INVESTIGATION OF SAW WOOD DUST WITH DIFFERENT PERCENTAGES IN SAND BRICK RATIO 1:3

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Thesis submitted in fulfilment of the requirements for the award of the degree of Bachelor Eng. (Hons.) Civil Engineering

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JUNE 2015

ABSTRAK

Kebimbangan terhadap isu-isu alam sekitar terutamanya berkaitan dengan pencemaran seperti sungai dan udara telah menarik minat dan usaha untuk menghasilkan bahan pembinaan mampan diperbuat daripada produk sisa industri seperti habuk kayu. Kenaikan harga bahan-bahan pembinaan juga menjadi faktor bagi penyelidik untuk mencari alternatif lain untuk menggantikan bahan-bahan pembinaan. Tujuan kajian ini adalah untuk mengkaji kesan habuk kayu terhadap kekuatan and sifat bata pasir. Eksperimen telah dijalankan menggunakan habuk kayu sebagai bahan pengganti pasir sebanyak 5 %, 10 %, 15 % dan 20 %. Sampel kawalan mengandungi 0 % habuk kayu digunakan untuk membandingkan data yang diperolehi dengan sampel yang mengandungi habuk kayu. Nisbah simen air telah ditentukan dengan menggunakan sistem percubaan dengan simen kepada nisbah pasir 1 : 3. Bancuhan bata diawet dengan menggunakan dua cara iaitu udara dan air serta tempoh pengawetan selama 7 dan 30 hari. Kemudian beberapa sampel bata telah diuji untuk kekuatan mampatan , penyerapan air dan ujian dimensi . Berdasarkan keputusan eksperimen , nilai yang diperolehi menunjukkan bahawa objektif berjaya dicapai. Kekuatan bata mengandungi habuk kayu berkurangan dengan peningkatan peratusan habuk kayu. Bata yang mengandungi habuk kayu saw tidak sesuai digunakan sebagai dinding membawa beban dalam pembinaan kerana kekuatan mampatan yang rendah dan kadar penyerapan air yang lebih tinggi.

ABSTRACT

Concern of environmental issues especially related to the river pollution and air pollution has attracting effort to produce sustainable construction material made of by product from industrial waste such as wood dust. The increasing price of the construction materials also become of the factor for researcher to find an alternative for construction materials replacement. The purpose of this research is to study the saw wood dust on the sand brick strength and engineering properties. The experiment have been conducted using saw wood dust as replacement material for sand in proportion 5%, 10%, 15% and 20%. Control samples contain 0% of wood dust is use to compare the data obtained with the samples containing wood dust. The water cement ratio was determined by using trial and error with cement to sand ratio 1:3. The mixes are cured using two types which is air and water curing for 7 and 30 days. Then the number of samples were tested for compressive strength, water absorption and dimension test. Based on the result of the experiments, it shows that the objectives were achieved. The strength of the saw wood dust bricks decrease with the increasing of saw wood dust percentages. The saw wood dust bricks did not suitable to be used as a load bearing wall in the construction due to the lower compressive strength and higher water absorption rates.

CHAPTER

CONTENT

5 CONCLUSION AND RECOMMENDATION

LIST OF TABLES

LIST OF FIGURES

LIST OF ABBREVIATIONS

BS	-	British Standard
C-S-H	-	Calcium Silicate Hidration
LOI	-	Loss On Ignition
MPa	-	Strength
MS	-	Malaysian Standard
OPC	-	Ordinary Portland Cement
SWD	-	Saw Wood Dust
SD	-	Standard Deviation
V	-	Volume

CHAPTER 1

INTRODUCTION

1.1 INTRODUCTION

Malaysia is among one of actively country in the world in developing new invention and innovation of a new technologies. Many researches and inventions have been produce conducted to produce green technologies and materials to replace uses of the natural resources with sustainable materials by reuse and recycling by-product materials. Among the materials potential materials is saw wood dust. Many researchers have found that saw wood dust can be use as substitute of fine aggregate and course aggregate in construction materials.

