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MICROSTRUCTURE AND STRENGTH OF MORTARS MADE WITH BLENDED CEMENTS CONTAINING HIGH CALCIUM FLY ASH

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1. INTRODUCTION

According to ECOBA (European Coal Combustion Products Association) statistics, the amount of high calcium fly ash in Europe is more than 50% of the total fly ash produced by burning hard coal and lignite. The amount of high calcium fly ash produced in Poland is about 5 Mtons per year, which corresponds approximately to 30% of the current cement production. Previous research [1-3] suggest that there is considerable variability in the characteristics and hydration behaviour of high calcium fly ash, and the subject deserves further investigations.

The focus of the present paper is on the microstructure, microhardeness and strength of mortars made with different blended cement containing high calcium fly ash. The research concerned prototype cement Type I and V made in laboratory conditions by milling cement constituents up to the same specific surface. Optical microscopy with image analysis, scanning electron microscopy with EDX analysis, depth-sensing indentation and standard methods for evaluating strength were applied.

2. MATERIALS AND LABORATORY TEST METHODS

Ordinary Portland cement CEM I and five blended cements were used. Binary cements with high calcium fly ash:

- CEM II/A-W (14% of HCFA) and
- CEM II/B-W (29% of HCFA),

ternary cements with:

- HCFA – 14% and fly ash class F – 14% , CEM II/B-M (V-W)
- HCFA – 14% and GGBS – 14%, CEM II/B-M (S-W) and
- HCFA – 24% and GGBS – 24% CEM V/A (S-W) were prepared and used in the research.

Standard mortar beams were prepared from the above cements. The specimens were analysed using optical transmitted microscopy – thin sections, scanning electron microscopy

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with EDX analysis – powder and mortars. The micromechanical tests were performed according to relevant standards.

3. RESULTS AND DISCUSSION

Early compressive strength of mortars made with blended cements was slightly lower than compressive strength of reference mortar from cement Type I. The compressive strength was decreasing with an increase of content of high calcium fly ash, siliceous fly ash or ground granulated blast furnace slag in to the cement. The results of the microhardeness led to believe that the slowly long-term increasing of mortar strength is a benefit from the application of the blended cements, especially in the case of cement Type II, CEM II/A-W.

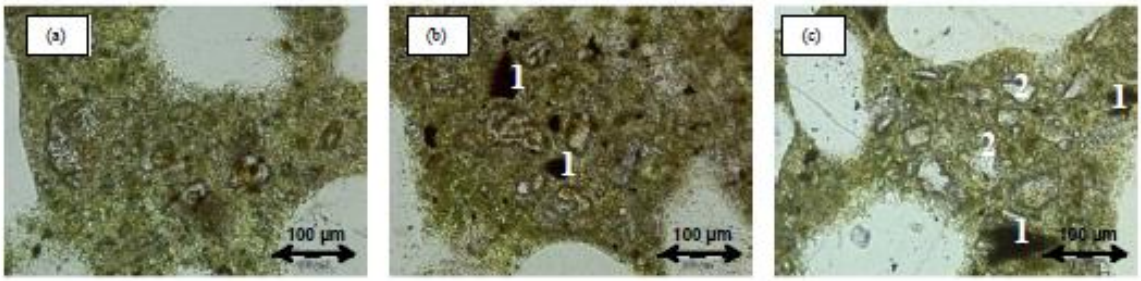

Fig. 1. Microstructure of mortars: (a) CEM I, (b) CEM II/B-W, (c) CEM V/A (S-W), transmitted light, magnifiaction200x, 1- unburned carbon particles, 2- slag particles.

All the pastes were characterized by a similar C-S-H structure, so-called "honey comb", the presence of portlandite plates, relicts of nonhydrated cement grains and spherical grains from fly ash. The water/cement ratio was estimated on the base of image analysis and it was similar for the all the tested mortars.

REFERENCES

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