

Exploratory study on the use of crushed cockle shell as partial sand replacement in concrete

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ABSTRACT: The increasing demand for natural river sand supply for the use in construction industry along with the issue of environmental problem posed by the dumping of cockle shell, a by-product from cockle business have initiated research towards producing a more environmental friendly concrete. This research explores the potential use of cockle shell as partial sand replacement in concrete production. Cockle shell used in this experimental work were crushed to smaller size almost similar to sand before mixed in concrete. A total of six concrete mixtures were prepared with varying the percentages of cockle shell viz. 0%, 5%, 10%, 15%, 20% and 25%. All the specimens were subjected to continuous water curing. The compressive strength test was conducted at 28 days in accordance to BS EN 12390. Finding shows that integration of suitable content of crushed cockle shell of 10% as partial sand replacement able to enhance the compressive strength of concrete. Adopting crushed cockle shell as partial sand replacement in concrete would reduce natural river sand consumption as well as reducing the amount of cockle shell disposed as waste.

Keywords –Cockle shell, Concrete, Compressive strength, Environmental problem, Partial cement replacement

I. INTRODUCTION

The growing need of construction trade along with the issue of environmental problem created from the disposal of by-product generated from cockle shell business have initiated research towards producing a new green cement brick. The consumption of natural fine aggregate specifically river sand for concrete production to meet the escalating demand construction industry has caused environmental pollution. Continuous and increasing quantity of sand mined would pollute the river water and create ecological imbalance at river bed environment that would finally affect the quality life of future generation. The sand mining imposes negative impact to the environment in terms of reduced water quality, destabilization of stream bed and bank which in turn cause the destruction of riverine vegetation [1] leading to ecological imbalance. Unless action taken to reduce the high dependency of the industry on natural sand supply, more fauna and flora would face extinction in future. One of the solutions to this problem is to find locally available waste material and integrate it as partial sand replacement in concrete production. This idea has motivated some researchers [2, 3, 4, 5, 6] to investigate the possibility of introducing waste material to function as partial sand substitute in concrete production.

In the meantime, the continuously growing Malaysian cockle trade has opened the door for the increase in cockle shell disposed as waste. The availability of cockles a marine bivalve molluscs which is an important protein source in the South East Asian region is one of the factor that boost the cockle trade in Malaysia [7]. In Malaysia, cockle aquaculture areas extend about 10,383.09 hectares contributing a production of 78,024.7 tonnes in year 2010 [8]. This fact has been highlighted by [9] that the active cockle trade has lead towards the generation of abundant waste shell. The shells that been dumped and left untreated may cause unpleasant smell and disturbing view to the surrounding [10]. Looking at the increasing cockles' production which the retail value of cockles alone increased by 33.53% by RM91.60 million in 2010 from 68.60 million the previous year [8], it is expected the availability of cockle shell as waste would be in larger amount as well which in turn will pose negative impact to the nearby area. Realizing this problem, efforts has been taken to convert this waste material into profit contributing element which would also save the environment.

So far, there are few researchers [10, 11, 12, 13] who have attempted to use cockle shell in producing materials which is more environmental friendly. More discoveries on the potential use of cockle shell in any material production would ensure lesser amount of this waste ending at landfill. Therefore, placing the issue of environment preservation for the future generation being the utmost importance has led towards the effort of innovating a new product through integration of this freely available wastage of fisheries industries in concrete production. This preliminary research investigates the effect of using crushed cockle shell as partial sand replacement towards compressive strength of concrete. Success in integrating cockle shell as one of the mixing