THE USE OF [illegible] REPLACEMENT

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ABSTRACT

Nowadays, construction industries have been commonly used concrete. However, the demand quantity of concrete increased due to the rapid infrastructure development. It is necessary to explore alternative way for overcome this demand such as using the waste material in concrete mixture. Eggshell is one of the waste materials. Therefore, one research the use of eggshell as a partial replacement in concrete mixture was conducted. The purpose of this research to develop concrete using the waste material as well as controlling the environmental pollution by replacing eggshell with the sand in the concrete mixture. The replacement of eggshell used in the concrete making are 5%, 10% and 15% by substitute the sand in order to determine the optimum percentage and characteristic of concrete beam compressive strength. The data collected show the cover strength development. The results showed that the 5% of eggshell replacement was excellent where the compressive strength of sample was higher than control concrete. Then, the others percentage of eggshell replacement were lower of compressive strength than the control concrete.

ABSTRAK

Pada masa kini, penggunaan konkrit dalam industri pembinaan semakin meluas. Walau bagaimanapun, permintaan konkrit semakin tinggi dan mahal disebabkan oleh arus pembangunan infrastruktur yang semakin maju dan pesat. Ia adalah perlu untuk mencari satu cara alternatif bagi mengatasi permintaan konkrit yang semakin meningkat ini seperti menggunakan bahan sisa buangan sebagai bahan campuran di dalam konkrit. Kulit telur adalah salah satu bahan daripada bahan-bahan buangan. Oleh itu, satu kajian yang menggunakan kulit telur sebagai pengganti bahan campuran di dalam konkrit telah dijalankan. Tujuan kajian ini adalah untuk membuat satu konkrit yang menggunakan bahan buangan dan juga mengawal pencemaran alam sekitar dengan menggantikan kulit telur dengan pasir dalam campuran konkrit. Penggantian kulit telur yang digunakan dalam pembuatan konkrit ini adalah sebanyak 5%, 10% dan 15% bagi menentukan peratusan optimum dan kekuatan mampatan rasuk konkrit tersebut. Data telah dikumpul bagi menilai tahap kekuatan setiap peratusan penggantian kulit telur tersebut. Hasil kajian menunjukkan bahawa 5% penggantian kulit telur adalah sangat baik di mana kekuatan mampatan sampel adalah lebih tinggi daripada konkrit kawalan. Kemudian, peratusan penggantian kulit telur lain adalah lebih rendah daripada kekuatan mampatan konkrit kawalan.

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LIST OF ABBREVIATIONS

BS	British Standard
g	Gram
kg	Kilogram
kN	Kilonewton
m	Meter
m^3	Cubic Meter
mm	Millimeter
mm^2	Millimeter Square
MPa	Megapascal
N	Newton
WBA	Wasted Bottom Ash

LIST OF SYMBOLS

G	Grade
%	Percentage

CHAPTER 1

INTRODUCTION

1.1 INTRODUCTION

Concrete is known as a composite material contain of water, fine and also coarse aggregate. In today's world, construction industries have been commonly used concrete as one of the main material which it's used in construction for bridges, buildings, dams and highways. Normally concrete structures can withstand some of the natural disaster such as hurricanes and also earthquakes. Because of the rapid infrastructure development, there will be increasing demand quantity of concrete that will be used in construction.

Currently, the construction industries have been searching the alternatives product that can help to minimize the cost of construction. There are a few products that have been identified which can help to minimizing the usage of cement which cement is one of the main ingredients in making concrete such as fly ash, silica fumes and also eggshell. Among of the products that have been identified, egg shells are known to have good characteristic in minimizing the usage of cement which results in reducing the amount of waste. Other than that, eggshells when mixed with concrete, it will produce high strength durability concrete. The used of eggshells in construction industry will results in reducing the cost of raw materials which directly reduce the cost of construction.

1.2 PROBLEM STATEMENT

There is a major problem occurs involving the using of sand, cement and aggregate for making concrete in construction industry. As the year passing, the demands of the concrete, aggregate and sand have been increasing day by day. The problem that occur is the materials used in concrete which is cement or sand is highly used in construction site which increasing the cost of construction. Besides that, it's also affecting the environmental problem in waste disposal in construction industry.

