UNIVERSITI TEKNOLOGI MARA

DEVELOPMENT OF SUSTAINABLE BRICKS UTILISING SOLID WASTE FLY ASH AND PAINT SLUDGE

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of the requirements for the degree of
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AUTHOR'S DECLARATION

I declare that the work in this thesis was carried out in accordance with the regulations of Universiti Teknologi MARA. It is original and is the results of my own work, unless otherwise indicated or acknowledged as referenced work. This thesis has not been submitted to any other academic institution or non-academic institution for any degree or qualification.

I, hereby, acknowledge that I have been supplied with the Academic Rules and Regulations for Post Graduate, Universiti Teknologi MARA, regulating the conduct of my study and research.

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ABSTRACT

Uncontrolled infrastructure development may produce excessive carbon emission and scarcity of natural resources that are exploited for development. The reuse of waste materials in general promote material ecology and the cradle to cradle concept. The utilisation of waste from industry in the development of advanced materials has been the researcher's aspiration to create eco-accommodating building components. The main objective of this research was to investigate the potential of utilising local industrial waste, for the development unfired bricks, evaluate, the mechanical, properties, durability and environmental performance to develop the material profile for sustainable unfired bricks. Solid Waste Fly Ash (SWFA) and Paint Sludge (PS) as target material replacing laterite soil that is non-renewable natural resources. During the preliminary stage of the research, compacted cylinder of 4 systems as target materials consists of Laterite clay (LC) and SWFA on its own as control, combination of LC with SWFA (LS) at 50:50 ratio, and to enhance sustainability, the combination of LC with SWFA and PS (LSP) at 50:25:25 ratio were investigated. Compacted cylinders of these target materials stabilised with Hydrated Lime (HL) and Ordinary Portland Cement (OPC) on its own and incorporating Ground Granulated Blast Furnace Slag (GGBS), (HL: GGBS and OPC:GGBS) both at 50:50 ratio at 10%, 20%, 30% and 40% stabiliser dosage. The cylinders are made under controlled laboratory conditions and cured for 7, 28, and 60 days prior to unconfined compressive strength (UCS) and water absorption tests. Results indicated that 30% stabiliser dosages achieved better strength and economical in optimal usage of OPC. With this preliminary results, pilot industrial and commercial trials are then carried out using full size unfired bricks of 225mm x 102mm x 65mm. These trials demonstrated that all key parameters of compressive strength, tensile strength, durability, water absorption, thermal and acoustic properties were within the acceptable engineering standards of masonry units for unfired clay bricks with the system of LSP with blended stabiliser HL-GGBS recorded the best engineering performances. The test results obtained from this investigation suggest that there is potential in the use of SWFA and Paint Sludge as substitute to clay for unfired bricks especially for the mix of LSP bricks stabilised with Lime:GGBS stabiliser. This will certainly contribute to the effort of recycling of SWFA and Industrial Sludge (Paint Sludge and possibly others) and hence to minimise the impact of these by-product landfills on the environment. The manufacture of unfired bricks/blocks able to exploit locally available waste materials is a viable alternative instead of fired bricks, especially in certain applications of low-load bearing situation. It also suggests innovation and enhanced waste management and contribution towards the concept of green building has been made in this research study. Simultaneously this helps in the reduction of unrenewable clay usage to produce bricks. Furthermore, the energy usage and hazardous emissions of the firing process from bricks making will be minimised if not eliminated.

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