Soil Liner, Landfill, Palm oil boiler ash

1. Product Description

A geopolymer additive in laterite has shown significant positive effects on soil strength and chemical modification of geopolymerization. As a result of adding geopolymer to laterite, the soil becomes less soluble and does not absorb or allow leachate infiltration. This meets the requirements for plasticity index and liquid limit in soil liners. Furthermore, geopolymer also caused soil particles to be reoriented and interparticle pores to be reduced due to the presence of geopolymer. In this study, a model was developed to be used to determine and predict hydraulic conductivity with different percentages of geopolymer in designing landfill soil liners without/with minimal field testing. Geopolymers as new technology develop in soil stabilization and hence result in the effective soil liner design

2. Method Flow Chart and Product Model

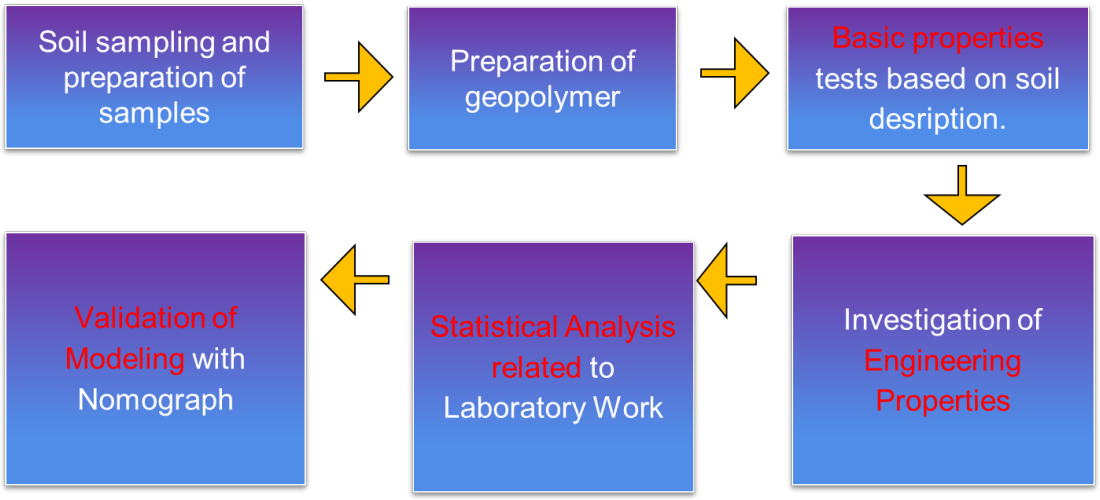

Figure 1. Model Flowchart of Research

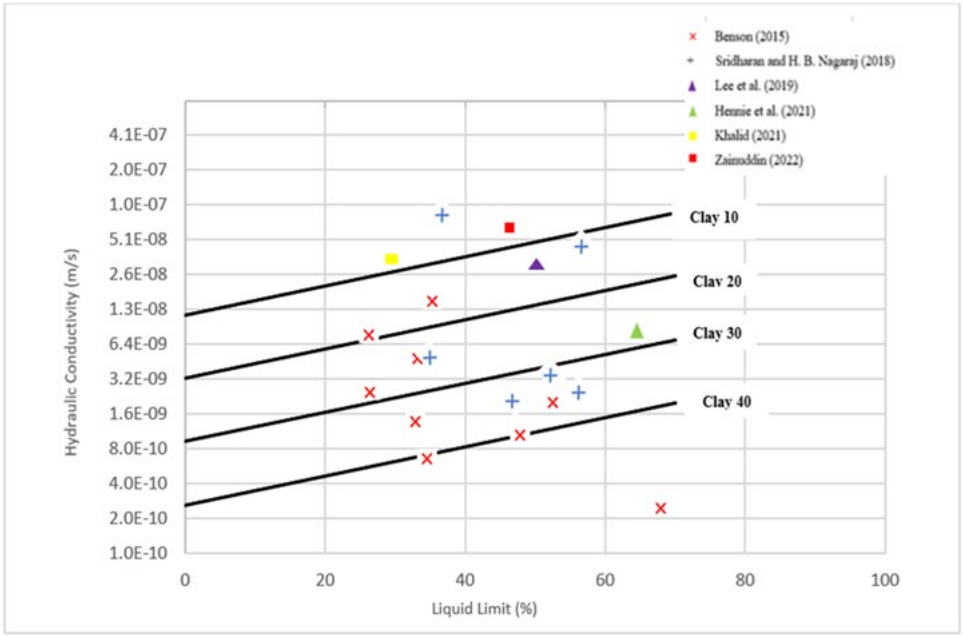

Figure 2. Nomograph of Hydraulic Conductivity, *k* value of Geopoba Mix.