Bricks are important construction materials that needed in the building construction. There are many types of bricks commonly uses such as sand brick and clay bricks. However in order to build economical yet provide good performance, sand brick is the main option. River sand are main type of mixture needed in sand brick manufacturing besides cement and water. When the demand of sand brick increase, the needed of river sand also increases. River was being exploited aggressively to gain sand that needed as one of the important materials in construction. As a result the corrosion of river bank, river bed degradation and poor water quality happed to our environment due to these uncontrolled activities.

Saw wood dust can be use as alternative to partially replace river sand. It is reliable replacement for sand bricks in term of sustainability and cost efficient. Different percentage of saw wood dust will be compared and analyze to get the optimum quality

and strength to be compared to ordinary sand bricks. Therefore the focus of the study is the lab works including the test that going to be conducted. There are three tests which are compressive strength, water absorption and dimension test. The engineering properties of the sand brick with different percentage of saw wood dust content will be determined throughout these tests.

1.2 PROBLEM STATEMENT

Sand bricks are widely used in construction compared to clay bricks. It is because sand bricks use less expensive raw materials which mixture of cement and sand. However due to the high demand on sand brick, the needed of river sand also increase. It causes concern to environmental problems such as river bank corrosion and river bed degradation. An alternative for substitute the fine aggregate and course aggregate with saw wood dust have been discovered by Dr. F.A. Olutoge in 1995. In construction industry, saw wood dust have high potential to use as sustainable construction materials. Besides that, saw wood dust also can function as pozzolan materials to act as filler inside the bricks.

The research is constructed and conducted to find the effectiveness of saw wood dust as partial replacement of river sand in sand bricks with different percentage of saw wood dust. The physical properties and chemicals properties are needed to be investigating to ensure the other materials in sand brick which are water and Ordinary Portland Cement can mix together with the saw wood dust to produce same result compared to normal sand bricks.

1.3 OBJECTIVE

The objectives of this research are as follow:

i. To investigate the compressive strength of sand brick with saw wood dust as partial sand replacement with percentage of 5%, 10%, 15% and 20%.

ii. To determine the water absorption of sand bricks with the percentage of saw wood dust as partial sand replacement with percentage of 5%, 10%, 15% and 20%.

iii. To identify the dimension of the sand bricks with the percentage of saw wood dust as partial sand replacement with percentage of 5%, 10%, 15% and 20%.

1.4 SCOPE OF STUDY

This research basically focused about the engineering properties of saw wood dust as partially replacement for river sand in sand bricks. The percentage saw wood dust as river sand replacement are varies from 5%, 10%, 15% and 20% with ratio cement to sand is 1:3 .

Generally, all testing will be done in the laboratory and will undergo necessary testing and analysis accordance to the standard requirement for the bricks. The engineering properties that will be analyzed are compression strength, water absorption and dimension of the bricks.

1.5 SIGNIFICANT OF STUDY

The important of this research is the partially replacing the river sand in sand brick with saw wood dust as it is a byproduct materials. The result might affect the production of cement and brick in structure in the construction of structure.

In addition, the study of the saw wood dust as partial replacement for river sand will produce bricks that can reduce the environmental issues related such as open burning and minimizing the waste sent to the landfill. Therefore, it could be realistic to reduce the reliable of natural resources if the byproduct of industry can be use in the brick manufacturing to improve properties of sand bricks and reduce economical sources for material usage.

CHAPTER 2

LITERATURE REVIEW

2.1 INTRODUCTION

The word of brick can be defined as rectangular block of hard material manufactured form clay, sand and concrete that was used for building walls. Brick was used as materials in construction for 5000 years and it was first made in Middle East near Tigris and Euphrates River.

2.2 TYPES OF BRICKS

There are a few types of bricks commonly used in the construction works. The bricks differentiate due to the materials used, method of manufacturing and the curing method applied during the manufacturing.

