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THE DEVELOPMENT OF THE SIZE OF FRACTURE ENERGY OF CEMENT PASTE WITH FLY ASH IN THE TIME

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Abstract: *The size of fracture energy of cement paste reaches values other than cement paste without admixtures. The cement paste increases the strength values in time. Paper describes experimental investigation on the field of material properties of cement paste, especially fracture energy.*

Keywords: ***Cement paste, Fracture Energy, Tensile Strength, Fly-ash, Bend Test, Prism Specimen.***

1. Introduction

The cement paste is material based only on two parts; water and cement (Neville, 1997). Properties of cement pastes are relatively well known. Particular, the compressive strength depends on the water/cement ratio w/c. Equally, an important factor for compressive strength, the water content in the material. Increasing the amount of water in cement paste allows the maturation of the cement paste.

Nowadays, much attention is focused on processing of waste materials. Very good usable waste material can be fly ash. This material is generated by burning coal to produce electricity in coal-fired power plants. This paper aims to evaluate the changing properties of cement paste if is into the paste added component of waste – fly-ash, typically.

2. Specimens

The advantage of the cement paste is the homogeneity. Homogeneous fine-grained materials are suitable for testing in smaller testing equipments. Therefore, the preparation of specimens was selected type of form 20 x 20 x 100 mm. Portland cement CEM I 42,5 R was used for production of specimens. Because the intention was not to use a plasticizer, was selected water-cement ratio 0.4. Grout with a water/cement ratio beyond the specified limit has high fluidity, which may cause segregation of cement and water. On the other hand, the grout may be too rigid and treated by practically no plasticizer. Consistency of 0.4 was chosen as a tougher type of cement paste. Specimens of cement paste were stored in the water basin for about 30 days. The specimens were removed from the water two days before testing. Subsequently, specimens were dried for 48 hours at 60 °C. Specimens prepared from fly ash and cement paste had w / c factor of 0.4.

3. Testing of specimens

Fracture energy was measured in the tests performed using the three-point bending test. Distance support the specimen was 80 mm. The notch was located in the middle of the range below the point where the applied load. To assessment the test were required two parameters, strength and vertical deflection of the specimen. For those of parameters it is possible to calculate the fracture energy of the test specimen. Before the tests were measured dimensions of each specimen.

Execution of experiments was carried out in the test machine MTS Alliance RT 30kN (Padevět, 2009). It is an electromechanical testing machine with a very subtle shift in the crosshead. By using relatively small specimens can achieve the desired results the test method.

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4. Results

The data obtained from tests carried out are summarized in graphs. The resulting graphs are shown in Fig.1. In the loading phase the specimen, there is a linear increase deformation of and strength. After reaching almost 90% strength is accelerate our growth deformation of the specimen. After reaching the ultimate strength is increasing with little deformation of to steep reduction strength of material.

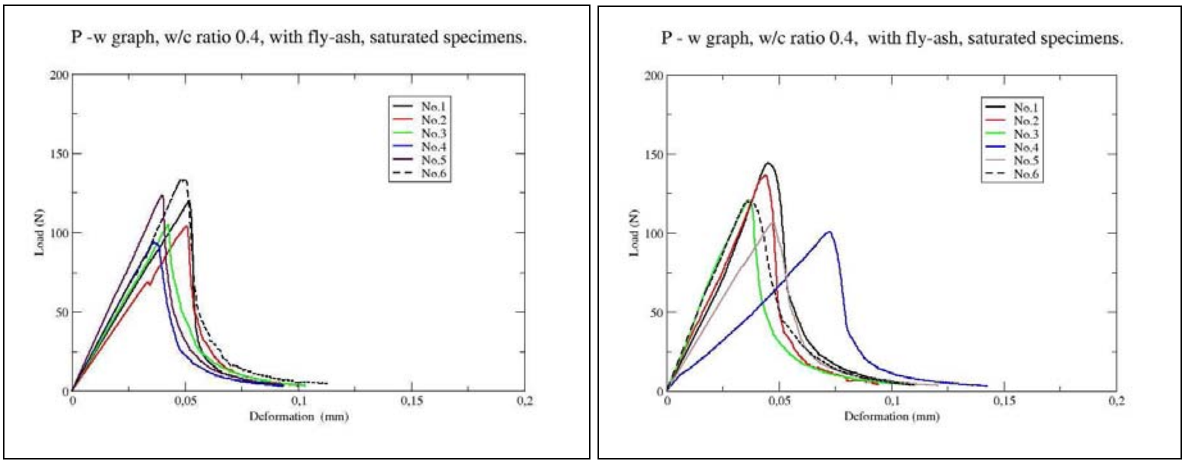

Fig. 1: P-δ graphs of water saturated specimens prepared using C/A 0.5/0.5 (left) and C/A 0.4/0.6(right).

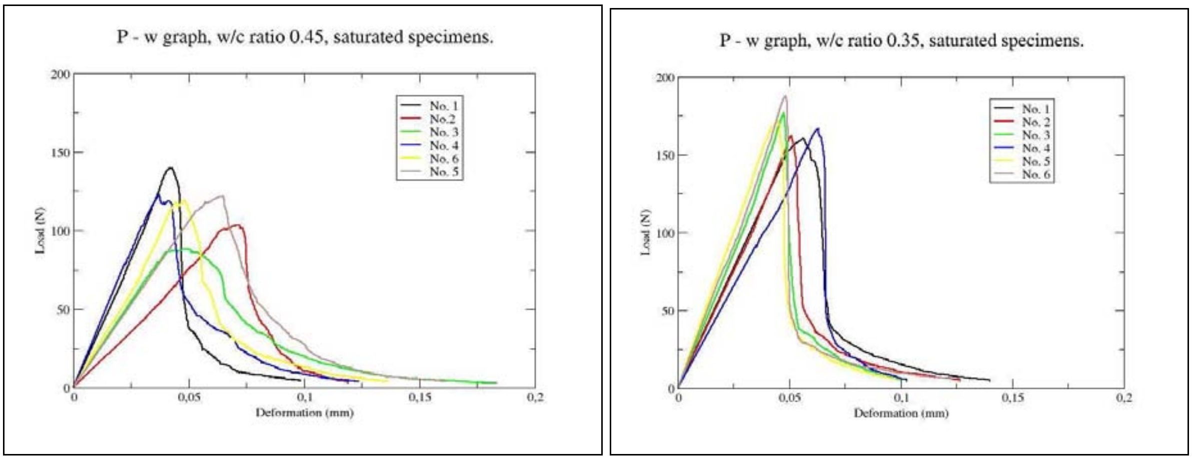

Fig. 2: P-δ graphs of water saturated specimens prepared using w/c 0.45 (left) and w/c 0.35(right) without fly ash.

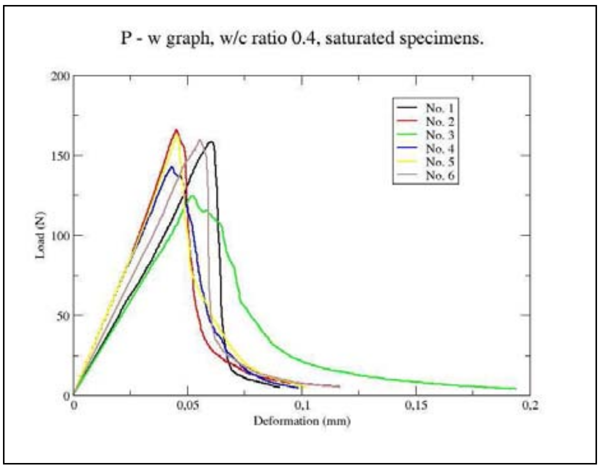

Fig. 2: P-δ graphs of water saturated specimens prepared using w/c 0.4 without fly ash.

Tab. 1: Fracture energy of cement paste.

w/c	Relation cement/fly ash	Fracture energy (N/mm)
0.4	0.5/0.5	16.66
0.4	0.4/0.6	18.73
0.35	--	26.74
0.40	--	24.13
0.45	--	22.02

5. Conclusions

Very interesting is the decrease of fracture energy of cement paste containing fly ash. Fracture energy for water-saturated specimens decreased by 18%, depending on the water / cement ratio increased from 0.35 to 0.45. Decline in value is up 30 % towards the value for the corresponding w/c ratio. Very interesting fact is the increasing value of fracture energy of cement paste, which contained a lower amount of cement and higher amount of ash. In conclusion, the value of fracture energy of cement paste with fly ash varies from 17 to 19 N/mm. On the other side fracture energy of cement paste without fly ash achieves values between 22 and 26.7 N/mm. The direct effect of humidity on the size of the fracture energy of cement pastes was not proved.

By contrast, significant changes in the fracture energy of cement paste in tensile strength, bending strength were no major changes. Comparison with values for w/c ratio we record a decrease of, but it is also depending on the amount of fly ash in the cement paste.

Reducing the strength of cement paste containing fly ash corresponds to the reduction volume weight. A very significant factor that has a definite influence on the mechanical properties of cement paste is the amount of fly ash in the mixture. Quantity ash is influencing factor in the case of fracture energy.

Acknowledgement
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