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DTA CONTRIBUTION TO STUDY OF HYDRATION FLY ASH - PORTLAND CEMENT PASTES

Štefan Slanička, Ján Madej, Doris Jakubeková

Research Institute for Civil Engineering, Bratislava, Czechoslovakia

ABSTRACT

Methods of thermal analysis were used to investigate the influence of fly ash fineness and dosage on pozzolanic reaction and hydration of blended cement pastes. The finer fly ash and the higher its amount the Portland cement being replaced in the blends, the lower is the amount of $Ca(OH)_2$ - this enables to evaluate a pozzolanic activity of fly ash.

INTRODUCTION

Fly ash - due its pozzolanic properties - reacts with $Ca(OH)_2$ liberated in the course of cement hydration. Several methods have been used for $Ca(OH)_2$ amount estimated in cement pastes. The aim of the present work was to investigate the role of the fly ash fineness on cement hydration.

EXPERIMENT

Three types of fly ash from the same plant /SONP Kladno/ were used. The chemical composition was approximately similar for each kind of fly ash. The fly ashes differed in fineness /Tabl./ - the grading was achieved by withdrawing from each the size-ordered separators /filters/. As cement the authors used the current Portland cement of class PC 400 /20,48 % SiO_2; 62,67 % CaO; 5 % Al_2O_3; 3,96 % Fe_2O_3/.

The Portland cement was mixed with fly ash to give the blends containing 15, 30 and 45 per-cent of the addition. The hydration was carried out at a water : solid phase ratio of 0,35. The cubes were cured in the water at 20 °C, measurements were made at hydration pe-

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riods of 3, 28, 90 and 365 days.

Tab. 1 Physical properties of fly ashes and cement

Property		fly ash			Portland cement
		fine	middle	coarse	
Blaine surface area [$m^2.kg^{-1}$]		409,2	304,8	160,7	338,2
Amount of particles [%]	below 60 /um	94,3	53,8	9,0	-
	below 40 /um	89,9	41,6	2,9	-

Thermal analysis system fy MOM, Budapest, was used to obtain thermograms in a temperature range from room temperature to 1000 °C. In each experiment 500 mg of sample was heated in air at 20 °C/min. The amount of $Ca(OH)_2$ was determined from TG-curves as a summary of mass decrease at temperature range 510-530 °C /endotherm corresponding to the dehydration of $Ca(OH)_2$/, and beyond 800 °C /endotherm representing the decarbonation of $CaCO_3$/.

The amounts of $Ca(OH)_2$ in the pastes in relation to percentage of fly ash are shown in Fig. 1. Consupmtion of Ca OH $_2$ due to pozzolanic reaction of fly ash /when comparing with the pure Portland cement paste/ is given in Fig. 2.

DISCUSSION OF RESULTS AND CONCLUSIONS

Methods of thermal analysis were used to investigate the influence of fly ash fineness on the hydration of fly ash - Portland cement pastes. Three kinds of fly ashes from the same plant of very similar chemical composition, but of different fineness /Blaine surface area from 160 to 409 $m^2.kg^{-1}$/ were used as a partial replacement of Portland cement in the amounts of 15, 30 and 45 per-cent.

The experimental results of $Ca(OH)_2$ in cement pastes given in Fig.1 and consumption of $Ca(OH)_2$ by fly ash during pozzolanic reaction given in Fig. 2 show the influence of fly ash fineness and dosage on hydration of Portland cement. While the quantity of $Ca(OH)_2$ in the pure Portland cement paste grew during hydration, the opposite process went on in the blended pastes. The finer fly ash and the higher its content, the lower was the amount of $Ca(OH)_2$.