To prevent this problem to continuously occur, this study will be carried out to determine the use of a waste material which is eggshells as a replacement to sand in the making of concrete for construction industry used to minimize the construction cost and also reducing the environmental problem.

1.3 OBJECTIVES OF STUDY

The aim of this study is to investigate the compressive strength of chicken eggshell concrete in order to maximize its strength reducing the disposal problem. The specific objectives of this study are:

i. To identify the use of chicken eggshell as partial replacement in concrete.

ii. To determine the flexural behaviour of chicken eggshell concrete beam by using beam flexural test.

1.4 SCOPE OF WORK

Based on the objective, this study will focused on how to overcome the problem that have occurred in construction industry regarding the performance of eggshells as in sand replacement in concrete mixed. The experiments that will be conducted to investigate are slump test, curing, compressive strength and flexural test. Thus, the amount of eggshell waste can be used as sand replacement in concrete beam production. Besides that, this test will be conducted at 1 day, 7 day and 28 days to get the strength and the results will be recorded. Other than that, to determine the hardened of the concrete beam, slump test was chosen as the workability test while the flexural test is to test maximum load beam that able to sustain.

1.5 SIGNIFICANCE STUDY

This researched will be carried out to determine how far the performance of eggshells in the making of concrete for construction industry. Other than that, the effect of eggshell use on concrete beam strength properties by using compressive strength test and the flexural behaviour of eggshell concrete beam by using beam flexural test based on the study also can be identified.

CHAPTER 2

LITERATURE REVIEW

2.1 INTRODUCTION

Literature review is several studies which related to this research project. The purpose of this chapter is to study and analyse the previous study that has been done earlier through journals, articles, research papers and also thesis. The detail about concrete, eggshell and concrete material will be discussèd in this literature. Besides that, study of industrial waste also will be discussed too.

2.2 INDUSTRIAL WASTE

Todays, environmental pollution has become serious that caused by industrialization due to the rapidly economy growth. For developing countries, industrialization was must and still in this activity very much demands to uplift the nation's economy nowadays. The demand of raw material increased for the purpose of industrial production. Since the material for production is considered as non-renewable sources and will be deplete on the coming years; therefore, disposal of industrial wastes were used to replace the raw material for various beneficial use.

However, the disposal of different wastes which produced from different industries is a great problem because many of them are non-biodegradable (Tara, and Mishra, 2010). Besides that, industrial waste not only contains solid water; it also includes the hazardous waste. Fortunately, the types of industrial waste which generated in developing countries are not usually large quantities of hazardous waste for disposal.

Industries in Malaysia contributed 30% of solid wastes and the wastes generation increased at about 4% annually. It was estimated that the industrial solid wastes generation has increased from 7, 721.58 ton/day in 1994 to 11, 519.24 ton/day in 2005; this amount is depending on the economic status of an area and it is not include the hazardous waste which produced from industries (Nasir et al., 1998). Malaysian solid wastes contain very high organic waste and consequently high moisture content and bulk density of above 200kg/m^3 (Malaysia Country Report, 2001)

With a rapid increased amount of industrial wastes generated, there are opportunities to increase waste recovery as resource and also help to reduce the industrial dependency on the non-renewable resources such as raw material. The practice for waste recovery was supported by Malaysian government through policy and legislation (Fariz, 2008).

Some of industrial wastes are disposed as construction material, if these materials can be suitably utilized in the construction area, the disposal problem and environmental pollution may be able to reduce slowly. Thus, the disposal waste should be handling with properly to reduce the environmental pollution problem and also provide a significant impact for the economic growth.

2.3 APPLICATION OF INDUSTRIAL WASTE

Nowadays, the waste which generated from different industries poses a significant of environmental pollution in the nearby locality, disposal of these huge amount of waste are required to solve the environmental problem. Then, the raw material consumption deserved attention to preserve limited natural resources for future

generation. Therefore, use recycled material will help to reduce the usage of raw material and the associated environmental impact of extraction processes (Chusid et al., 2009).

