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APPLICATION OF BAGASSE WASTE ON LIGHTWEIGHT STRUCTURE COMPOSITE MATERIAL

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SUPERVISOR DECLARATION

"I hereby, declare that I have read this thesis and in my opinion this report is sufficient in terms of scope and quality for the award of the degree of Bachelor of Mechanical Engineering (Structure and Material)"

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This report is submitted to Faculty of Mechanical Engineering as a requirement to get reward of
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DECLARATION

"I hereby declare that the work in this report is my own expect for summaries and quotations which have been duly acknowledged."

Signature : …………………………

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Specially dedicated to

my family and beloved companion

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ABSTRAK

Konkrit merupakan salah satu contoh struktur komposit. Konkrit biasa memberikan berat badan berat dan kos yang tinggi semasa proses pengeluaran. Oleh itu, konkrit ringan mempunyai permintaan tinggi dalam pasaran berbanding dengan konkrit biasa. Konkrit ringan terdiri daripada simen, pasir, bahan pengikat dan air. Penghasilan konkrit ringan membawa pelepasan gas-gas rumah hijau yang berjumlah besar. Isu alam sekitar memainkan peranan yang penting dalam pembangunan mampan industri konkrit. Penggunaan bahan buangan pertanian dalam industri konkrit telah menjadi fokus kajian atas sebab-sebab ekonomi dan alam sekitar. Dengan menggunakan konsep 4R - Reduce, Reuse, Recycle dan Replace, hampas tebu akan menggantikan beberapa komposisi bahan asas dalam konkrit. Dalam usaha untuk menilai kemungkinan penggunaan hampas tebu dalam konkrit ringan, beberapa ujian seperti ujian mampatan dan analisis mikrostruktur akan dijalankan untuk menentukan kekuatan, ketumpatan dan keliangan konkrit hampas tebu.

ABSTRACT

Concrete is one of the examples of composite structure. Typical concrete gives heavy weight and high cost during production. Hence, lightweight concrete has higher demand in market compared to typical concrete. Lightweight concrete is made up of cement, sand, admixture and water. Production of lightweight concrete leads to the release of significant amount of greenhouse gasses. Environmental issues are playing an important role in the sustainable development of concrete industry. Utilization of agricultural waste products in concrete industry has been the focus of research for economic and environmental reasons. By applying the 4R concept – Reduce, Reuse, Recycle and Replace, bagasse ash is going to replace some composition of basic ingredients in concrete. In order to evaluate the possibility of bagasse use in lightweight concrete, some tests such as compression test and microstructure analysis will be conducted to determine the strength, density and porosity of bagasse concrete.

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CHAPTER 1

INTRODUCTION

1.1 BACKGROUND

A composite is a structural material that consists of two or more combined constituents that are combined at a macroscopic level and are not soluble in each other. By applying this technology, the development of light-weight, high-temperature resistant composite materials will bring evolvement to the next generation of high-performance, economical composite structure material. Typical composite structure material includes composite building material such as concrete. Concrete is a construction material which made up of cement, sand, aggregates and water. However, the manufacturing process of concrete will produce green-house gasses emissions, which subsequently lead to air pollution. In view of environmental benefits brought about by widespread usage of concrete, it is therefore ethically justified to mass produce environmentally friendly concrete.

Sugar cane represents a major crop especially in tropical region country. Due to the increasing demand for sugar in the last century, large areas in the tropical countries all around the world were allotted for sugar cane crops. (Juraimi, 2013). Malaysia produces a large amount of sugar cane per year. The main product, sugar juice, is collected and processed for production of sugar while the remaining crushed and squeezed cane stalk, named bagasse. Bagasse is essentially a waste product that causes additional disposal cost. (Juraimi, 2013). Current research is concerned about the usage of bagasse in industrial field. Hence, this study aims at using bagasse on composite concrete.

1.2 PROBLEM STATEMENT

Sugar-cane bagasse is a fibrous waste-product of the sugar refining industry. This waste-product is already causing serious environmental pollution which calls for urgent ways of handling the waste (Aigbodion et al., 2010). To solve this issue, there is some way outs such as reuse the sugar-cane bagasse in certain industries such as construction industry. Construction industry has a high demand on the usage of concrete. Concrete is lightweight composite structure material which consists of cements, water, and aggregates. These are the essential constituent of concrete, leads to the release of significant amount of carbon dioxide gasses and other greenhouse gas. One ton of Portland cement clinker production is said to create approximately one ton of carbon dioxide gas and other greenhouse gases (Naik et al., n.d.).

Environmental issues are playing an important role in the sustainable development of the concrete industry. Bagasse ash can act as one of the aggregate replacement. It is partially replaced in the different weight ratio in concrete (Srinivasan , 2010). This reduces energy use in the kiln and carbon dioxide gas emissions from calcinations (Naik et al., n.d.). The reuse of post-consumer wastes and industrial byproducts in concrete is imperative to create an eco-friendly environment.