2.2.1 Clay Brick

A Clay brick is widely use in construction industry. It is made from clays that are molded into shape and fired in the oven. The clay will transform the clay to have high compressive strength and good in weathering qualities during the firing process. Clay bricks have variety of natural colors and the color remain stable without need rendering or painting works. Furthermore, clay bricks have high compressive strength that can support relatively high load.

Clay bricks has high thermal mass. It is able to maintain stable level of heat energy for extended period in heating and cooling because bricks absorb and releases

heat slowly. Clay bricks also an excellent in fire resistance and sound insulation due to their high mass.

2.2.2 Sand Brick

Sand brick is a type of bricks made of mixture sand, cement and water. The fine aggregates are blended with cementious materials such as Ordinary Portland Cement and water. The wet mixture of the bricks cement paste can be spread into the mold and will set and harden when it dries. It turns into firm glue that will hold the bricks mixture together.

Sand bricks and concrete bricks are almost similar except the concrete bricks use mixture of course and fine aggregate while sand bricks only use fine aggregates. Sand bricks will produce smooth and evenly surface and can be blended with various colors.

2.2.3 Fire Brick

It also known as refractory bricks is a block of refractory ceramic that is build with ability to withstand high heat but having low thermal conductivity for great energy saving. The applications of dense firebricks are in application with extreme chemical, mechanical or high thermal stress. For example, it is use inside wood-fired kiln which subject to high temperature. It also designs to have low thermal conductivity to make the environment of the operating process safe. The dense and porous if the fire brick is depending on the application it is design for and its intended utility.

2.2.4 Sand Lime Bricks

It is also known as Calcium Silicate bricks. Raw materials including lime, quartz, crushed siliceous rock and fly ash mixed together with mineral colorants during wet mixing. The mix is molded under pressure forming the bricks.

Bricks that are made by mixing are chemically bonded bricks and have advantages compared to clay bricks such as lighter in weight, can be produced on

desired color and required no plastering because the appearance are uniform in shape and smooth.

2.3 MATERIALS

2.3.1 Cement

Cement is the main materials in concrete production. It was develop from natural cement in early of nineteenth century in Britain and its name was derived from "Portland stone", a type of stone that can be found in Isle of Portland in England. Nowadays, cement become essential in every construction works to use in structure such as building, tunnel, bridge and others.

Cement is a finely pulverized, dry material that by itself is not a binder. In present of water and cement minerals, the chemical reaction known as hydration process will takes place. (Concrete: Microstructure, Properties and Materials, 2006). Cement usually acts like glue because its properties to binds aggregate which are sand and gravel together. There are many types of cement used in the construction materials, such as:

i. Ordinary Portland Cement

Ordinary Portland Cement (OPC) is the commonly used in concrete construction for the case that there is no exposure to sulphates in groundwater or soil. The raw materials in Ordinary Portland Cement consist of lime, silica, alumina and iron oxide. Every year huge production of Ordinary Portland Cement is produce and used for construction of building, road and bridge and local purposes.

ii. Sulphate Resistance Cement

Sulphate Resistance Cement is blended cement that design to improve the performance of concrete particularly in condition where there is a risk of

damage to concrete from sulphate attack. It is recommended to be use in places where concrete is in contact with ground water, seacoast and sea water. It is a type of Portland cement with the quantity if tricalcium aluminates are less than 5% in the cement content.

2.3.2 River Sand

Sand is used as fine aggregates in concrete. Natural river sand is product of natural weathering of rocks and due to natural process of attrition, it tend to possess smoother texture and better shape. River sand is commonly choose as fine aggregate that useful especially in construction purpose such as plastering work. This sand usually whitish grey in color and has rounded particles. The moisture that trapped between the sand particles makes the concrete workability higher.