By reuse the industrial waste for the construction purpose, it will help clear valuable land of huge dumps of wastes and also help to preserve the natural reserves of aggregates, thus protecting the environment (Tara and Mishra, 2010). In recent years, some of the researches had been done by using a few type of industrial waste and applied on the construction.

2.4 WASTE PRODUCT REUSABLE ON CONSTRUCTION INDUSTRY

The construction industry plays a significant role in Malaysia's development both in terms of infrastructure and economic development. The disposals of general waste become a major environmental problem in Malaysia. Therefore, the possibility of reusable the waste products in construction materials is increasing importance.

2.5 EGGSHELL

Egg is a very familiar in Asian country such as Malaysia, Singapore, Thailand and Philippines. Egg contains lots of nutritious, however, the main contain of egg is protein. Meanwhile, protein that contained in egg is rich than the protein in other foods. High consumption of egg shell also follows increasing the eggshell waste development rate.

The eggshell is an important structure for two reasons which it forms an embryonic chamber for the developing chick and providing protection of the contents and a unique package for a valuable food. Most good quality eggshells from commercial layers contain approximately 2.2 grams of calcium in the form of calcium carbonate. About 95% of the dry eggshell is calcium carbonate weighing 5.5 grams

(Gary & Richard., 2003). Many factors are known to be related to eggshell quality including: adequacy of nutrition, flock health problems, management practices, environmental condition and breeding (Gary & Richard., 2003). Based on Kabkaew et al. (2007) eggshell thickness is 1.09±0.07 mm in length and 0.25±0.05 mm in width. However, eggshell thickness does not necessarily mean that it is strong. This is because sometimes a thinner eggshell is stronger than a thicker eggshell. The main reason is due to the shape and organization of the organic and inorganic components of the shells.

2.6 EGGSHELL ON ROAD CONSTRUCTION

Eggshells are seldom used to stabilizing materials in most part of world. However, it could be a stabilizing of the construction industry. Olarewaju et al. (2010) revealed that eggshells mixed with lateritic soil can produced the low binding properties and significant to improve strength of the soil which can use as sub grade where have a good performance. The capacities of the stabilization have not met with the requirement of the base or sub base for road construction.

Stabilizing material was then added to each of the soil sample in certain percentages of 2%, 4%, 6% and 8% of the soil by weight of eggshell after which the Atterberg's limit test was carried out as well as the determination of engineering properties of each of the samples (Olarewaju et al., 2011). Addition of the eggshell in percentages to the soil sample caused to change in plastic limit and liquid limit, which can purposely, affected the plasticity of the soil. Liquid limit for eggshell is increase from 30.20% to 37.10% and the plastic limit also increases from 13.48% to 24.14%. Thus the plasticity index of the eggshell in lateritic soil reduced from 17.29% to 12.96%.

It is concluded that eggshell powders can increase the strength of the soil and it can be suitable stabilizing materials. From the investigation, resulted eggshell powders significantly increase the optimum moisture content and maximum dry density of the soil. As 8% eggshell stabilization lateritic soil processes close optimum moisture

content and maximum dry density properties. Eggshell can be also used in road construction and not only in building structure construction.

2.7 CONCRETE

Concrete is known as a composite material contain of water, fine and also coarse aggregate. Concrete production is consisting of several methods to produce a high strength concrete that is batching, mixing, consolidating, finishing and curing. Each steps of the process makes a unique contribution to the quality of the final concrete product (Kejin & Jiong, 2005). Insufficient attention to any steps may result in poor concrete. Concrete also needs more attention in production process.

Due to the waste management problems, concrete have to evolve in the respect of environment within a sustainable development perspective. Then, the production of cement are producing large amount of carbon dioxide which is dangerous to the environment. Therefore, waste components like oil palm and sludge are mixed into concrete in order to reduce the waste material and decrease the environment pollution.