3. Novelty and uniqueness

This study is unique in that it develops a model and nomograph to easily determine and predict hydraulic conductivity, with varying percentages of GeoPOBA, in landfill soil liner designs without/with minimal field testing. In the study, laterite's physical and chemical properties were influenced by GeoPOBA (geopolymer), a soil liner additive. Understanding the mechanism of geopolymerization will provide advanced knowledge of green technology

applications in soil. According to Duxson et al. (2007) and Yunsheng et al. (2010), geopolymers are effective soil stabilizers due to their low shrinkage potential and excellent adhesion to aggregates. In order to develop eco-friendly geotechnical products that use less energy, this study could stimulate research on boiler ash as a geopolymer. Engineering practice will be enhanced by developing empirical formulas and nomographs for predicting hydraulic conductivity based on the relationship between laterite soil content and GeoPOBA percentage. With the empirical formula and developed nomograph, it is possible to predict the K-value quickly. The model can be quickly calculated, reducing both time and cost in comparison with a laboratory test. In the end, GeoPOBA modeling should help engineers accelerate landfill design.

4. Benefit to mankind

By varying GeoPOBA percentages, the compaction parameter and permeability of the sample can be determined, which allows for a deeper understanding of the product's properties. According to statistics validated by physical and engineering properties, initial laboratory tests of the Laterite-GeoPOBA mix provided a good prediction of hydraulic conductivity, k for soil liner application. Empirical formulas and nomographs for predicting hydraulic conductivity, k, based on available variables (LL, Clay, and GeoPOBA content) These guidelines were developed to aid engineers in designing landfill soil liners without conducting laboratory testing, which can be time-consuming and expensive.

5. Innovation and Entrepreneurial Impact

Geopolymers have the potential to inspire innovative technologies, business models, and innovative practices in construction and infrastructure through soil stabilization. In the years to come, geopolymers will continue to evolve, reshaping soil stabilization processes and opening up new opportunities for entrepreneurs and innovators. This study shows the alteration and ratio of geopolymer material which is boiler ash and alkaline solution gives the impact and different effects to soil stabilization. The geopolymer mixed binder with soil can improve performance by enhancing bonding properties, and long-term stability. Low-Cost Raw Materials such as palm oil boiler ash where innovations that focus on sourcing and utilizing waste materials, which reduce the cost of producing soli stabilization material. The application of geopolymer soil stabilization on a large scale, especially in developing countries, can be made more affordable and scalable through this process.

6. Potential commercialization

Geopolymers have the potential to inspire innovative technologies, business models, and innovative practices in construction and infrastructure through soil stabilization. In the years to come, geopolymers will continue to evolve, reshaping soil stabilization processes and opening up new opportunities for entrepreneurs and innovators. This study shows the alteration and ratio of geopolymer material which is boiler ash and alkaline solution gives the impact and different effects to soil stabilization. The geopolymer mixed binder with soil can improve performance by enhancing bonding properties, and long-term stability. Low-Cost Raw Materials such as palm oil boiler ash where innovations that focus on sourcing and

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7. Acknowledgment

The project member acknowledges financial and supported by UiTM Shah Alam, Faculty of Civil Engineering and Faculty of Chemical Engineering, UiTM Johor Kampus Pasir Gudang for providing the facilities to accomplish the experimental work for this research.

8. Authors' Biography

Mazidah Mukri (Prof Madya. Ir. Ts. Dr) is an associate professor under the Faculty of Civil Engineering, UiTM Shah Alam Selangor. She is holding a PhD in Civil Engineering from UKM Bangi. Her research interest includes soil stabilization and Geotextile / Prefabricated Vertical Drains (PVD). Over the past 5 years, she has been actively working on nano-based research, particularly, for environmental remediation.

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Diana Che Lat (Ir Ts. Dr.) is currently senior lecturer under Faculty of Civil Engineering, UiTM Johor Kampus Pasir Gudang. She obtained her B.Eng Hons in Civil Engineering from Universiti Kebangsaan Malaysia and MSc in Universiti Teknologi Mara and Doctoral in Civil Engineering at Universiti Teknologi Malaysia. Her research interests: Polyurethane and soil stabilization.