WET COCONUT FIBER AS AN ADDITIVE IN THE CONCRETE MIXTURE

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ABSTRACT

Concrete is one of the materials that is widely used in construction all around the world. This material is used because it has several benefits such as, more durable, energy-efficient, low maintenance, affordability, fire-resistance, excellent thermal mass and also versatility. This study was conducted to determine the workability, compressive strength and flexural strength of concrete to produce good fibrous concrete by using wet coconut fiber as an additive in concrete mixture. Agriculture waste material can help to increase the strength of concrete. The source of natural fiber are found in plant and they are readily environmental friendly and cheap. In addition, natural fiber has an excellent potential to improve the performance of concrete. In this study, workability of concrete means the ability to work with concrete. The workability of the concrete was tested by using slump test.. The slump test was conducted when the concrete mixture still fresh. For compressive strength, the test was conducted to know the strength of cube concrete with different percentages which are 1% and 2% compared between normal concrete. A total of 27 cubes with 150mm×150mm×150mm were used to determine the compressive strength of concrete with addition of wet coconut fiber. For flexural strength, , the test was conducted to know the strength of beam concrete with different percentages with are 1% and 2% compared between normal concrete. A total of 27 beams with 100mm×100mm×500mm were used to determine the strength of concrete with addition of wet coconut fiber All this specimens is curing for 7 days, 14 days and 28 days using water curing method. The best result is from the flexural strength because the concrete with addition of wet coconut fiber was better than normal concrete. The result for 28 days show 9.57 MPa for normal concrete, 9.58 MPa for concrete with 1% addition of wet coconut fiber and 10.95 MPa for concrete with 2% addition of wet coconut fiber.

ABSTRAK

Konkrit adalah salah satu bahan yang digunakan secara meluas dalam pembinaan di seluruh dunia. Bahan ini digunakan secara meluas kerana ia mempunyai beberapa faedah seperti, lebih tahan lama, tenaga yang cekap, penyelenggaraan yang rendah, rintangan api, jisim haba yang sangat baik dan juga serba boleh. Kajian ini dijalankan untuk menentukan kebolehkerjaan, kekuatan mampatan dan kekuatan lenturan konkrit untuk menghasilkan konkrit berserat yang baik dengan menggunakan sabut kelapa basah sebagai bahan tambahan dalam campuran konkrit. Pertanian bahan buangan boleh membantu untuk meningkatkan kekuatan konkrit. Sumber serat semula jadi terdapat dalam tumbuhan dan mereka mudah mesra dan murah alam sekitar. Di samping itu, serat semula jadi mempunyai potensi yang sangat baik untuk meningkatkan prestasi konkrit. Dalam kajian ini, kebolehkerjaan konkrit bermaksud keupayaan untuk bekerja dengan konkrit. Kebolehkerjaan konkrit telah diuji dengan menggunakan ujian kemerosotan Ujian kemerosotan dijalankan apabila campuran konkrit masih segar. Untuk kekuatan mampatan, ujian telah dijalankan untuk mengetahui kekuatan konkrit kiub dengan peratusan yang berbeza dengan 1% dan 2% berbanding dengan konkrit biasa. Sebanyak 27 kiub dengan 150mm × 150mm × 150mm digunakan untuk menentukan kekuatan konkrit dengan penambahan serat kelapa basah. Untuk kekuatan lenturan, ujian telah dijalankan untuk mengetahui kekuatan konkrit rasuk dengan peratusan yang berbeza dengan 1% dan 2% berbanding dengan konkrit biasa. Sebanyak 27 rasuk dengan 100mm × 100mm × 500mm digunakan untuk menentukan kekuatan konkrit dengan penambahan serat kelapa basah Semua ini adalah spesimen menyembuhkan selama 7 hari, 14 hari dan 28 hari dengan menggunakan kaedah pengawetan air.. Analisis menunjukkan hasil, Keputusan terbaik adalah dari kekuatan lenturan kerana konkrit dengan penambahan serat kelapa basah adalah lebih baik daripada konkrit biasa. Keputusan untuk 28 hari menunjukkan 9.57 MPa untuk konkrit biasa, 9.58 MPa untuk konkrit dengan tambahan 1% daripada gentian kelapa basah dan 10.95 MPa untuk konkrit dengan tambahan 2% serat kelapa basah.

