MODIFICATION OF MIX DESIGN TO UTILIZE FLY ASH AND GLIRICIDIA ASH IN CONCRETE PAVING BLOCK

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Degree of Master of Science

Department of Materials Science and Engineering

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Thesis submitted in partial fulfillment of the requirements for the degree Master of Science

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Declaration

"I declare that this is my own work and this thesis does not incorporate without acknowledgment any material previously submitted for a degree or diploma in any other university or institute of higher learning and to the best of my knowledge and belief it does not contain any material previously published or written by another person where the acknowledgment is made in the text.

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Abstract

Last few decades demand for renewable energy has increased. Among those resources, biomass is widely used to produce energy as it renewable and low-cost material. Therefore, it has led to the accumulation of industrial byproducts such as wood ash. Wood ash is the byproduct produced from the biomass power plant as used for the generation of electricity. The production of cement leads to emitting a large number of greenhouse gases caused environmental disasters all around the world. Also, cement is the expensive cost factor in manufacturing cement-based products. Concrete paving block (CPB) is a successful alternative for asphalt or concrete pavement. It is different from other paving methods from manufacturing, structural design, installation and replacing techniques, etc. It can be easily placed and removed when it is damaged. The present study was conducted to produce low-cost and performance-effective (complying with the standard requirements) paving blocks by using industrial by-products produced from the Tokyo Cement biomass power plant. Laboratory trials were carried out at the Tokyo cement construction research center laboratory which has been accredited as per ISO 17025. The 15MPa mix designs were used as per SLS 1425 standard. 5%, 10%, 15%, 20% of wood (Gliricidia) ash was replaced from cement content for mix design. workability, dimensions, verification of visual aspects, compressive strength, flexural strength, total water absorption were determined. Workability was reduced when increasing the percentage of wood ash. Dimensions were measured of all of the paving blocks. The length, width, and height of the B05 block have deviated from standard specifications. Visual aspects have shown that when increasing the wood ash percentage texture of those blocks was roughened. Smoothness has gradually decreased when increasing the wood ash percentage. Flexural strength and compressive strength have also been reduced when increasing the wood ash percentage. Total water absorption value has increased when increasing the wood ash percentage. Due to the increase of porosity of the paving block. Therefore, from all the results observed it can be concluded that 20% replacement of wood ash (B05) results were exceeded the standard requirements in SLS 1425. Also, we observed the scanning electron microscope (SEM) images of cross-sections of all 05 block types. It shows a gradual increment in porosity by increasing the wood ash percentage. Materials cost per cubic meter of every block type were calculated. The lowest materials cost is shown by the B05 type. 15% wood ash replacement (B04) results were complying with the standard requirements and show 2nd lowest materials cost from all block types.

Keywords:

Concrete Paving block, Wood ash, Fly ash, Concrete Flexural strength, Concrete Compressive strength, Total water absorption.

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Amunugama H.M.T.M. (179427C)

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List of abbreviations

CPB	Concrete paving block
SLS	Sri Lankan Standard
MPa	Mega Pascal
XRD	X-ray diffraction
SEM	Scanning electron microscope
XRF	X-ray fluorescence
EDAX	Energy dispersive analysis of X-ray
OPC	Ordinary Portland cement
ISO	International organization for standardization
BS	British standard
BSEN	British & European standard
SD	Standard deviation
CW	Cube weight
IL	Indicated load
CL	Corrected load
SSDW	Saturated surface dry weight
ODW	Oven dry weight