PERFORMANC USK WASTE UNDER

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ABSTRACT

Nowadays, the utilization of unwanted materials to be added into concrete mix to improve its performance is continuously studied by many researchers. A study has been conducted in the laboratory to investigate the performance of concrete with rice husk waste under different environments. A number of 60 cubes, 100 mm x 100 mm x 100 mm were prepared with 30 cubes as a control and another group of 30 cubes containing rice husk waste. All these samples were left under various environments for 7 and 28 days. The environments were acidic, alkaline, outdoor, clean water and indoor environment. The performance of concrete samples was monitored through their compressive strength at 7 and 28 days. The results obtained indicated that the strength of concrete with rice husk wastes have decreased at all ages and environments by almost half of the strength of the normal concrete cubes.

ABSTRAK

Pada masa kini, kajian sedang dilakukan tentang penggunaan bahan terbuang untuk di campurkan dengan konkrit untuk meningkatkan prestasinya. Satu kajian telah dijalankan di makmal untuk mengkaji kesan persekirataran terhadap prestasi konkrit dengan sekam sisa padi terpakai. Sebanyak 60 kiub dengan setiap satunya berukuran 100 mm x 100 mm x 100 mm telah disediakan. Sebanyak 30 kiub dijadikan sebagai kawalan dan 30 kiub lagi dengan sekam sisa padi terpakai. Kesemua sampel – sampel ini telah ditinggalkan dibawah persekitaran yang berbeza seperti asid, alkali, air bersih, persekitaran luaran dan dalaman. Sampel – sampel ini telah diuji untuk memperoleh kekuatan mampatannya selepas 7 dan 28 hari. Keputusan menunjukkan bahawa kiub konkrit dengan sekam sisa padi terpakai mempunyai kekuatan mampatan yang lebih rendah pada 7 dan 28 hari dan juga pada kesemua persekitaran jika dibandingkan dengan kiub konkrit kawalan.

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HCL	Acidic Environment, Hydrochloric Acid
NaOH	Alkaline Environment, Sodium Hydroxide
WTR	Water Environment, Clean Water
OUTDR	Outdoor Environment
INDR	Indoor Environment

CHAPTER 1

INTRODUCTION

1.1 Introduction

Non-degradable wastes has been a major issue now in the 21st century as more and more of these wastes are piling up in our world today and being disposed of in landfill areas without being recycled. These wastes take up a very long period of time to decompose and up till now, the decomposition period of waste is still unknown. Because of this problem, researches have been done to fully utilize these wastes as the final products for construction materials such as concrete and mortar.

Concrete has been the most commonly used material in construction which is very versatile in nature and application. It consists generally of cement, water, coarse aggregates and fine aggregates. The main material which binds the concrete mix together is the Portland cement which is a cementitious material used centuries ago. However, concrete is weak in terms of tensile strength, low ductility, high permeability and weak against chemical attacks. In order to increase the performance of concrete, improvements can be done.

1.2 Significant of Study

Nowadays, with the worlds technology getting more and more advanced, it might be possible that one day the usage of wastes in construction can be utilized, which may help to reduce the ever increasing cost of waste disposal and due to the stringent environmental regulations.

This study is to observe the performance of rice husk waste in concrete under different environments. By understanding more on the properties of this waste in concrete, in the future, it might just be one of the main components in concrete as it is abundant and a far cheaper material to be used.

1.3 Problem Statement

Concrete is the most common material in constructions nowadays and it is used extensively from very developed countries to underdeveloped countries in many aspects. The properties of concrete can be predetermined by design, selection of constituent materials and quality control (Shan Somayaji, 2001). These properties are then related to the strength and durability of the concrete which shows that the performance of concrete is associated to the design, environment and the workmanship of the concrete. To produce concrete which is strong and durable against all harmful agents who may cause deterioration of concrete, many types of cement and additives have been researched on. By providing additives or certain type of cement, the performance of the concrete might improve and reduces the deterioration effect of the concrete.

Rice husk waste is introduced into this study as an additive into concrete to determine its contribution in terms of strength performance to the concrete under various aggressive environments. Any reaction between the hardened concrete containing rice husk waste and the existing agents in the environments is observed during the study.

