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2ND INTERNATIONAL SCIENCE,
ENGINEERING AND TECHNOLOGY
COLLOQUIUM



THE POWER OF SCIENTIFIC INNOVATION

INTELLIGENT SOLUTIONS FOR A
SUSTAINABLE WORLD

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PREFACE

Welcome to the 2nd International Science, Engineering and Technology Colloquium 2025 (ISETC 2025)!

It is with great pleasure that we present this year's colloquium, a distinguished gathering of scholars, researchers, and professionals dedicated to the advancement of applied sciences. Held virtually on 9th July 2025, ISETC 2025 serves as a platform to highlight cutting-edge research, foster meaningful networking, encourage collaborations, and explore innovative solutions to global challenges.

This year's theme, "The Power of Scientific Innovation: Intelligent Solutions for a Sustainable World" highlights our shared goal to solve global challenges through applied science. It celebrates innovation as a key to building a more sustainable and resilient future. We're proud to feature keynote speakers and presenters who bring fresh insights, bold ideas, and breakthroughs shaping tomorrow's world.

We would like to extend our heartfelt appreciation to the Faculty of Applied Sciences, Universiti Teknologi MARA, Perak Branch, Tapah Campus, for their outstanding support and assistance throughout the planning and execution of the event. Their dedication has been instrumental to the success of this colloquium. We would like to sincerely thank all participants and researchers for their valuable contributions. We also appreciate the reviewers for their careful evaluations and helpful feedback. Your hard work and support mean a lot to us.

As editors, we are proud to present this collection of proceedings. It is an honour to bring together the interesting and meaningful work of our speakers and authors. We hope the ideas shared will lead to new discoveries, encourage more research, and help solve global challenges through science and innovation.

Warm regards,

Dr. Emi Norzehan Mohamad Mahbob

Dr. Saiyidah Nafisah Hashim

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ISETC 2025 Proceedings Editors

IMPACT ON VARYING CONSTRUCTION WASTE CONTENT ON THE PHYSICAL PROPERTIES OF WASTE GLASS-BASED FIRED CLAY BRICKS

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Abstract: The wastage from the construction activity is the major contributor to the global solid waste production. Improper disposal, especially for concrete waste possesses a significant environment challenge such as land scarcity and environmental degradation. This study explores the potential in the utilization of industrial waste, specifically glass waste from the beverage industry and concrete waste from the construction sector. The integration of this waste into fired clay bricks to reduce environmental impact and enhance material sustainability. A total of five different brick compositions were prepared, varying the concrete waste content from 0 wt.% to 20 wt.% while maintaining a constant clay-glass ratio. The bricks were fired at 1000 °C and their physical properties were analysed, including bulk density, linear shrinkage, water absorption, porosity and loss on ignition. Results showed that moderate additions of concrete waste improved porosity and maintained acceptable density and shrinkage values. Excessive amounts, however, led to reduced structural consistency. This study concludes that integrating construction waste into fired bricks is a feasible step toward eco-friendly material production. Future recommendations include long term mechanical testing and exploring other types of waste to optimize performance.

Keywords: *Fired clay bricks, concrete waste, physical properties, green building materials*

INTRODUCTION

Clay bricks remain a foundational element in the global construction landscape due to their mechanical strength, affordability, and thermal insulation properties. However, the conventional production of fired clay bricks depends on the extraction of fertile clay soil, a non-renewable resource essential for agriculture and ecological balance (Doğan-Sağlamtimur et al., 2021). Additionally, the energy-intensive firing process, typically carried out at high temperatures and fueled by fossil sources, results in significant carbon emissions. In response to these environmental concerns, researchers and industry stakeholders are increasingly exploring alternative raw materials such as glass and concrete waste that could replace a portion of natural clay without compromising the quality of the bricks (Aneke & Shabangu, 2021; Erdogmus et al., 2021).