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LIST OF SYMBOLS

kN	kiloNewton
MPa	MegaPascal
N/mm^2	Newton per milimeter square
mm	Milimeter
cm	Centimeter
%	Percent

CHAPTER 1

INTRODUCTION

1.1 BACKGROUND OF STUDY

Nowadays, construction industries have been commonly used concrete as the main material to construct bridges, buildings, dams, highways and other structures. Concrete is known as a composite material contain of cement, water, fine aggregate and also coarse aggregate. The concrete can be cast up to 50 MPa, so it can withstand some of the natural disaster such as hurricanes and also earthquakes.

The new developments continue in the advance of concrete materials. There are many researchers used natural fiber as fibrous material to increase the concrete strength. The investigation has been carried out using several natural fibers as fibrous materials such as bamboo, banana, eggshell and also coconut fiber. In addition, the natural fiber is known to have good characteristic in increasing the flexural strength of the lightweight concrete and also in reducing the amount of waste. Nowadays, many studies had been done to utilize natural waste as additive in concrete mixture. As an example, the addition of coconut fiber significantly improved many of the engineering properties of the concrete in toughness and tensile strength (Yalley and Kwan, 2009).

Coconut fiber is a fibrous material found in fibrous husk of the coconut palm. From Ramakrishna studies in 2005, coconut fiber can enhance concrete and mortar, and proved to improve the toughness of the concrete and mortar. Yalley and Kwan (2009), found the addition of coconut fiber significantly improved many of the engineering properties of the concrete in toughness and tensile strength. So, used of fibrous material like coconut fiber as additive in concrete will produce high flexural strength concrete. The practice will also results in reducing the cost of raw materials which directly maximize the use of waste materials and it is also reduce the total cost of construction.

1.2 PROBLEM STATEMENT

As the year passing, the demands of the concrete have been increasing day by day. The problem that occur is the concrete is highly used in construction site which increasing the cost of construction. Besides that, it is also affecting the environmental problem in construction industry.

Agriculture waste material can be used to increase the flexural strength of concrete. The source of natural fiber as fibrous material are found in plant and they are readily environmental friendly as well as cheap. In addition, natural fibers such as coconut fiber an excellent potential to improve the properties of materials, and could be also used effectively to improve the performance of concrete.

To solve the problem from continuously occur, a study will be carried out to determine the use of an agriculture waste material which is coconut fiber as an additive in concrete mixture for construction industry. Coconut fiber used to minimize the construction cost, reducing the environmental problem and also maximize usage of waste materials.

1.3 OBJECTIVES OF STUDY

i. To determine the workability of concrete when added with 1% and 2% of coconut fiber in the concrete mixture.
ii. To determine the compressive strength of concrete when added with 1% and 2% of coconut fiber in the concrete mixture.
iii. To determine the flexural strength of concrete when added with 1% and 2% of coconut fiber in the concrete mixture.

1.4 SCOPE OF STUDY

This study was conducted to determine the strength of concrete added with coconut fiber. In addition, coconut fiber has an excellent potential to improve the performance of concrete. The scope of work mainly focuses on:

i. In this study, grade concrete 15 MPa using 0.55 w/c ratio were design. The mixture is contains fine aggregates, coarse aggregates, cement and water.
ii. Specimens of coconut fiber concrete will be added with two different percentages of coconut fiber (1% and 2%).
iii. This study will compare the strength of concrete between coconut fiber concrete and control concrete.
iv. The slump test will be carried out to determine the workability of concrete according to British Standard (BS EN 12350: Part 2 (2009)).
v. The compression test will be carried out to know the compressive strength of concrete according to British Standard (BS 1881: Part 116: 1983) and ASTM C 39-03. The size of cube that will be cast is 150mm x 150mm x 150mm for 27 cubes.
vi. The flexural test will be carried out to know the flexural strength of concrete according to British Standard (BS 1881: Part 118) and ASTM C 78-02. The size of beam is 100mm x 100mm x 500mm for 27 beams.
vii. The concretes will undergo curing process for 7, 14 and 28 days in water curing.