1.3 OBJECTIVES

- To determine the physical properties of lightweight composite structure material
- To determine the mechanical properties of lightweight composite structure material

1.4 RESEARCH SCOPE

- To determine the density and porosity of the concrete
- To investigate the strength of concrete by using compression test and microstructure observation

CHAPTER 2

LITERATURE REVIEW

2.1 HISTORICAL OF CONCRETE

Concrete today is an indispensable part of the fabric of modern society, used for everything from mundane road pavements and high rise building. However, concrete as a building material has been around for a very long time. Inventions in reinforced concrete started in the mid-nineteenth century with Joseph Lambot's boat as shown in Figure 2.1 (Neville, 1995). There is another agriculturist who called Joseph Monier has inspired by Lambot was built a bridge in 1875 at the Château de Chazelet. The bridge is shown at Figure 2.2. (Neville, 1995). Francois Hennebique, inspired by Monier's successes, he initiates the trend of structure building using concrete in Europe.

Figure 2.1: Boat Built by Joseph Lambot
(Source: Neville (1995))

Figure 2.2: Bridge Built by Joseph Monier
(Source: Neville (1995))

Figure 2.3: First Reinforced Concrete Building in the USA
(Source: Neville, (1995))

Figure 2.4: Improvement of Concrete Building from Nineteenth Century to Twentieth Century

(Source: Neville, (1995))

Nowadays, reinforced concrete became a successful building medium because of continual improvements in its strength, its economy, its durability, its fire resistance, and its beauty. Reinforced concrete continues to be improved.

2.2 BASIC INGREDIENTS OF CONCRETE

2.2.1 Cement

Cement is the most common binder which adheres on the surface of a product to strengthen the structure of product. Cement is the final outcome from the grinding of clinker in one of the clay types which is marl or mixture of limestone and clay.

There are two types of cements which commonly in use, one is hydraulic cements whereas the other one is non-hydraulic cements. Non-hydraulic cements include such materials like lime and gypsum plasters, which must be kept dry in order to gain strength. Hydraulic cements are materials that will be harden after being combined with water, as a result of chemical reactions with the mixing water and after hardening; it will retain strength and stability even under water. This strength and stability is that the hydrates formed on immediate reaction with water and be essentially insoluble in water.

Most construction cements today are hydraulic, and most of these are based on Portland cement, which is made primarily from limestone, certain clay minerals, and gypsum in a high temperature process that drives off carbon dioxide and chemically combines the primary ingredients into new compounds. However, the choosing alternatives is still depends on the designer's recommendations in the project specifications (Abddallah et al. , 2009).

The main types of cement in British standards and those of the American Society for Testing and Materials (ASTM) are shown in Table 2.1.

Table 2.1 : Types of Cements in ASTM and British Description (Abddallah et al. , 2009)

Cements Types	
ASTM Description	British Description
Type I	Ordinary Portland cement
Type II	Modified cement
Type III	Rapid hardening Portland Extra rapid hardening Portland Ultra high early strength Portland
Type IV	Low heat Portland
Type V	Sulfate resisting Portland

Characteristic of Cements in ASTM standard:

a) Type I:

- It is common cement used in concrete for making pavements, floors, reinforced concrete buildings, bridges, tanks, pipes, etc.
- It is used in concrete not subjected to aggressive exposures, such as sulfate attack from soil and water, or to an objectionable temperature rise

b) Type II:

- It is used where precaution against moderate sulfate attack is important, as in drainage structures, which may be subjected to a moderate sulfate concentration from ground waters
- It usually generates less heat of hydration at a slower rate than Type I cement and therefore can be used in mass structures such as large piers, heavy abutments, and retaining walls
- Due to less heat generation it can be preferred in hot weather.

c) Type III:

- It is chemically and physically similar to Type I cement, except that its particles have been ground finer
- It provides high early strengths at an early period
- It is used when forms need to be removed as soon as possible or when the structure must be put into service quickly
- It is preferred in cold weather for reduction in the curing period

d) Type IV:

- It is used where the rate and amount of heat generated from hydration must be minimized
- It develops strength at a slower rate than other cement types
- It is most suitably used in massive concrete structures, such as large gravity dams, where the temperature rise resulting from heat generated during hardening must be minimized to control the concrete cracking

e) Type V:

- It is used only in concrete exposed to severe sulfate action – principally where soils or ground waters have a high sulfate content
- Its high sulfate resistance is due to its low C3A content of about 4%
- It is not resistant to acids and other highly corrosive substances

2.2.2 Sand

Sand is a naturally occurring granular material composed of finely divided rock and mineral particles. It is defined by size, being finer than gravel and coarser than silt. It is a naturally occurring, finely divided rock. Sand comprises particles, or granules, ranging in diameter from 0.0625 (or 1⁄16 mm) to 2 millimeters. An individual particle in this range size is termed a sand grain. The next smaller size class in geology is silt: