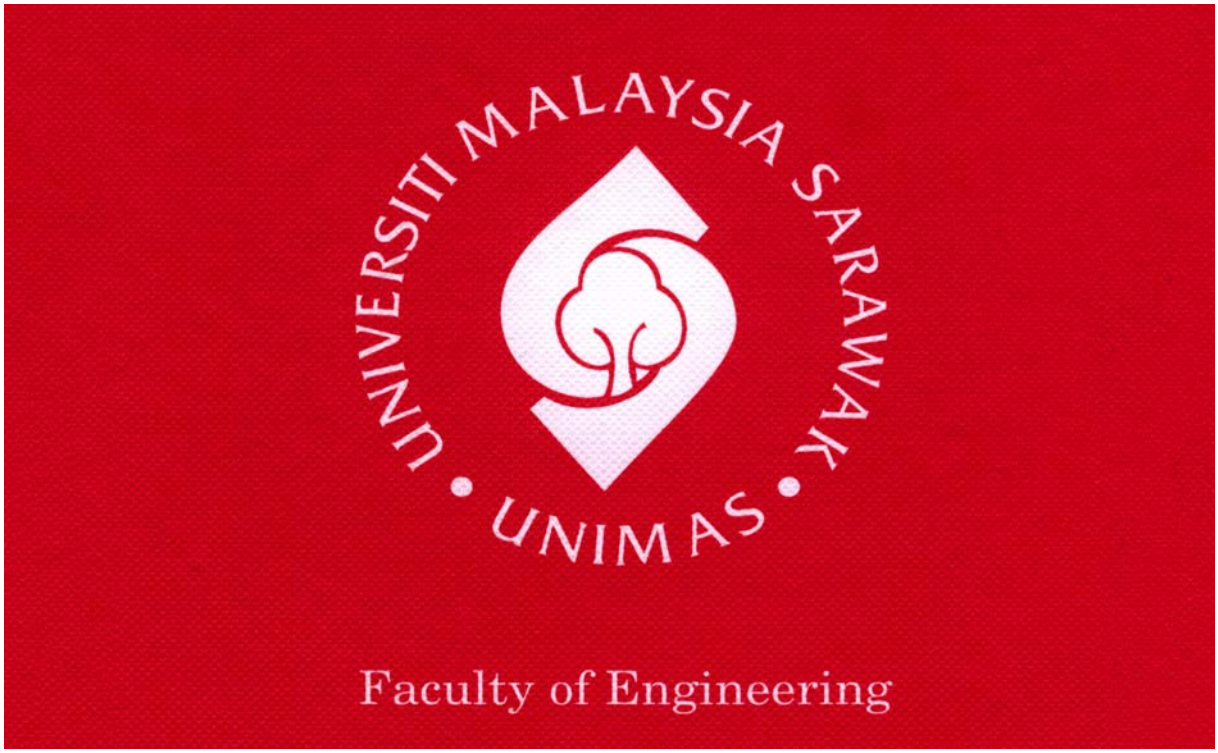

PROPERTIES OF POLYSTYRENE CONCRETE BRICKS WITH SAWDUST ASH

Mcfarlane Chua Kang Wei

Bachelor of Engineering with Honours
(Civil Engineering)
2009

UNIVERSITI MALAYSIA SARAWAK

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PROPERTIES OF POLYSTYRENE CONCRETE BRICKS WITH SAWDUST ASH

Mcfarlane Chua Kang Wei

A thesis submitted in partial fulfilment of the requirements for the award of the degree of Bachelor of Engineering with Honours (Civil Engineering)