1.5 SIGNIFICANCE OF PROPOSE STUDY

This study will be carried out to determine the performance of coconut fiber as additive in concrete for construction industry. The performance of coconut fiber will be tested by using slump test for workability of concrete, compression test for compressive strength and flexural test for flexural strength. From the researched data, the coconut fiber has excellent potential to improve the properties of materials, and could be used effectively to improve the performance of concrete.

CHAPTER 2

LITERATURE REVIEW

2.1 INTRODUCTION TO CONCRETE

Concrete is a composite material composed of water, aggregate, and cement. Often, additives and reinforcements are included in the mixture to achieve the preferred physical properties of the finished material. When these ingredients are mixed together, they form a fluid mass that is easily moulded into shape. Over time, the cement forms a hard medium which binds the rest of the ingredients together into a durable stone-like material with many uses. Each steps of the process makes a unique contribution to the quality of the final concrete product (Kejin & Jiong, 2005). Concrete also needs more attention in production process to avoid in producing poor concrete.

The new developments continue in the advance of concrete materials. There are many researchers used natural fiber as additive or replacement in concrete to increase the concrete strength. The investigation has been carried out using several natural fibers as palm kernel shell, bamboo, banana, eggshell and also coconut fiber. In addition, the natural fiber is known to have good characteristic in increasing the flexural strength of the lightweight concrete and also in reducing the amount of waste. Nowadays, many studies had been done to utilize natural waste as additive or replacement in concrete mixture.

The production of cement are producing large amount of carbon dioxide which is dangerous to the environment. Therefore, waste components like oil palm sludge and coconut fiber are mixed into concrete in order to reduce the environmental problem.

2.2 HISTORY OF CONCRETE

The legacy of concrete is as lasting as the material itself. Concrete is a material used in building construction, consisting of a hard, chemically inert particulate substance, known as an aggregate (usually made from different types of sand and gravel), that is bonded together by cement and water.

In early century, the Assyrians and Babylonians used clay as the attachment substance or cement and Egyptians used lime and gypsum cement. In year 1756, British engineer, John Smeaton made the first modern concrete (hydraulic cement) by using pebbles as a coarse aggregate and mixing powered brick into the cement. In 1824, English inventor, Joseph Aspdin invented Portland Cement, which has remained the main cement used in concrete production. Joseph Aspdin created the first true artificial cement by burning ground limestone and clay together. The burning process changed the chemical properties of the materials and Joseph Aspdin created a stronger cement than what using plain crushed limestone would produce.

The other major part of concrete besides the cement is the aggregate. Aggregates include sand, crushed stone, gravel, slag, ashes, burned shale, and burned clay. Fine aggregate is used in making concrete slabs and smooth surfaces. Coarse aggregate is used for sections of cement or massive structures.

2.3 ADVANTAGES AND DISADVANTAGES OF COCNCRETE

Concrete is an artificial stone-like material used for various structural purposes. It is made by mixing of cement, fine aggregates, course aggregates and water and allowing the mixture to harden by hydration.

Concrete definitely presents technological advantages that can be made from local inexpensive materials and it can be cast in any shape. Concrete has a good compressive strength and it also does not rot. Concrete is not affected by humidity does not burn and it was not attacked by insects but it can be attacked by certain bacteria. Moreover, when concrete was well mixed, transported, placed and cured, it becomes a durable construction material in most environmental conditions. Concrete technology was simple because it consists essentially in mixing a fine powder with aggregates, water and admixtures and in compacting of this freshly mixed material into forms where it takes its final hardened shape and strength within less than a day.

Concrete also presents some disadvantages there are weak in tension, heavy, not volumetrically stable because it shrinks and creeps or sometimes swells. Moreover, concrete must be properly cured to reach its full potential as a structural material, and its durability can be impaired in severe environmental conditions, usually acidic conditions which stated by Baron and 011ivier (1992). Today, some of these weaknesses have been partly overcome with reinforcing bars, fibres, admixtures and lightweight aggregates.