2.8 CEMENT

Cement is a fine powder that have a properties of self-hardening when reacted with water and to form a rigid chemical structure. There are many different properties and applications of cements for used in concrete including Portland, blended, and hydraulic cements. Portland cement is currently defined as a mixture of clay-like and calcaneus material mixed with gypsum.

According to Portland Cement Association (2009), the basic ingredient of concrete is a closely controlled chemical combination of calcium, silicon, aluminium, iron and small amounts of other ingredients to which gypsum is added in the final grinding process to regulate the setting time of the concrete lime and silica make up

about 85% of the mass. Common among the materials used in its manufacture are limestone, shells and chalk or marl combined with shale, clay, slate or blast furnace slag, silica sand and iron ore. Therefore, the properties of concrete are influenced by the properties of cement.

Cement should place in dry condition and should be used within three month of the date manufacture and it is recommended that never use the cement has lump in it, otherwise will affect the strength of production (Vibraform Manual V2 LE V2 LD).

2.9 AGGREGATES

Concrete is a cement and water paste in which aggregate particles are embedded. Aggregate are granular material such as sand, gravel, crushed stone and blast-furnace slag. Aggregates make up 60-75% of concrete so have a large influence of the properties of the concrete (ACI E1-07). Natural sand and gravel is the produced by the action wind and water, while crushed stone coarse and fine aggregate are produced by crushing natural stone. The shape and texture of aggregate affects the properties of fresh concrete more than hardened concrete. According to Hudson (2003), shape and texture of the aggregates are more important than grading and asserts that the focus on grading is mainly due to the historic use of natural sands. Thus, for the aggregate with certain shape and texture will significantly influence the performance of concrete.

2.10 COARSE AGGREGATES

Coarse aggregate usually contain of small particle of that are bounded differences to the aggregates surface (Steven et al., 2005). The different types of coarse aggregate will influence the strength of concrete while sizes of the coarse aggregate also playing an important role to improve strength of concrete (Chen et al., 2005). According to (Erol et al., 2005), research about influence of coarse aggregate shape of the strength of asphalt concrete mixture, known that shape coarse aggregate is significantly to

concrete mixtures. Therefore the effects of aggregate shape and texture on the strength of hardened concrete should not be over-generalized. Other than that, aggregate properties significantly affect the workability of concrete and also the durability, strength, thermal properties and density of hardened concrete. More angular and less spherical coarse aggregates required higher mixing water and fine aggregate content to provide a given workability.

2.11 FINE AGGREGATES

Fine aggregate is an essential component of concrete. Fine aggregate consists of natural resources and manufactured from stone gravel. The most commonly used fine aggregate is natural river sand. Sand defined as a natural loose, granular material made of separate mineral or rock particles from 0.0625 to 2.00 mm in size. Larger particles are granules, pebbles, cobbles, or boulders (more than 256 mm) and smaller grains are silt (0.0625-0.00 mm) or clay (below 0.004 mm). Particle size is measured by passing samples through series of screens with various sizes of openings (Nelson, 2006).

If the quality of sand is not available due to any reason, the blending of sand should be done by adding more coarse sand to achieve the required finest modulus. The quality of fine aggregates or sand can be check by some techniques, one of the technique is put some quantity of sand in a glass of water. Then it is vigorously shaken and allowed to settle. If the clay is present in sand, its distinct layer is formed at the top of sand.

Sand is one of the materials that easy availability and common used in various construction areas such as component of concrete, structural base and landfill. Sand can be in many types, for example river sand, pit sand, manufactured sand and sea sand.

2.12 WATER

Water is the principle considerations on the quality of mixing water are those related to the effect on workability, strength and durability (Cement Concrete & Aggregate Australia). Water for mixing concrete should be free from acid, alkali, oil and organic purities. According to Wood (1992), less water in mixing definitely cause concrete more strength and durability but ensure it is workable. Yet, too much water resulting in weak and porous concrete. Almost any natural water that is drinkable and has no pronounced taste or odour can be used as part for making concrete. Wash water is commonly used as mixing water in ready mixed concrete. Excessive impurities in mixing water not only may affect setting time and concrete strength, but also may cause efflorescence, staining, corrosion of reinforcement, volume instability and reduced durability. However, oversea countries like United States are used waste water such as industries waste water and sewage water in mixing concrete (CCAA, 2004). Waste water also needs to fulfil the requirement by ASTM C 94 to mixing with concrete without affecting strength and durability of concrete.

