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The effects of using agricultural waste as partial substitute for sand in cement blocks

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ABSTRACT

The disposal of agricultural waste is a serious environmental problem. Use of agricultural wastes in the production of cement block may reduce the global environmental pollution. This study analyzes the feasibility of using agricultural waste like rice husk, sawdust, peanut shell, rice straw and coconut shell as a partial sand replacement in the manufacture of cement blocks. The experiments have been conducted to determine the physical, strength and durability properties of cement block. Test results show that cement blocks with agricultural waste were satisfied the strength requirement according to the ASTM standard but durability is the major issue for these blocks. Cement block with coconut shell and peanut shell shows reasonable strength and durability properties.

1. Introduction

Environmental pollution increases with increasing population due to waste generation and unlimited consumption of raw materials. Open dumping of agricultural wastes is becoming a major issue. Because open damping destroying the aesthetic appearance of nature and harmful to public health. To reduce the negative effect on the environment, agricultural waste materials have to be converted into useful materials [1].

Unlimited consumption of earth resources is another reason for environmental pollution. In developing countries like Sri Lanka, due to the recent growth in the construction industry, the demand for fine aggregates is escalating rapidly. River sand is mainly used for all kinds of civil engineering constructions. The annual sand demand for the construction industry in 1992 is 9.4 million metre cubes [2]. Studies by Katupotha [3] and Dias et al. [4] have attempted to estimate sand demand and however, it has been found to be incomplete, as these have covered only a part of the country or a section of the construction industry. Based on cement usage and engineering computations (i.e. cement consumption and the ratio of cement to sand for various construction purposes), sand demand for 2007 was estimated to be 17.37 million metre cubes. River sand has been the most widely used fine aggregate in Sri Lanka, and over-exploitation of river sand to meet the demand has led to various harmful consequences. This kind of large river sand consumption very badly impacts on the environment as follows;

- The depth of the river bed is increased.
- The water table is lowered.
- Aquatic lives are disappeared from freshwater.

Artisanal sand mining was the norm until the introduction of the current Mines and Minerals Act No. 33 [2] established by the Geological Survey and Mines Bureau (GSMB) of Sri Lanka, which regulates the exploration for and mining of minerals, including sand. The Geological Survey and Mines Bureau (GSMB) of Sri Lanka currently keeps records of all the licenses issued for sand mining and transportation. According to these records, the approximate annual sand supply is 7.99 million metre cubes, which is far below the estimated demand [5].

Considering the environmental issue due to waste materials and scarcity of sand, many research works have been carried out to investigate the possibilities of using the waste materials in the production of masonry block. Recycling waste materials by incorporating them into building materials is a practical solution for pollution problems. These waste materials can be divided into three categories: construction and demolition waste, industrial waste and agricultural waste. Sabai et al. [6] reported that, it is possible to produce the concrete blocks with a compressive strength of at least with 7 MPa by replacing fine aggregates with construction and demolition waste in the content of 89%. However, concrete blocks produced with 100% construction and demolition waste were weaker than control blocks. Raut et al. [7] stated that enhance performance in terms of achieved lighter density, lower thermal conductivity and higher compressive strength of the various waste-

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