

Eggshell Powder: Potential Filler in Concrete

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Abstract—An investigation of eggshell powder as potential additive to concrete. In this investigation, five different percentages of eggshell powder with respect to cement were added into the concrete mix of Grade 25. The materials used were mainly Portland cement, crushed sandstone, river sand, plasticizing accelerator and eggshell powder. From the investigation, all the slump results of eggshell concrete were at medium degree of workability ranging from 65-75 mm. Eggshell concrete of 10% achieved the highest compressive strength at 42.82 N/mm² which is 57% higher than the control specimen. There is an increasing trend of flexural strength from 2.36 to 3.50 N/mm² with the increase of eggshell powder from 0 to 20%. Besides that, the eggshell concrete has shown significant reduction in water absorption and water penetration.

Keywords—eggshell; concrete; compressive strength; water absorption; additive.

I. INTRODUCTION

Malaysian is one of the largest eggs eater in the world consumed 20 millions egg daily [1]. Most of the eggshell waste is commonly disposed in the landfills without pretreatment because it was traditionally useless [2]. Although eggshell is known as natural solid waste which is non hazardous, it may attract rats and worms due to the organic protein matrix that may pose health problem to the public [3]. Waste disposal and landfilling has been one of the major issue in Malaysia. The number of landfilling in Malaysia has increased from 49 in 1988 to 161 in 2002, and the number is still increasing alarmingly [4]. The scarcity of land has increase the cost of landfill tremendously causing waste disposal to be expensive. High disposal of waste may pose treat environmentally as such as contamination to the surface water, soil and ground water. On top of that, it may affect the health of exposed populations and ecosystems. Not much research has been conducted for eggshell. Eggshell powder which is rich in CaCO₃. Amu et al. (2005) used eggshell powder as stabilizer of lime in clay expansive soil [5]. Besides that, eggshell is also used as stabilizing material to increase the liquid limit and plasticity index of lateritic soil [6]. Since there is not much research has been conducted on eggshell powder, further investigation can be conducted to identify the use of eggshell powder as construction material.

II. EXPERIMENTAL

A. Materials

The material used in this investigation are Portland Composite cement, granite, river sand, eggshell powder, water and plasticizing accelerator. Portland Composite cement manufactured by YTL, which can produce high early strength, complied by NS EN 197-1:2000 CEM II/B-M is used as the binder. Eggshell powder which have high calcium content up to 95% is used as filler in the concrete mix. The eggshells were obtained from Eggtch Manufacturing Sdn Bhd located at Puncak Alam, Selangor. The eggshells dried under the sun and grinded into powder. The eggshell powder then was sieve using 2.36 mm sieve. Particles passing through 2.36 mm sieve will be used as filler in concrete.

B. Slump Test

Slump test was conducted to determine the workability of concrete. The slump test was conducted according to BS 1881: Part 102 [7].

C. Compressive Strength Test

Concrete cubes (100 mm x 100 mm x 100 mm) were used for compressive strength test. All concrete cubes were cured in the water tank. The compressive strength test were conducted according to BS 1881: Part 116 [8]. The cubes were tested using Shimadzu Universal Testing Machine of capacity 1,000 KN at a loading rate of 0.25N/mm²/sec. A total of nine cubes were case for each mix design. The compressive strength test was carried out at concrete age of 3, 7 and 28 days.

D. Flexural Strength Test

Beam (100 mm x 100 mm x 500 mm) were used for flexural strength test. The flexural strength of beam were tested using T-Machine Universal Testing Machine according to BS 1881: Part 118 [9]. A constant loading rate of 0.03 N/ mm²/sec was maintained for this test.

E. WaterPenetration Test

Water Penetration test is to define the rate movement of water through the porous material under capillary action. It