While the potential for recycled materials in brick production is promising, their integration into standard manufacturing practices remains limited due to inconsistent research findings and a lack of industrial-like standard prototypes. Laboratory scale facilities have contributed to the inability to expand the potential in utilization industrial wastage. Often concrete waste has been under-utilized as a clay substitute despite its mineral composition, which may enhance certain physical properties of bricks. Past studies have often overlooked a systematic assessment of physical properties which have only tested the limited binary matrix of level of substitution. As a result, there remains a gap in understanding the optimal percentage of concrete waste that can be incorporated into waste glass-based fired clay bricks while maintaining structural integrity and performance under the same thermal treatment.

To address this gap, the present study aims to evaluate the effects of incorporating varying amounts of concrete waste (0–20 wt.%) into clay bricks, with a particular focus on thermal treatment at 1000 °C held for 6 hours. The research emphasizes key physical properties such as bulk density, linear shrinkage, water absorption, porosity, and loss on ignition, which are vital indicators of brick quality. By analysing how these parameters respond to both the waste content and firing temperature, the study seeks to identify sustainable formulations that reduce environmental impact while meeting construction standards. This research not only contributes to waste valorisation but also supports the transition toward green building materials in the construction sector.

LITERATURE REVIEW

As the world is experiencing rapid pace of urbanization, this has led to the accumulation of abundant demolition waste, including materials such as concrete debris, bricks, glass, and metals (Nizar et al., 2018). These waste products are often discarded in landfills, posing environmental hazards and occupying valuable land space. Research has been conducted by (Xin et al., 2023) to promote sustainable practices via reuse of these materials in the construction sector, particularly in brick production. Recycled materials like concrete waste offer the potential to reduce dependency on raw resources while addressing the issue of construction waste management. Their mineral composition, which includes hydrated cement and aggregates, can contribute to the structural strength of alternative construction materials when processed properly.

Among the various types of industrial waste, concrete waste is particularly promising for reuse due to its high silica (SiO_2) content and pozzolanic properties when ground finely (Cardoza & Colorado, 2023). Studies have shown that glass waste can serve as an effective partial replacement for clay in brick manufacturing. For example, research by (Rodsini, 2021) demonstrated that crushed glass improves the compressive strength and reduces the water absorption of clay bricks. Glass acts as a fluxing agent during the firing process, lowering the required sintering temperature and promoting vitrification, which enhances the final brick's durability. These findings support the concept of using waste glass not only to improve brick properties but also to reduce the environmental footprint of brick production.

MATERIALS AND METHODS

The procedure related to this study was divided into two parts. The first part is the preparation of the precursors, and the second part is the preparation of the prototype of fired clay bricks. For the first part, the precursors such as waste glass and concrete waste, are collected from the local construction site and neighboring restaurant around Universiti Teknologi MARA, Perak Branch Tapah Campus. The waste glass (WG) then cleaned and rinsed 3 times with tap water mainly to remove the dirt. Then, it was dried in an electrical oven at 110°C for 24 hours before crushed and ground into fine powder. The powder was proceeded with sieving step with the industrial sieve of size $\sim 45\ \mu\text{m}$. Next, concrete waste (CW) was crushed and ground into $\sim 45\ \mu\text{m}$ fine powder via the same sieving technique. The clay soil (CS) was bought from Perbadanan Kemajuan Kraftangan Malaysia, Perak Branch in Enggor, Kuala Kangsar. The CS was prefiltered from coarse sand and dirt. Then, it was ground into $\sim 45\ \mu\text{m}$ by means of the industrial sieve.

The next section is for the preparation of the fired clay bricks where the precursors were mixed into 40 grams mixture according to the chemical composition of $[0.5\text{CS}:0.5\text{WG}]1-x: [\text{CW}]x$, where x varies at 0 wt.%, 5 wt. %, 10 wt.%, 15 wt.%, and 20 wt.%. Then, the 40 grams of the fine mixtures were mixed with distilled water (30 wt.%) by means of soft mud technique in brickmaking process. The wet mixture was then mould in a hollow cylindrical of 5 cm in diameter. It was then pre-dried in an electrical oven at 110°C before proceeded with sintering process at 1000°C held for 6 hours. The sintered sample became the fired clay brick which is then proceeded with physical characterizations of bulk density, linear shrinkage, water absorption, porosity and loss of ignition (Rabiatul et al., 2021).