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2009

To my beloved family

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ABSTRAK

Projek ini dijalankan untuk menkaji ketahanan dan sifat bata konkrit polistirena yang mengandungi abu sisa-sisa kayu. Biji-bijian polistirena padat sebagai bahan ringan digunakan untuk mengganti pasir di dalam adunan konkrit manakala abu sisa-sisa kayu sebagai pengantian simen. Sejumlah 216 bata dengan saiz 195 mm x 100 mm x 65 mm (panjang x lebar x tinggi) disediakan. Enam kajian dijalankan untuk menkaji dan membanding sifat-sifat konkrit polistirena. Kajian-kajian yang dijalankan ialah ujian daya kemampatan, penyerapan air, ujian serangan air laut, berat dan ketumpatan, saiz dan ujian serangan asid. Kekuatan mampatan bata bergantung kepada jenis-jenis bahan yang dicampurkan dan nisbahnya. Walaubagaimanapun, kandungan abu sisa-sisa kayu yang banyak mengurangkan kekuatan konkrit, tetapi keputusan memaparkan abu sisa-sisa kayu boleh menyumbang kekuatan kepada konkrit dalam masa pengawetan yang panjang. Bata yang dikaji dalam air laut dibandingkan dengan bata yang dikaji dalam air paip. Keputusan mendapati berat dan ketumpatan yang rendah akan meninggikan kadar penyerapan air. Abu sisa-sisa kayu juga mempengaruhi kadar penyerapan air kerana ia adalah bahan-bahan yang berupaya untuk menyerap air. Kekuatan bata-bata yang dikaji dalam air laut mempunyai kekuatan mampatan yang lebih rendah berbanding dengan bata-bata yang dikaji dalam air paip. Bata-bata yang dikaji dengan ujian serangan asid didapati perubahan fizikal dari segi rupa luaran, berat dan ketumpatan, dan dimensi. Perubahan fizikal bagi bata konkrit polistirena lebih tinggi dengan kandungan biji-bijian polistirena dan abu sisa-sisa kayu yang tinggi di dalam adunan.

ABSTRACT

This project was carried out to investigate the mechanical and durability properties of hardened polystyrene concrete bricks containing sawdust ash. In this study, polystyrene beads as lightweight aggregate are used to replace fine aggregate in the concrete mixture whereas sawdust ash is for replacement of cement. A total of 216 bricks with the size of 195 mm x 100 mm x 65 mm (length x width x height) were prepared. Six tests were carried out to investigate and compared the properties of polystyrene concrete bricks. The tests were compressive strength test, water absorption, sea water attack, weight and density, dimension and acid attack. The compressive strength of bricks was depended on the materials mixed and the ratio used. Although higher ash content decreased the strength of concrete, the test result indicated that sawdust ash can contribute strength to concrete at longer curing periods. The bricks tested in sea water were compared with the bricks tested in tap water. The result shows the bricks with low weight and density recorded high water absorption rate. Sawdust ash also influenced the water absorption as it is a good water absorbing materials. The bricks tested in sea water recorded lower compressive strength than bricks tested in tap water. The bricks tested in acid attack also show changes in physical properties such as appearance, weight and density and dimension. The changes of properties of polystyrene concrete bricks are much higher for high content of polystyrene beads and sawdust ash in the mix.

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LIST OF SYMBOLS

%	Percentage
kg/m3	Kilogram per metre cube
MPa	Mega Pascal
mm	millimeter
°C	Degree of Celsius
m^3	metre cube
kN/s	Kilo Newton per second
kN	Kilo Newton
kg	kilogram
m_1	Wet brick weight
m_2	Dry brick weight
N/mm^2	Newton per millimeter square

CHAPTER 1

INTRODUCTION

1.1 General Background

Concrete has been in use for hundreds of years. The word concrete comes from the Latin *concretus*, which means “mixed together” or compounded, or "hardened". Concrete is made up through the mixture of cement, aggregate that is coarse aggregate such as crushed stone or gravel plus a fine aggregate commonly sand, water and chemical admixtures. The mixing of concrete and water will form hard and stone-like materials. This process is due to a chemical process known as hydration.

Concrete, was firstly used by Romans in their aqueducts and roadways construction for over 2,000 years. In the passed, Romans used a primitive mix to produced the concrete and used the mortar consisted of small gravel and coarse sand mixed together with hot lime and water. Horse hair is used to reduce shrinkage and some even mix with animal blood for the purpose to make the mix become more durable.

The use of concrete and its cementatious (volcanic) constituents, such as pozzolanic ash, has been made since the day of the Greeks, the Romans, and possibly earlier ancient civilizations. In 1850, J.L.Lambot constructed for the first time a small cement boat for exhibition in the 1855 World's Fair in Paris and Koenen in 1886 published the first manuscript on the theory and design of concrete structures. Many buildings, bridges and liquid containers of reinforced concrete were already constructed by 1920, and the era of linear and circular prestressing began. (Edward G, 1996)

Brick is defined as small unit of building materials and it maybe solid, hollow or architectural terra cotta to use in construction purposes. The size of brick is standard and easy to be hold in one hand. Brick also retain heat, with-stands corrosion and resists fire. All types of brick serve a structural function or decorative function depends on their formation and composition. Concrete brick is made from the mixture of cement, sand, water and cast in the mould and cured. Bricks are easily recycled-mineral materials and can be reused as bedding material in road construction, for sound insulation walls, tennis court material and etc. There are a few types of bricks such as Sand Cement brick, Clay bricks, Calcium Silicate bricks for the construction application and brick's density varies according to the manufacturer and its uses.

