

Influence of Burning Method of Sewage Sludge Ash on ESP-SSA Mortar Brick Mechanical Properties

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Abstract. The increasing growth of population has led to increasing number of waste generated every year. One of the concerns is on the effective management of the solid waste. The production of sewage sludge from the waste water treatment plant is increasing every year. Its high content of heavy metal was harmful to environment and must be dump in proper way at the landfill area to prevent pollution to surrounding. The major components of SSA are SiO_2 , CaO , Al_2O_3 , Fe_2O_3 , Na_2O , K_2O , MgO and FeO . Furthermore, eggshell is also classified as waste material that has high rate of consumption in Malaysia. Nowadays, as the construction industries develop rapidly, the demand of cement mortar brick has also increased. This will lead to increase in cement production and emission of carbon dioxide because the cement industry is one of the major contributors of carbon dioxide emission in the world. Hence, this research is helping in reducing usage of cement with replacing cement partially with the sewage sludge ash (SSA), and also helping reducing the waste to environment by using eggshell powder as additive. It is necessary to burn the sludge to remove the heavy metals contains in sewage sludge before it can be use in the mixture of mortar brick. Two different methods was use in this research to burn the sewage sludge which are Incineration method and also Microwave method. Heavy metals in the sewage sludge were removed by incinerate in the furnace at the temperature of 800°C with the period of 3 hours producing Incinerated Sewage Sludge Ash (ISSA) while the Microwave Sewage Sludge Ash (MSSA) was produced by burning the sewage sludge at medium high temperature of microwave for 30 minutes. While the dry eggshell is only grind into the powder form after 24hour of drying process under the sun. Four different percentages of Eggshell Powder (ESP) and 10% fixed of MSSA and ISSA as optimum dosage partially replacing the cement are used to test the brick mortar properties in term of compressive strength, flexural strength and also water absorption. Result shows that ISSA with 10% replacement of ESP is the most optimum brick with highest compressive strength and flexural strength compared to MSSA brick. While, MSSA brick with 10% of ESP shown the best result in water absorption. But, the water absorption rate for 10% ESP in ISSA still good as low in its range.

1 Introduction

For sustainable development, waste should be recycled, reused, and channelled towards the production of value added products. The Eggshell is an agricultural waste largely considered as useless and is discarded mostly because it contributes to pollution [1]. The food industry in Malaysia generates huge amount of eggshell waste every year as Malaysian is one of the largest egg-eaters in the world consumed 20 million eggs daily averaging 320 eggs per person per year as compared to only 250 in the USA [2]. Although eggshell is known as natural solid waste which is non-hazardous, it may attract rats and worms due to the organic protein matrix that may pose health problem to the public [3]. Through research, found that Calcium Carbonate (CaCO_3) replacing cement can have benefits in minimizing the usage of natural lime in cement production [4].

Approximately 95% of a dry eggshell is calcium carbonate [5]. The chemical composition (by weight) of by product eggshell has shown percentage of calcium carbonate (95%), followed by 5% of magnesium, aluminium, phosphorus, sodium, potassium, zinc, iron, copper, ironic acid and silica acid [6]. Similarly, CaCO_3 is the primary raw material in the production of cement.

Otherwise, Indah Water Consortium Sdn Bhd recorded that an estimation of 7 million cubic meter of sewage sludge will be produced annually in the year of 2020 [7]. In recent years sewage waste production has increased and may lead to high usage of landfills [8]. The usage of burning method in this research to burn the sewage sludge may produce refined pozzolan that can trigger pozzolanic reaction in the cement based reaction [9]. Sewage Sludge Ash which contains inorganic components, including Al_2O_3 , SiO_2 and in flux (i.e., Fe_2O_3 , FeO , CaO , MgO , Na_2O , and K_2O), has been used

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