It was found, that determination both quantity of $Ca(OH)_2$ by

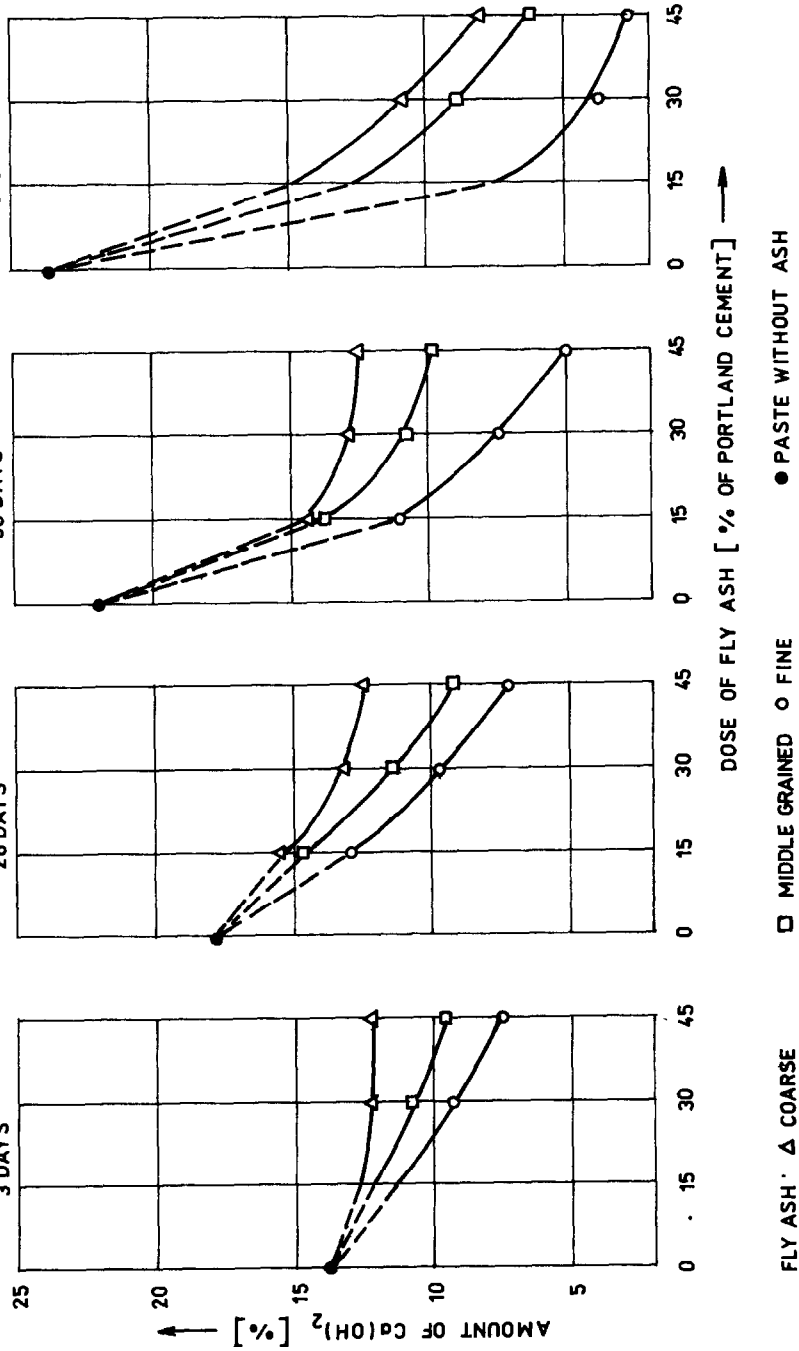
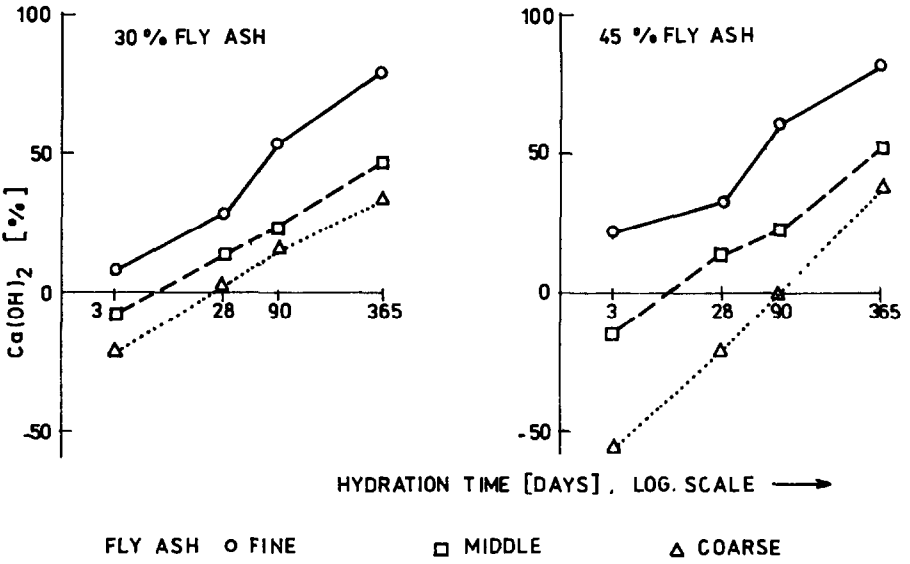


FIG 1 RELATION BETWEEN AMOUNT OF $Ca(OH)_2$ IN CEMENT - FLY ASH PASTES AND DOSAGE OF FLY ASH OBTAINED BY THERMAL ANALYSIS, RELATED TO DRYED PASTES (105°C)

FIG. 2 CONSUMPTION OF $Ca(OH)_2$ DUE TO POZZOLANIC REACTION OF FLY ASH (RELATED TO IGNITED PURE PC PASTE)



methods of thermal analysis and calculation of ratio

$$\frac{Ca(OH)_2 \text{ in blended paste}}{Ca(OH)_2 \text{ in paste made from pure PC} \cdot \text{portion of PC in blend}}$$

enabled to evaluate the pozzolanic activity of fly ash. The obtained results are in agreement with investigations on X-ray analysis and strength development and show a way of possible conservation of cement when it is partially replaced by fly ash of suitable fineness.

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