Concrete can be classified into three categories that is normal-weight concrete (2400 kg/m^3), lightweight concrete (< 1800 kg/m^3) and heavyweight concrete (> 3200 kg/m^3). The strength of concrete is depending on the hydration reaction whereby the strength of concrete increase when less water is added to the mix of concrete. However

concrete is actually mixed with more water not only for the hydration needs but also to give concrete sufficient workability.

Mostly the lightweight concrete with wide range of concrete densities (300–1800 kg/m^3) was studied mainly for compressive strength, split tensile strength, moisture migration and absorption. Besides, the shape, size density and strength of aggregate particles can vary significantly, and can therefore influence the properties of the concrete. Aggregate tends to represent a relatively high volume percentage of concrete, to minimize costs of the material.

1.2 Problem Statement

Nowadays, the problem of waste materials such as sawdust, flyash, silica fume, plastic bottle and others which may cause pollution and health problems to the public. Steps have to be taken to decide on the best ways of making waste useful and renewable. Expanded polystyrene foams (EPS) are widely used as packaging material, construction material, and in household appliances as well as many others. EPS has caused environmental pollutions because it is hard to decompose. Therefore, this research has been done to study the utilization of waste EPS in concrete technology.

The normal weight aggregate, natural stone such as limestone and granite is used to produce normal weight concrete. However, due to the increasing demand of concrete,

natural environment and resources are excessively exploited. Therefore, waste materials can be recycled and used as raw material in cement clinker, admixtures in cement, or as aggregates in concrete to produce lightweight concrete.

Lightweight concrete is typically 25% to 35% lighter but its strength equivalent to normal weight concrete and suitable to be use for structural application. The normal concrete has high self weight and the density is range from 2200 kg/m^3 to 2600 kg/m3. The high self weight of concrete is considered as an uneconomical structural material. Therefore, lightweight concrete with lighter density will be used to replace normal concrete as structural materials

Lightweight concrete gives better thermal insulation and has higher cement content than normal weight concrete. Lightweight concrete also bring benefits in term of load bearing elements of smaller cross-section area, reduction in the size of foundations, lower pressure applied to the formwork and also reduced the total mass of materials needed with a consequent increase in productivity. (Neville, 2003)

In the future, it is expected that lightweight concrete will move forward in advancement compare to normal concrete. Synthetic aggregate will be made with the properties of more stronger and lighter so that the structural lightweight concrete become better and better.

1.3 Objectives

The objectives of this study are:

1) To produce concrete bricks containing polystyrene concrete mixed with sawdust ash
2) To test the mechanical and durability properties of EPS concrete brick containing sawdust ash.

1.4 Scope of works

The purpose of this project is to produce lightweight concrete bricks and test the compressive strength of the brick to compare with the normal concrete. The testing of durability to sea water attack is important to make sure the concrete bricks able to withstand the conditions such as weathering action, chemical attack and abrasions throughout the life of a structure. Other testing such as water absorption and density test also will be carried out.

The mixture of EPS concrete brick is cement, sand, expanded polystyrene bead and sawdust ash. Different ratio of the proportion will produce different type of concrete brick with different properties. The sawdust ash is used as concrete replacement in the mixes and to improve the strength of the concrete brick. The sawdust ash may change the physical and properties of the EPS concrete brick such as dimensions and color. The

testing is according to Malaysian Standard, Specification for Bricks and Blocks of Fired Brickearth Clay or Shale Part 2, Metric Units (MS 76:1972).

1.5 Outline of the project

In chapter 1, introduction about this study and some problems statements was discussed. It also shows the objectives and scope of works that will be carried out. Chapter 2 is the literature review where it shows the past research and result which has been done by other peoples. The journal or research information is important to shows a guideline or references which related to this study. Chapter 3 is methodology which explains type of materials and equipments used for the experiments. It also shows the production and experimental test carry out for the samples. In chapter 4, the result and analysis of the samples in different type of testing will be discussed further. Conclusion and recommendations for this study will be discussed in chapter 5.

1.5 Project Planning

Activity / Duration	JULY 2008	AUG 2008	SEPT 2008	OCT 2008	NOV 2008	DEC 2008	JAN 2009	FEB 2009	MAC 2009	APR 2009	MAY 2009
Literature Review											
Lab Preparation. Data Collection.											
Data Analysis											
Report Writing. Final Report.											