2.3.3 Water

Water is the key ingredient to mix cement together to form paste that binds aggregates. The presence of water causes the hardening of concrete through process of hydration. According to BS 3148, "Test for Water for Making Concrete", the water must meet the requirement that it should be free from impurities or particles that can give adverse effect to the properties of concrete. The role of water is important to prevent side reaction during hydration process which may weaken the concrete. Normal tap water is the most suitable to be use in concrete mixing.

2.4 SIZE OF BRICKS

Bricks can be made in multiple shapes and size depending on the application. The size of bricks is made for convenient to handle and light enough for lifting and placing with hand.

According to British Standard, BS3921:1985, the size for one unit of brick must have dimension at least 215mm long, 102.5mm width and 65mm height. The proposed size of the bricks for this research is in the table below:

Table 2.1: Working sizes of bricks

Size of Bricks	Length	Width	Height
Coordinating size (mm)	225	112.5	75
Work size (mm)	225	115	75

2.5 SAW WOOD DUST

Saw wood dust is industrial waste materials that can be easily found at sawmill in various shapes and size. It is a by-product of cutting, grinding sanding or otherwise pulverizing wood with tools like saw. Heaps of saw dust generated daily because this daily activity. It is reprocessed into other material or otherwise it will be used as burner material. Continuous generation of waste arise from industrial by-product can create acute environmental problem in term of treatment and disposal.

Finally the saw wood dust can use to create benefits for our environment. The density of the saw wood dust are varies from 650 kg/m^3 to 1650 kg/m^3 and if the saw wood dust is use as sand substitution, it can help to reduce the density to considerable extent (Dr. T.N. Boob, 2014). Saw wood dust can be used as alternative to substitute for fine aggregates is light weight and excellent in heat insulation and high fire resisting value. Concrete obtained from the mixture of saw wood dust, gravel with certain percentage of water to entrance the workability and full of hydration which help the bonding of the cement. (Usman and Idusuyi, 2012). By producing durable concrete, serviceability and life cycle cost of structure and other construction works can be reduce.

CHAPTER 3

EXPERIMENTAL PROGRAMME

3.1 INTRODUCTION

In this chapter, the material used in the experimental and the test method and experimental investigation conducted will be discuss in detail. The main focus of this research is to determine the engineering properties, compressive strength of the sand brick as stated in the scope of study. However the other focus of the research is the potential of the saw wood dust to be implemented as waste product in construction field. The experimental are conducted in the Heavy Concrete laboratory Universiti Malaysia Pahang. The collection and preparation of all the materials are carried out after all the detailed calculation of the materials was decided and finalized. Then the step of mixing and manufacturing of the sand bricks samples are done. Later, the procedures for testing the sand brick samples are conducted with referring the related standard used in the industry. The results of the testing are presented and discussed. Figure 3.1 below shows the overview of the work done in the laboratory and after results obtained.