2.4 PROPERTIES OF FRESH CONCRETE

Concrete is an artificial stone made essentially of Portland cement, water, and aggregates. While cement in one form or another has been around for centuries, the type we use was invented in 1824 in Britain.

The performance requirements of fresh concrete were more or less well defined with respect to shape, finish, strength, durability, shrinkage and creep. To achieve these objectives economically, the fresh concrete, in addition to having a suitable composition in terms of quality and quantity of cement, aggregates and admixtures, should satisfy a number of requirements from the mixing stage till it was transported, placed in formwork and compacted. The mix should be able to produce a homogenous fresh concrete form the constituent materials of the batch under the action of the mixing forces.

The mix should be stable, in that it should not segregate during transportation and placing when it was subjected to forces during handling operations of limited nature. Besides that, the mixture should be cohesive and sufficiently mobile to be placed in the form around the reinforcement and should be able to cast into required shape without losing continuity or homogeneity under the available techniques of placing the concrete at the particular job which termed as flowability and mobility for of fresh concrete. Besides that, it can be be ameable to proper and thorough compaction into a dense, compact concrete with minimum voids under the existing facilities of compaction at the laboratory work or site. Lastly, it should be possible to attain a satisfactory surface finish without honeycombing or blowing holes from moulds and on free surface by troweling and other process which namely by finishing. These entire requirements were affected of the workability of the concrete.

2.4.1 WORKABILITY OF CONCRETE

Workability defined as that property of freshly mixed concrete or mortar which determined the ease and homogeneity with which it can be mixed, placed, compacted and finished. A slump test can be used to measure the workability of concrete. The workability was affected by the amount of cement paste added. The cement paste was the soft or liquid part of the concrete mix. The more mixed with the coarse and fine aggregates, the more workable a mix. Furthermore, it's also affected by the aggregate grading. Well- graded, smooth, rounded aggregates will improve the workability of a mix. An additional water to the concrete mixture will lead to the lowers the strength and durability of the concrete.

There 3 types of slumps which is true slump, shear slump and collapse slump. Figure 1 shows the method to measure the slump.

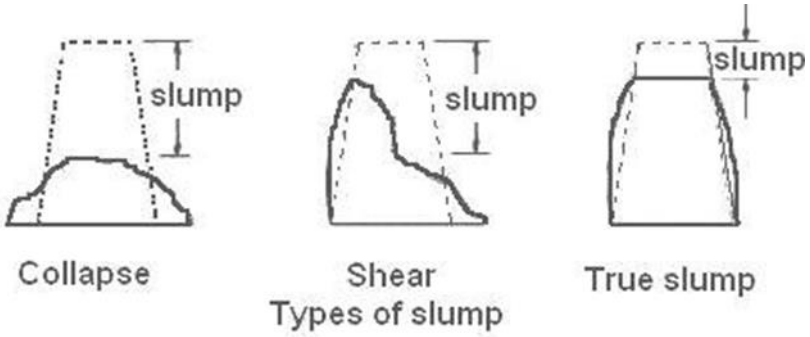

Figure 2.1: Method to Measure the Slump

Source: Civil Engineering Portal (2014)

Figure 2.1 above shows, in a collapse slump the concrete collapses completely. A collapse slump will normally mean that the mix is too wet or that it is a high workability mix, for which slump test is inappropriate.

In a shear slump the top portion of the concrete shears off and slips sideways or if one-half of the cone slides down an inclined plane, the slump is said to be a shear slump. First, if a shear or collapse slump is achieved, a fresh sample should be taken

and the test is repeated. Second, if the shear slump persists, as may the case with harsh mixes, this is an indication of lack of cohesion of the mix.

In a true slump the concrete simply subsides, keeping more or less to shape. This is the only slump which is used in various tests. Mixes of stiff consistence have a Zero slump, so that in the rather dry range no variation can be detected between mixes of different workability.

