Utilization of Industrial By-products as Cement Replacement Materials in Thailand

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ABSTRACT

In this work, a number of by-products available in Thailand were investigated for use as cement replacement materials. Particle size analyses were carried out using a scanning electron microscope and a laser particle size analyser. Measured particle size of these by-products was compared with those of Portland cement and also to the ASTM fineness requirement. The results showed that both fly ash and rice-husk ash had to be further processed through sieving and milling respectively in order to obtain the suitable particle size. Silica fume, on the other hand, was found to be extremely fine with its particle size being in the nano range (≈100nm). These by-products are also pozzolanic which can improve the properties of cement and concrete and therefore, has good potential for use as cement replacement materials in the Thai construction industry, provided its particle size is fine enough and meets the ASTM requirement.

Key words: Particle size, Cement, Fly ash, Rice-husk ash, Silica fume

INTRODUCTION

The use of industrial by-products as cement replacement materials started receiving a lot of attention in the late 20th century in Europe and America to cut down high energy required in the Portland cement manufacturing process (Malhotra and Mehta, 1996). Today, with the high price of petrol continues to increase, cutting back on energy use has become the nation's primary policy. However, in Thailand the primary cement being used for making concrete is still Portland cement. Although, there has been increasing use of fly ash (Mae Moh power plant technical information, 2001), other by-products are not recognized as widely. In this work, a number of by-products available in Thailand were investigated for use as cement replacement materials. These are rice-husk ash, silica fume as well as fly ash. This work looks into the potential of their uses in the Thai market in relation to their development in making them suitable for use as cement replacement materials. Test standards now recognize the mixture of such replacement materials and Portland cement as new cements, i.e., pozzolanic cements. Characterisations of the pozzolanic by-products were investigated, using various methods such as scanning electron microcopy (SEM) and laser particle analyser.

MATERIALS AND METHODS

Industrial by-products used in this investigation were rice-husk ash, silica fume and fly ash. Fly ash was collected from Mae Moh power plant in Lampang province while rice-husk ash was collected from a rice mill in Lampoon province and silica fume was obtained from a local construction material store. Powder characteristics such as the particle size, distribution