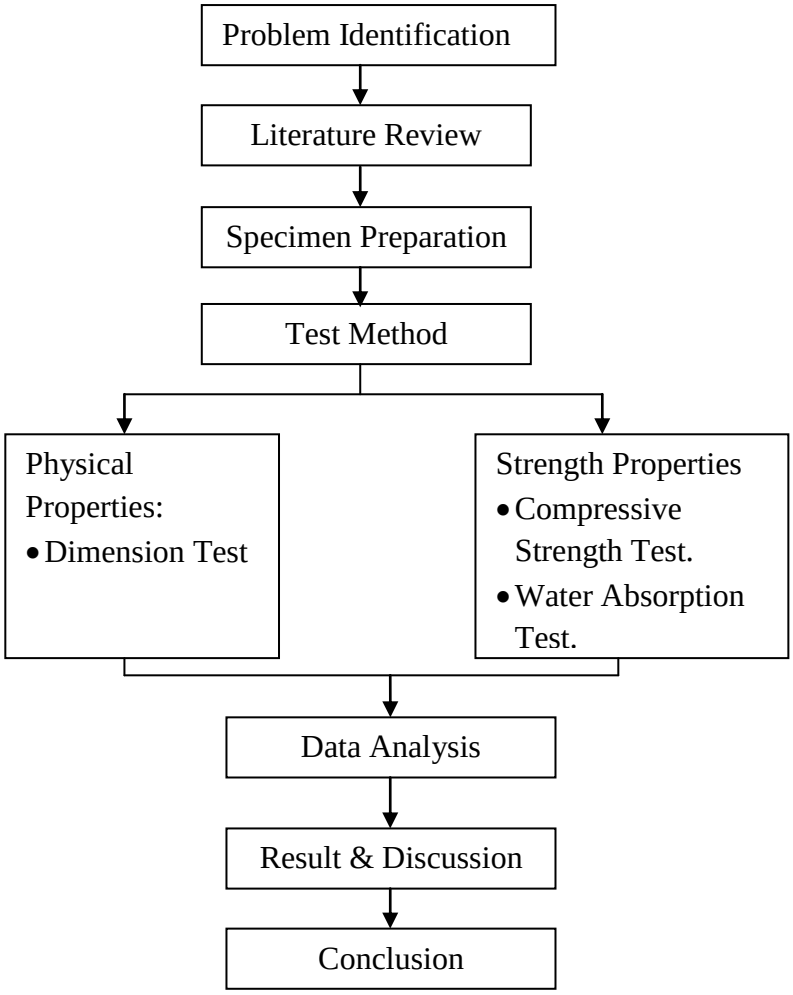

Figure 3.1: Flow of research study

3.2 MATERIAL USED

The materials use in the sand bricks manufacturing are ordinary Portland cement, river sand, saw wood dust and water. The preparation of the materials are done and handled carefully to make sure the bricks produce followed the study research. All the materials are tag and keep in container closed tightly by lid to ensure it is in good condition and to avoid mixing with other materials.

3.2.1 Ordinary Portland Cement (OPC)

The cement used in the mixes ratio 1:3 to river sand. The ordinary Portland cement was produced by YTL Cement Sdn. Bhd. This cement product is suitable for brick making and all general purpose applications. During preparation of the materials, the cement that has been weighted was kept in airtight container to avoid the effect to the cement reaction with air and vapor.

Table 3.1: The chemical composition of Ordinary Portland Cement

Chemical Constituents	Percentage by mass in cement (%)
Calcium Oxide (CaO)	46
Silica Oxide (SiO_2)	43.1
Aluminium Oxide (Al_2O_3)	5.0
Ferric Oxide (Fe_2O_3)	2.6
Loss On Ignition (LOI)	1.3
Magnesium Oxide (MgO)	1.1
Potassium Oxide (K_2O)	0.5
Sodium Oxide (Na_2O)	0.2
Manganese Oxide (MnO_3)	0.2

Source: Dr. Kimberly Kurtis

3.2.2 Saw Wood Dust

The saw wood dust used in this study was collected from the sawmill factories located around Gambang and Kuantan, Pahang. The saw wood are waste from wood planning and the dust come in varies of sizes and thickness.

In order to prepared the material, first step is the collected saw wood dust were let dry in room temperature for a few days in order to remove excessive moisture. This is because the saw wood dusts collected from the saw mill are damp due to surrounding humidity at the saw mill factories and seasonal changes. Second, the saw wood dusts are sieve. The bigger sizes wood and unwanted impurities are removed and only wood dust passing sieve size 2mm are taken to be use in this study.

Figure 3.2: The saw wood dust collected from saw mill

Figure 3.3 Procedure sieving saw wood dust

3.2.3 River Sand

Fine aggregate is used in the manufacturing of sand brick. The fine aggregate is prepared by filtering it to remove the unwanted impurities and any bigger of aggregate that size more than 5mm. The sand used is normal surrounding temperature and not contain excessive moisture.

3.2.4 Water

Water is needed to mix the material and during hydration process of the concrete and bricks. The type of water used to bind the materials is ordinary tap water. Tap water is used because it is assure clean, easy to obtain and not harmful in the hydration process of cement.