2.5 STRENGTH OF CONCRETE

Cement, water, fine aggregates, course aggregates and sometimes admixtures is one of the ingredient of concrete. The mixing of these materials in specified proportions produces concrete. Accordingly cement alone is not a building material, it is the concrete which is a building material. For a given cement and acceptable aggregates, the strength that may be developed by a workable, properly placed mixture of cement, aggregates, and water which is under same mixing, curing and testing conditions.

2.5.1 COMPRESSIVE STRENGTH OF CONCRETE

The compressive strength is the capacity of structure or material to withstand loads tending to reduce size. It can be measured by applying force against deformation in a testing machine. Some materials cracked at their compressive strength limit and others deform permanently, so a given amount of deformation may be considered as the limit for compressive load. Compressive strength is a key for design of structures.

To measure the compressive strength is by using Universal Testing Machine (UTM). This UTM is specifically design to test the compressive strength. Measurements of compressive strength are affected by the specific test method and conditions of measurement.

Figure 2.2: Universal Testing Machine (UTM)

2.5.2 FLEXURAL STRENGTH OF CONCRETE

Flexural strength is one measurement of the tensile strength of the concrete. This kind of measurement is used for concrete beam or slab to resist failure in bending. The flexural strength is expressed as Modulus of Rupture (MR) in psi (MPa) and is determined by standard method ASTM C 78 (third-point loading) or ASTM C 293 (center-point loading).

Flexural strength is about 10 to 20 percent of compressive strength depending on the type, volume and size of coarse aggregate used. However, the best correlation for specific materials is obtained by laboratory tests for given mix design and materials.

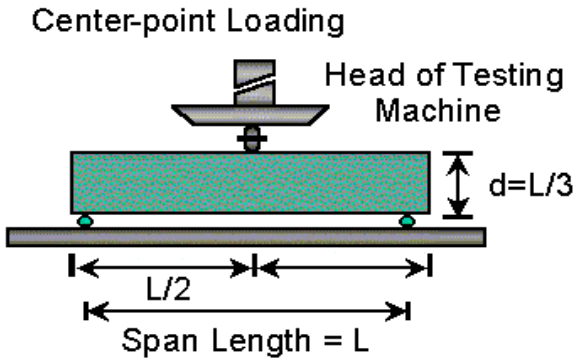

Figure 2.3: Flexural test for Third-Point Loading

Source: American Concrete Pavement Association (2013)

Figure 2.3 above shows, it is show Flexural Strength of Concrete using a Simple Beam with Third-Point Loading. These flexural tests is also called Modulus of Rupture test and its performed using concrete beams that have been cast and cured in the field. If the strength values are measured using some other test method, it must be converted to the 28-day third-point strength.

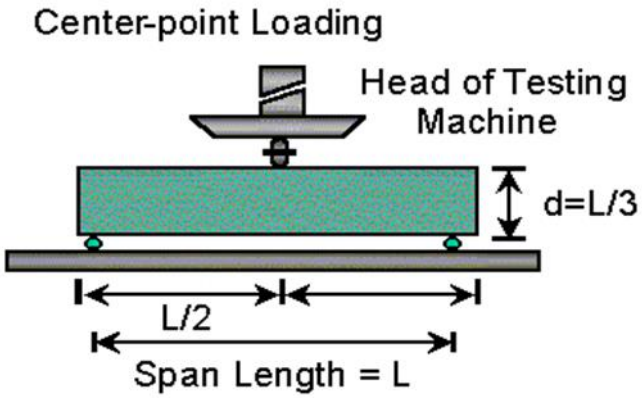

Figure 2.4: Flexural test Center-Point Loading

Source: American Concrete Pavement Association (2013)

Figure 2.4 shows the Center-point loading forces the beam to fail directly under the center of the loading. By forcing the beam to fail at the center, the center-point flexural test results are higher than the third-point test results. Typically, the center point

results are about 15% greater. It is provide a reasonable estimate of the concrete's average strength.

2.6 CONCRETE MATERIAL

There are few elements in the making of concrete which are cement, aggregates and water.