RESULTS

Figure 1(a) has explicitly depicted the graph of different CW concentration affecting the findings on bulk density and linear shrinkage of the waste glass-based fired clay bricks. Meanwhile, Figure 1(b) depicted the other physical characteristics such as water absorption and porosity against the CW concentration. The trend lines in dashed condition is showing the effects of CW composition relative to the physical characteristics.

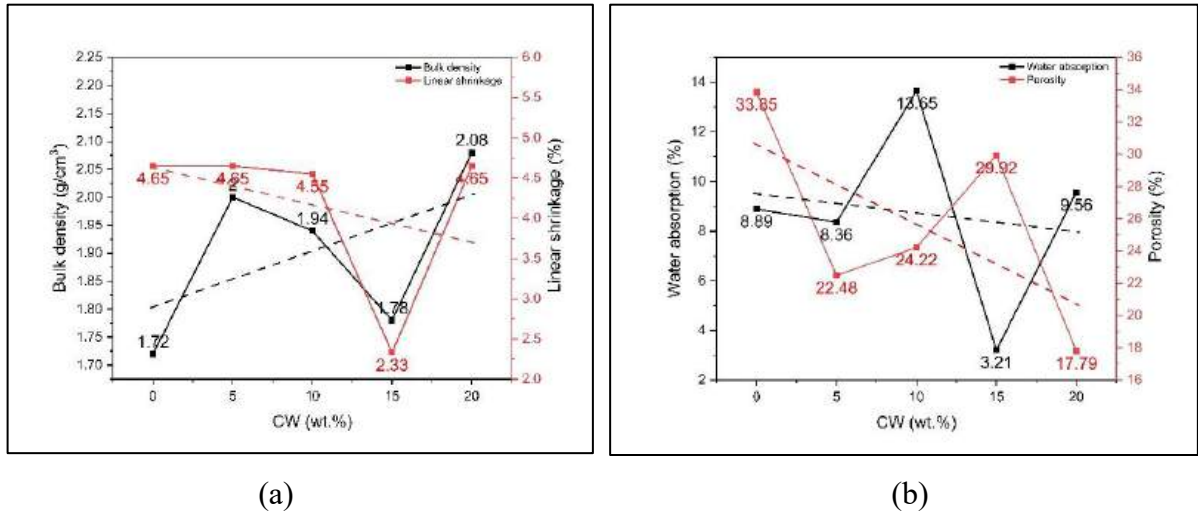


Figure 1. Physical characteristics of waste glass-based fired clay brick with different CW composition. (a) The bulk density and linear shrinkage against CW concentrations, and (b) the water absorption and porosity versus CW concentrations.

DISCUSSION/ANALYSIS

Figure 1 illustrates the influence of varying CW (concrete waste) content on the physical properties of fired clay bricks. As shown in Figure 1(a), the bulk density increased with increasing CW content, reaching a maximum of 2.08 g/cm³ at 20 wt.% CW. This suggests improved packing and possible vitrification due to interactions between the glass phase and the other metallic oxides of CW (Rodsini, 2021). Meanwhile, linear shrinkage remained relatively stable (4.65%) across most compositions, with a significant drop at 15 wt.% CW (2.33%), possibly due to the formation of a rigid framework that limits sintering-induced contraction.

In Figure 1(b), water absorption exhibited a non-linear trend, peaking at 13.65% (10 wt.% CW) and declining sharply to 3.21% at 15 wt.%. This anomaly may reflect localized densification or pore sealing during sintering. However, a moderate increase to 9.56% at 20 wt.% was still within Class 1 brick limits ($\leq 10\%$) (Phonphrak et al., 2016). On the other hand, porosity showed a consistent decrease with increasing CW, dropping from 33.85% (0 wt.%) to 17.79% (20 wt.%), suggesting enhanced densification and reduced open pore network (Chen et al., 2021).