1.4 Objective of Study

The focus of this study was to find out on how concrete with rice husk wastes perform under stresses. The objectives of the study were:

i) To observe the effects of rice husk waste on the performance of concrete.
ii) To investigate the effects of various environments on the performance of concrete containing rice husk waste.

1.5 Scope of Study

The scope of this study is to focus on the compressive strength of concrete containing rice husk waste under the effects of different environments. The implication of the use of rice husk waste as additives in the concrete will be ranked according to different environments. Compression tests were done to obtain the compressive strength after 7 and 28 days after the production of concrete cubes. The environments related to this research are as follows:

- Acidic environment, HCL
- Alkaline environment, NaOH
- Submerged in water, WTR
- Outdoor environment, OUTDR
- Indoor environment (control Environment), INDR

Limitation to this study is listed as follows:

i) The size of the cube samples to be used is 100 mm x 100 mm x 100 mm

ii) The specification of the concrete mix design in of grade 30

iii) Raw materials used in the mix design consists of Ordinary Portland Cement (OPC), coarse aggregates, and fine aggregates (sand) of 40% passing 600 μm sieve.

iv) The optimum content of rice husk waste to be added into the concrete mix would be determined through test of 10%, 20%, and 30% and 50% by volume. Control concrete cubes of 0% waste would also be prepared.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

Concrete is one of the most common construction materials nowadays. The 3 factors which predetermined the properties of concrete are the design, selection of constituent materials, and quality control. Generally concrete consists of cement, aggregates, water and admixtures. By mixing and molding all of these components together into the desired size and shape while the mixture is still wet. Within a few minutes of mixing, hydration process occurs which is the chemical reaction of cement and water. This process continues with time, producing a hard, strong, durable material called concrete, (Shan Somayaji, 2001). Under certain circumstances, admixtures are added to the concrete to change one or more of the properties. The design mix which is commonly used is defined as the criteria of compressive strength at 28 days and designed according to the grade.

For example, concrete grade 30 has a compressive strength of 30N/mm2 at 28 days, (Blackledge, 1992) since concrete is one of the most used construction materials; the technique used to produce concrete at its best in terms of quality must

be understood and reviewed thoroughly. The quality of concrete depends on the quality of the raw materials used (cement, aggregates and water).

The rate of mixture, water/cement ratio, the way of mixing, transporting, placing and compacting of concrete which has been mixed, the quality of formwork and curing, (Mat Lazim Zakaria, 1997) If the quality of the raw materials used is low or the concrete is not mixed according to the standard, the quality of the concrete would differ from what is expected and could cause the concrete structure to fail as it did not reach the strength that it is designed for. If this happens, the consequences would be very high. Because of that, the materials used should be tested according to the standard stated before being used for construction purposes.

2.2 Concrete

2.2.1 Introduction

As explained earlier, Portland cement concrete is a combination of cement, aggregates and water. We can see it as a mixture of aggregates which consists of fine and coarse aggregates, bound together by cement paste which consists of cement and water. About 60 – 70% of the concrete is made up of aggregates and 25 – 40% of the paste and the remaining is water. Besides that, concrete also consists of air with the volume ranging from 2 – 8% of the total volume, (Shan Somayaji, 2001). Since all of these materials would determine the strength of the concrete, it is important to fully understand the materials used.

2.2.2 Constituents of Concrete

2.2.2.1 Cement

Cement is produced by grinding clinker formed by burning materials (argillaceous and calcareous) primarily consisting of lime (CaO), Silicate (SiO2), alumina (Al2O3), and iron oxide (Fe2O3). The characteristic of cement is that it sets and hardens when it is mixed to a paste with water. It will harden and bind all of the materials together into a tough and solid form through the hydration process. Cement can be classified into two groups which is the hydraulic cement and non-hydraulic cement. The most common form of hydraulic cement is the ordinary Portland cement (OPC) which consists mainly of silicate and alumina, a finely pulverized material that develops its binding property thanks to its reaction with water.