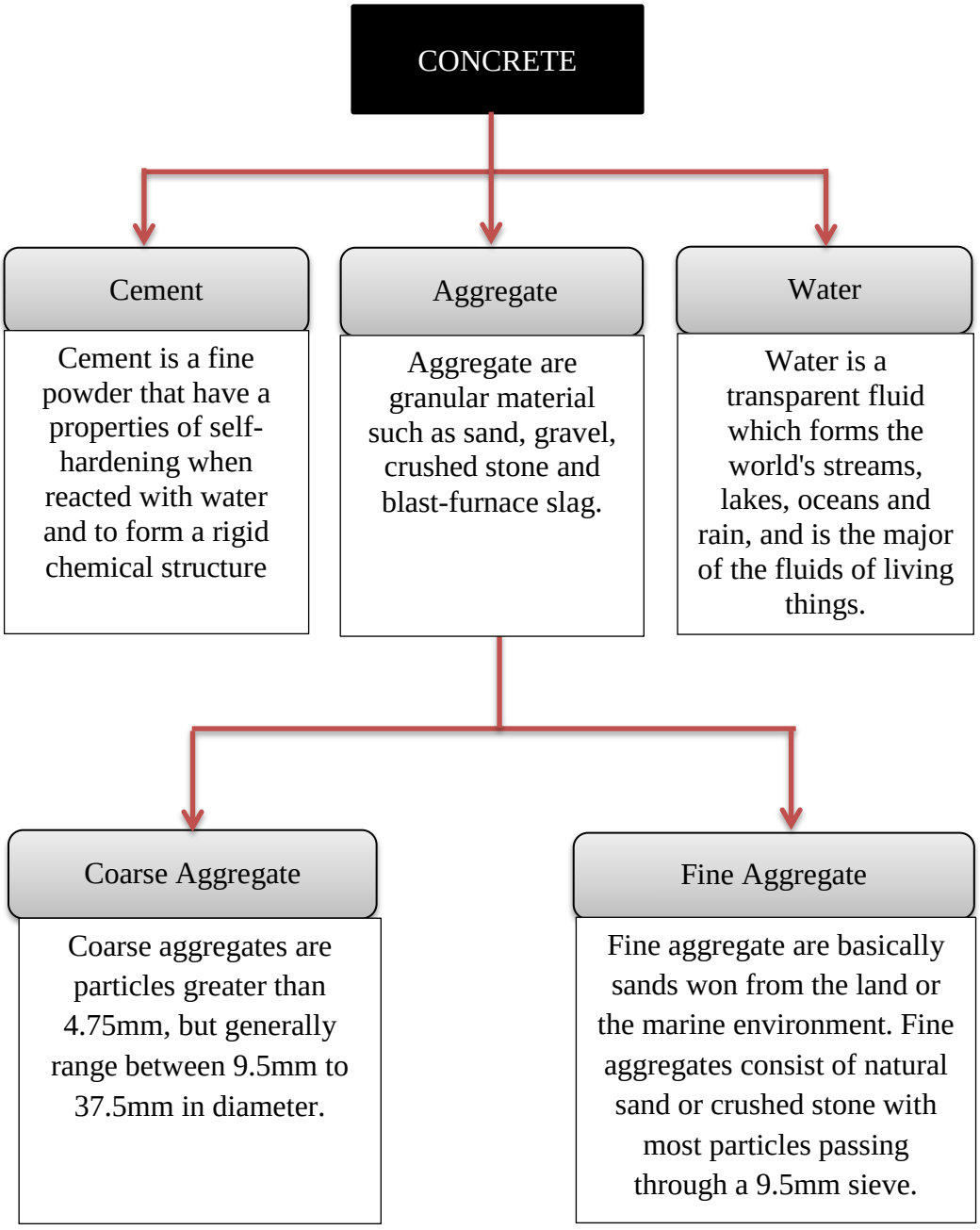

Figure 2.5: Type of elements in concrete

2.6.1 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.

Based on Civil Engineering Laboratory Manual (2011), 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.

Figure 2.6: Portland Cement