Overall, the results indicate that 20 wt.% CW yields bricks with favorable physical characteristics, including high density, low porosity, and acceptable water absorption, supporting their classification as Class 1 structural bricks suitable for load-bearing and weather-resistant applications.

CONCLUSIONS

The ternary waste glass-based fired clay bricks have been successfully fabricated with the variation of concrete waste substitution. The fired clay bricks were mainly evaluated based on physical characteristics. The decrement of linear shrinkage, water absorption and porosity have been impacted by the increment of CW composition. Meanwhile, the bulk density has opposite reaction with the increment of CW. The 20 wt.% of CW composition was suggested as the best composition as it achieved highest bulk density, considerably low water absorption and linear shrinkage, and the lowest water absorption. This performance suggests that 20 wt.% CW is classified under 1st class fired clay bricks according to Malaysian Standard MS 76:1972. Besides, this class of fired clay bricks has potential to be applied as

external walls materials specifically as load-bearing masonry. In the future, the extension of mechanical properties evaluation should be applied to reaffirm the performance of these bricks in order to explore for a broader application.

REFERENCES

- Aneke, F. I., & Shabangu, C. (2021). Green-efficient masonry bricks produced from scrap plastic waste and foundry sand. *Case Studies in Construction Materials*, 14. <https://doi.org/10.1016/j.cscm.2021.e00515>
- Cardoza, A., & Colorado, H. A. (2023). Alkali-activated cement manufactured by the alkaline activation of demolition and construction waste using brick and concrete wastes. *Open Ceramics*, 16. <https://doi.org/10.1016/j.oceram.2023.100438>
- Chen, X., Chen, S., & Li, G. Q. (2021). Experimental investigation on the blast resistance of framed PVB-laminated glass. *International Journal of Impact Engineering*, 149. <https://doi.org/10.1016/J.IJIMPENG.2020.103788>
- Doğan-Sağlamtimur, N., Bilgil, A., Szechyńska-Hebda, M., Parzych, S., & Hebda, M. (2021). Eco-friendly fired brick produced from industrial ash and natural clay: A study of waste reuse. *Materials*, 14(4). <https://doi.org/10.3390/ma14040877>
- Erdogmus, E., Harja, M., Gencel, O., Sutcu, M., & Yaras, A. (2021). New construction materials synthesized from water treatment sludge and fired clay brick wastes. *Journal of Building Engineering*, 42. <https://doi.org/10.1016/j.jobbe.2021.102471>
- Nizar, M., Munir, E., Munawar, E., & Irvan. (2018). Implementation of zero waste concept in waste management of Banda Aceh City. *Journal of Physics: Conference Series*, 1116(5). <https://doi.org/10.1088/1742-6596/1116/5/052045>
- Phonphuak, N., Kanyakam, S., & Chindaprasirt, P. (2016). Utilization of waste glass to enhance physical-mechanical properties of fired clay brick. *Journal of Cleaner Production*, 112. <https://doi.org/10.1016/j.jclepro.2015.10.084>
- Rabiatul, A. A., Zakri, F. A. A., Sokri, N. K. N. M., Norizam, N. A. F., Karya, A. Q., Zaid, M. H. M., Mohamad, M., & Mazlan, M. (2021). Physical and mechanical properties of fired clay bricks substituted with agricultural waste. *AIP Conference Proceedings*, 2332(February). <https://doi.org/10.1063/5.0042901>
- Rodsin, K. (2021). Confinement effects of glass FRP on circular concrete columns made with crushed fired clay bricks as coarse aggregates. *Case Studies in Construction Materials*, 15. <https://doi.org/10.1016/j.cscm.2021.e00609>
- Xin, Y., Robert, D., Mohajerani, A., Tran, P., & Pramanik, B. K. (2023). Transformation of waste-contaminated glass dust in sustainable fired clay bricks. *Case Studies in Construction Materials*, 18. <https://doi.org/10.1016/j.cscm.2022.e01717>



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Tarikh : 20 Januari 2023



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Sekian, terima kasih.

"BERKHIDMAT UNTUK NEGARA"

Saya yang menjalankan amanah,

Setuju.

27.1.2023

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