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Influence of Fly Ash Fineness on Calcium Hydroxide in Blended Cement Paste

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บทคัดย่อ

This research demonstrates the effect of fly ash fineness on calcium hydroxide ($Ca(OH)_2$) in blended cement paste. The investigation of $Ca(OH)_2$ quantity was determined by thermogravimetry analysis (TGA). Two sizes of fly ash, original fly ash and classified fly ash were used to replace Portland cement type I paste with water-to-binder ratio (W/B) of 0.35. This was used in all mixtures and the percentages of fly ash to replace Portland cement of 0, 20, and 40% by weight of binder were used in this investigation. Test results indicated that the amount of $Ca(OH)_2$ in the blended cement pastes containing fly ash is lower than in neat Portland cement paste due to the dilution effect and the pozzolanic reaction of fly ash. The amount of $Ca(OH)_2$ of the blended cement paste with fly ashes decreased with increasing replacement percentage of fly ash and were lower than that of PC paste. It was found that the fineness of fly ash had an effect on the reduction rate of $Ca(OH)_2$. The $Ca(OH)_2$ of fine fly ash pastes dropped more rapidly than those of coarse fly ash pastes. This may be due to the fact that the particle sizes of fine fly ash are smaller than those of coarse fly ash. This reason is that the fine fly ash has a larger surface area to provide the silica and alumina compounds for pozzolanic reaction. The paste containing finer fly ash showed higher pozzolanic reaction rate than the paste containing coarse fly ash.

คำสำคัญ: Fineness, Fly ash, Calcium hydroxide, Blended cement paste.

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Abstract

This research demonstrates the effect of fly ash fineness on calcium hydroxide ($Ca(OH)_2$) in blended cement paste. The investigation of $Ca(OH)_2$ quantity was determined by thermogravimetry analysis (TGA). Two sizes of fly ash, original fly ash and classified fly ash were used to replace Portland cement type I paste with water-to-binder ratio (W/B) of 0.35. This was used in all mixtures and the percentages of fly ash to replace Portland cement of 0, 20, and 40% by weight of binder were used in this investigation. Test results indicated that the amount of $Ca(OH)_2$ in the blended cement pastes containing fly ash is lower than in neat Portland cement paste due to the dilution effect and the pozzolanic reaction of fly ash. The amount of $Ca(OH)_2$ of the blended cement paste with fly ashes decreased with increasing replacement percentage of fly ash and were lower than that of PC paste. It was found that the fineness of fly ash had an effect on the reduction rate of $Ca(OH)_2$. The $Ca(OH)_2$ of fine fly ash pastes dropped more rapidly than those of coarse fly ash pastes. This may be due to the fact that the particle sizes of fine fly ash are smaller than those of coarse fly ash. This reason is that the fine fly ash has a larger surface area to provide the silica and alumina compounds for pozzolanic reaction. The paste containing finer fly ash showed higher pozzolanic reaction rate than the paste containing coarse fly ash.

Keywords: fineness, fly ash, calcium hydroxide, blended cement paste.

1. Introduction

Concrete is a composite material which has a complex microstructure and exhibits a wide range of scale lengths from nanometers to millimeters. Aggregates are the biggest materials in concrete and have particle size in millimeters. At the micrometer scale, the cement paste is a composite of unhydrated residues of cement grains and hydration products (C-S-H, $Ca(OH)_2$, and capillary pore). The availability of $Ca(OH)_2$ is one of the factors affecting the pozzolanic reaction rate since it is the main compound in pozzolanic reacrion. It is known that replacing cement with fly ashes results in lower amount of $Ca(OH)_2$ in paste. Many researches have established its effect of fly ashes on the physical properties and pozzolanic reaction of paste, mortar and concrete. However, the $Ca(OH)_2$ changes due to differences in fly ash fineness are not well established. The present paper, therefore, attempts to provide essential information on the $Ca(OH)_2$ of blended cement with fly ash of two finenesses.

2. Experimental Methodology

2.1 Material

Fly ash from Mae Moh power plant in the north of Thailand, Portland cement type I (PC) and tap water were used in this study. The chemical composition of PC, original and classified fly ashes (OFA and CFA) are given in Table 1. The total amount of the major components SiO_2, Al_2O_3, and Fe_2O_3 in OFA and CFA are 81.54% and 79.44%, respectively. They can be classified as class F fly ash in accordance with ASTM C 618. It should be noted that there is no significant difference in the chemical composition of OFA and CFA. Two fly ash sizes of OFA with median particle size of 19.1 microns and CFA with median particle size of 6.4 microns were used to replace Portland cement. Physical properties of PC, OFA, and CFA are shown in Table 2 and particle size distributions are shown in Figure 1. Particle shapes of PC, OFA, and CFA by SEM are shown in Figure 2.