2.13 CONCRETE WITH FLY ASH, RICE HUSH ASH AND EGGSHELL POWDER

Fly ash is one of the non-combustible materials portions of coal consumed in a coal fuelled power plant. Fly ash is collected from energy power plant and different with bottom ash although also collected from power plant. Rice hush ash is taken from rice because approximately 600 million tons of rice is produced. According to Jayasankar et al. (2010), on an average 20% of the rice paddy is husk, giving an annual total production of 120 million tonnes. In the majority of rice producing countries much of the husk produced from the processing of rice is either burnt or dumped as a waste. Eggshell is one of the waste materials and dispose used landfill although volume of eggshell less than the rice hush paddy but also polluting the environment.

Fly ash taken power plant and sieved before used, rice hush ash handling with incinerated, cleaned and sieved before used. Then the eggshell is grinded and sieved before used. Chemical analysis will carry to determine the chemistry properties of these three waste materials.

2.14 FLY ASH

Fly ash is the finely divided residue that the results from the combustion of pulverized coal and is transported from the combustion chamber by exhaust gases. Basically, fly ash is produced by coal-fired electric and steam generating plants. In more detailed, coal is pulverized and blown with air into the boiler's combustion chamber where it immediately ignites, generating heat and producing a molten mineral residue. Then, the boiler tubes extract heat from boiler, cooling the flue gas and causing the molten mineral residue to harden and form as ash (Tara and Mishra, 2010).

When the coal is burned, approximately 5 to10% of it is turned into ash (Chusid et al., 2009). Prior to exhausting the flue gas, fly ash is removed by particulate emission control devices, such as filter fabric bag houses (Tara and Mishra, 2010). Fly ash is a lightweight ash product, so it can rise with the flue gases and stacked on top of the smokestack (Chusid et al., 2009).

In general, a 1000 MW power station used 3500 kilo calories per kg and approximately 40-50% of ash need around 500 hectares for disposal of fly ash for about 30 years operation. Therefore, with a huge amount of fly ash generation should be utilized to minimize the environmental degradation. In India, there are numerous innovative work completed to demonstrate that fly ash was a potential material to use for development material.

2.15 CHEMICAL PROPERTIES OF FLY ASH

The chemical properties of the fly ash are impacted by the properties of the coal being burned and the distinctive of strategies of taking care of and storage. Normally, there are 3 types of the coal, which is bituminous, sub-bituminous and lignite. In addition to being handled in a dry condition, or wet form, fly ash also classified according to the type of coal from which the ash was derived.

Then again, the mineralogical composition of fly ash is depends on the geological factors related to the information and deposition of coal. The combustion condition of fly ash can be established by analysis of X-ray diffraction (XRD). The dominant mineral phases are quartz, kaolinite, ilite and sideraete and the less predominant mineral in unreacted coals are included calcite, pyrite and hematite (Ahmaruzzaman, 2009).

2.16 BOTTOM ASH

Bottom ash is the most critical by-product from municipal solid waste incineration. Coal bottom ash is a dark grey, coarse, granular and incombustible by-product that are collect from the bottom of furnaces that burn coal for the production of electric power. When a sufficient amount of bottom ash drops into the hopper, it is removed by means if high pressure water jets and convoyed by sluiceways either to a disposal pond or to a decant basin for disposal or use.

Bottom ashes have angular particles with a very porous surface texture. In addition, this ash particles range in size from fine gravel to a fine sand with very low percentages of silt-clay sized particles. Bottom ash is well-graded material; although variations in particle size distribution may be encountered in ash sample taken from the same power plant at the different times (Tarmizi, 2010).