It is manufactured by heating a mixture of limestone and clay until it almost fuses and then grinding the clinker to a fine powder. Hydraulic cement is cement which solidifies and hardens under water because of chemical reaction. Besides that, the most common form of non-hydraulic cement is gypsum and lime. Non-hydraulic cements could not solidify and harden under water but needs air to harden.

2.2.2.2 Aggregates

Aggregates are rocklike materials of various sizes and shapes used in the manufacture of concrete. American Society on Testing of Materials (ASTM) defines aggregates as granular material such as sand, gravel, crushed stone used with

cementing medium to form mortar or concrete. Natural aggregates are taken from natural deposits without change in their nature during production. Besides that, manufactured aggregates are produced from crushing and processing of quarried stone. Aggregates are mixed into concrete to control shrinkage of concrete, reduce heat during hydration process and produces concrete which is suitable for its usage besides reducing cost.

Aggregates can be classified into 3 types which are based on source or method of manufacture, based on size or based on density. But for the use in concrete, aggregates are divided into two groups which are fine and coarse aggregates. Fine aggregates (also called sand) consist of natural or manufactured particles ranging in size from 150μm to 4.75mm. In concrete construction, fine aggregate is defined as an aggregate with particles predominantly of size smaller than 4.75mm and equal to or larger than 75 μm. Coarse aggregates consists of round gravel, crushed stone or manufactured aggregate with particles of size equal to or larger than 6.35mm.

Important properties of aggregates such as its shape, texture mechanical properties (bond, strength toughness and hardness), physical properties (specific gravity, bulk density, porosity, absorption, moisture content, bulking of sand and soundness) and thermal properties are the main priority. To produce a strong concrete, aggregates should be angular and rough to increase the bonding with cement and interlocking among aggregates. Since aggregates are cheaper compared to concrete, it is better to use more aggregates and reduce the cement content for the concrete mix as it will reduce cost and thus increases the volume stability and durability of concrete.

2.2.2.3 Water

To produce concrete which is high in quality, the quality and quantity of water used to mix the concrete should be considered. Water is used for the hydration process of cement and also to control the workability of concrete. Based on the relationship between the water-to-cement ratios, the compressive strength of concrete can be measured. The relationship between the water-to-cement ratio of the mix and the compressive strength of concrete is called Abram's Law.

The higher the water-to-cement ratio is, the lower the compressive strength of the concrete will be and vice versa. Besides that, the durability of concrete is affected by the quality of water. By using impure water for aggregate washing could cause the aggregates to be coated with silt, salts or organic materials. It could produce distressed concrete due to chemical reactions with the cement paste or poor aggregate bonding.

2.2.3 Properties of Fresh Concrete

Fresh concrete is concrete at the mixing stage. It should be such that it can be transported, placed, compacted and finished without harmful segregation. A proper mix should maintain its uniformity inside the forms and should not bleed excessively. It should set within a reasonable amount of time and hydrate in a manner that ensures adequate strength when the structure is put into service (Shan Somayaji, 2001). The properties of fresh concrete such as the workability, the setting time of concrete, segregation and bleeding are very important properties as it will then affect the properties of the hardened concrete's performance.

2.2.3.1 Workability

Workability is the amount of work required in mixing, placing and compacting fresh concrete without segregation. The three mutually independent characteristics usually used to express workability are consistent, mobility and compatibility. Factors affecting workability are

i) Water content
ii) Cement content and fineness
iii) Aggregate types and grading
iv) Size of aggregates
v) Aggregate – cement ratio
vi) Admixtures
vii) weather/temperature

Tests that could be done to measure the workability of concrete are the slump test, compacting factor test and the vebe test

2.2.3.2 Setting Time

By mixing water with cement, the resulting paste would lose its behavior and form into a hard rock. One or two hours after the mixing of cement and water, the paste would lose its fluidity. After a few hours after mixing, stiffening which is noticeable occurs. This mechanism is called setting. It could be divided into two stages which is the initial set and the final set. The initial setting time is not less than 45 minutes after water is poured into the mix and the final setting time occurs not more than 10 hours. During the final setting time, hydration process still occurs