DEVELOPMENT OF BRICK FROM MUD FLOOD: MECHANICAL PROPERTIES AND MORPHOLOGY CHANGES

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To;

My Parent

&

My family…

Thanks for your pray, attention and spiritual support…

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ABSTRACT

After the flood event, there is lots of debris and muds were found along the affected area. Soil treatment is an alternative method used to utilize the mud flood to increase the strength of the material to produce bricks. In this study, a series of laboratory test was conducted to determine the optimum mixture stabilizer of non-traditional additives called “SH-85” to stabilize mud flood soil to form a brick. The mud flood soil sample was taken from Kuala Krai, Kelantan after the flood event. Basic test such as Atterberg limit test, specific gravity test, sieve and hydrometer were carried out to determine the physical properties of mud flood soils thus used for soil classification. Unconfined Compressive Strength (UCS) test was conducted for treated and untreated of mud flood soils which were used to assess the engineering properties of the stabilized soil. The proportions of stabilizer added were 3, 5, and 10% from the soil weight and tested at 0, 3 and 7 days curing periods. Based on the results, it was found that the used of stabilizer could increase the soil strength. To achieve minimum values of crushing strength for bricks 2750 kPa, additional 2% of sodium nitrate was added to soil with 10% of SH-85 and cured for 3 days at 105 °C temperature. Microstructure analyses were conducted using Energy-Dispersive X-Ray spectrometry (EDX) and field-emission scanning electron microscopy (FESEM) tests. FESEM results show that the void of untreated soil was filled by a new cementations product and show the presence of white colour lumps in treated soil. This finding indicates that the mixture of SH-85 stabilizer and sodium nitrate is suitable for the mud flood soil to become bricks for building construction.

ABSTRAK

Selepas peristiwa banjir, terdapat banyak serpihan dan lumpur telah ditemui di sepanjang kawasan yang terjejas. Rawatan tanah adalah salah satu kaedah alternatif yang boleh digunakan untuk memanfaatkan banjir lumpur bagi meningkatkan kekuatan bahan untuk menghasilkan batu bata. Dalam kajian ini, satu siri ujian makmal telah dijalankan untuk menentukan campuran optimum penstabil bahan tambahan bukan tradisional yang dikenali sebagai "SH-85" untuk menstabilkan tanah banjir lumpur bagi membuat bata. Sampel tanah banjir lumpur telah diambil dari Kuala Krai, Kelantan selepas kejadian banjir. Ujian asas seperti ujian had Atterberg, ujian graviti tentu, ujian tapisan dan hidrometer telah dijalankan untuk menentukan sifat-sifat fizikal tanah banjir lumpur dan digunakan untuk pengelasan tanah. Ujian kekuatan mampatan tak terkurung (UCS) telah dijalankan pada tanah banjir lumpur yang dirawat dan tidak dirawat untuk menilai ciri-ciri kejuruteraan tanah. Kadar penstabil yang ditambah adalah 3, 5, dan 10% daripada berat tanah dan diuji pada 0, 3 dan 7 hari pengawetan tempoh. Hasil kajian mendapati bahawa penstabil yang digunakan boleh meningkatkan kekuatan tanah. Untuk mencapai nilai minimum kekuatan bata iaitu 2750 kPa, 2% natrium nitrat telah ditambah kepada tanah dengan 10% kadar SH-85 dan diawet selama 3 hari pada suhu 105 °C. Analisis mikrostruktur telah dijalankan dengan menggunakan tenaga serakan X-Ray spektrometri (EDX) dan ujian lapangan pelepasan elektron imbasan mikroskop (FESEM). Keputusan FESEM menunjukkan bahawa kekosongan tanah yang tidak dirawat telah dipenuhi dengan produk cementations baru dan juga menunjukkan kehadiran ketulan warna putih di dalam tanah yang dirawat. Kajian ini menunjukkan bahawa campuran SH-85 penstabil dan natrium nitrat sesuai untuk menjadikan tanah banjir lumpur sebagai batu bata untuk pembinaan bangunan.

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CHAPTER 1

INTRODUCTION

1.1 Background of Study

Natural disaster is any catastrophic event that is caused by nature or the natural processes of the earth. Flash flood is one of the common natural disaster that occurring in most parts of the world. Flash flood happens when a sudden and short duration rise in the discharge of a stream with a dramatic contrast among the event and the extended period between floods. On December 2014, East Coast Peninsular Malaysia was hit by flash flood and it's considered the worst in decades. The hardest hit areas are along the east coast of peninsular Malaysia in the states of Kelantan, Terengganu and Pahang were affected by heavy rainfall that triggered flooding. Total of 22,716 persons have been evacuated to 104 Evacuation Centres (Ecs) in Perak and Kelantan. 9 out of 10 Townships in Kelantan Province were affected by flood. The flood cost nearly millions of dollars of property (Association of Southeast Asian Nations, 2014).

After the flood event, it can be seen as shown in Figure 1.1 that a lot of debris and mud were found along the affected area. It is wise if we make use of flood deposit instead of thrown away as a disposal material. Tse (2012) had made a research and was used flood deposit as raw materials in the local manufacture of burnt bricks for the construction of houses.

Figure 1.1: Mud flood that need to be removed after flood event

The brick was anciently produced by mixing the virgin resources, forming the bricks, drying them and then firing them. The conventional method to prepare the mud brick is by mixing mud manually with water into a plastic paste. Then the sample compacted in wooden mould and dried before fired (Tse, 2012). Furthermore, the minimum compressive strength of bricks should be 3500 kPa and the water absorption should not exceed 20% (Ibanga *et al.*, 2007). According to Tamizi *et al.*(2013), the conversional cement brick is 3020 kPa after 3 days curing.

In order to achieve sustainability aspects many researches were conducted to develop a bricks from waste materials. They used entirely wastes without exploiting any sort of natural resources. The products that normally used to made the brick material are waste treatment residual, granite waste, paper sludge, straw fibers, waste treatment sludge and fly ash (Shakir & Mohammed, 2013). Soil stabilization is a process to improve the physical and engineering properties of soil to obtain some predetermined targets (Ali, 2012). Any material containing mostly Silicon (Si) and Aluminium (Al) in amorphous shape might be suitable to produce a brick (Mathew *et al.,* 2013). Due to the mud flood consist of Si and Al; therefore it is suitable for the brick production.

Using chemicals for soil stabilization nowadays is getting more attention and this popularity is due to the low cost and convenience of this technique, especially for high volume of soil improvement in the geotechnical projects. The objective of this stabilization technique is to increase the strength parameters of soils (Ou *et al.,* 2011). Biomass Silica (BS) is the one non-traditional chemical soil stabilizers that are used in some geotechnical projects in Malaysia. 'SH-85' stabilizer is a commercial BS product that was proven suitable to stabilize soil (Marto *et al.,* 2014). Latifi (2013) also reported that SH-85 stabilizer agent can increase soil strength with curing time while SEM results indicated that this stabilizer agent filled the porous areas inside the soil by forming cementation gel.

In this study, an effort was made to investigate the reaction of mechanisms after mixing the SH-85 stabilizer with mud flood soil. Hence, the alteration in microstructural properties of treated soil was monitored at different combinations. Several tests that were employed in this study were unconfined compression strength (UCS), Atterberg limits, Energy-Dispersive X-Ray spectrometry (EDX) and Field-Emission Scanning Electron Microscopy (FESEM) tests.

1.2 Problem Statement

International Federation of Red Cross and Red Crescent Societies (2014) reported on 15 December 2014 to 3 January 2015, East Coast Peninsular Malaysia was hit by serious flood event. The flooding is considered the country's worst in the decades. After the flood event, there is lots of debris and muds were found along the affected area. In the extreme condition, the mud was encountered inside the flood victim houses and along the road. To clean up all the mess it is require a lot of effort, energy and financial to settle it down. At one point that the mud flood doesn't have enough place to put and desperately stacked besides building and road waiting to be thrown away. It is wise if the mud flood deposit can be reuse for other benefits. Based on the previous study, the mud flood is suitable to be used as a raw material for the brick production. The brick production from waste material has potential to produce economical bricks and also it is a sustainable solution.

1.3 Objective of Study

The objectives of the study are:-

1) To develop brick based on mud flood and non-traditional stabilizer.

2) To evaluate the soil classification of the mud floods soil

3) To determine the optimum mixture stabilizer and the microstructure of treated and untreated mud floods

4) To determine the compressive strength of develop brick from mud floods

1.4 Scope of Study

The study scopes are using mud flood soil taken from Kuala Krai, Kelantan approximately a week after the flood event settled down. The mud flood soil was transported to the laboratory to determine the engineering properties and the compressive strength of mud flood soil under treated and untreated conditions. Development of bricks in this study is using Biomass Silica (BS) or also well known as non-traditional stabilizer agent. Stabilizer agent utilized in this study with the commercial name ‘SH-85’ was supplied by Probase Manufacturing Sdn Bhd, a local company in Johor state of Malaysia. Stabilizing agent is a chemical which tends to inhibit the reaction between two or more other chemicals. The proposed of different proportion of SH-85 stabilizer shown in Tables 1.1 and 1.2. The optimum mixture between stabilizer and mud floods can be identified. In addition, Energy-Dispersive X-Ray spectrometry (EDX) and field-emission scanning electron microscopy (FESEM) tests is use to determine the microstructure of untreated and treated mud floods with SH-85 stabilizer.

Table 1.1: Proposed proportion of SH-85 stabilizer using curing method

Sample	**Curing Period**		
	0 day	**3 days**	**7 days**
Untreated Soil	✓	–	–
Soil + 3% SH85	–	✓	✓
Soil + 5% SH85	–	✓	✓
Soil + 10% SH85	–	✓	✓

Table 1.2: Additional proposed proportion of SH-85 stabilizer after three days stabilization period

Sample	Curing Method	Oven Method
Soil + 0% SH85	✓	✓
Soil + 10% SH85	✓	✓
Soil + 10% SH85 + 2% sodium nitrate	✓	✓

1.5 Significance of Study

The developed bricks will help to reuse and fully utilized waste material from flood deposit to become a construction product and can be used to rebuild the damaged houses. Moreover, to produce lower cost of bricks compare to the commercial bricks in the market using waste material.

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