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MECHANICAL PROPERTIES OF CEMENT PASTE WITH VARIOUS CONTENT OF FLY ASH AFTER 6 MONTHS

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Abstract: *Nowadays there is a heated discussion about using fly ash as an important concrete binder. It is therefore essential to define properties of this material. This paper presents results of an experiment which deals with mechanical and material properties of cement paste with different proportion of fly ash. More specifically, the compressive strength and tensile strength in bending of individual mixtures after 6 months will be presented.*

Keywords: ***Cement, fly ash, compressive strength, tensile strength in bending.***

1. Introduction

Fly ash has already been used as an essential part of concrete for several decades. This fact is demonstrated by construction of one of the most significant structures in the Czech Republic, which is a water reservoir Orlík built and opened in 1961 (Bittnar at al., 2011). This secondary energy product is currently used when constructing significant structures such as Washington Dept. of Transportation, USA, in 2006 and Liu Center U.B.C, Canada, in 2000 (Schmidt & Fast, 2000). It is possible to produce alkali-activated fly ash and make it part of the concrete hydration process (Němeček at al., 2010). Fly ash has been used in construction industry for many years but there is still a considerable number of issues and problems to be dealt with. The paper deals with mixtures of concrete, water and fly ash free of alkaline agents and development of material properties over time.

2. Types of mixtures for production of test specimens

Water ratio of all mixtures - cement – fly ash – water - reaches up to 0.4. Cement was acquired from Radotín locality and it is Portland cement labelled CEM I 42,5R. Fly ash was acquired from Mělník and is commonly added in blended cements. Several types of mixtures with different ratio of fly ash in comparison to cement content were produced. Individual sets are described in Table 1 which shows density development of individual sets of mixtures. The larger content of fly ash, the sparser the density.

Tab. 1: Types of mixtures and their density

Type of mixture [-]	Cement [%]	Fly Ash [%]	Density [kg/m^š]
I	100	0	2059 ± 89
II	60	40	1820 ± 22
III	50	50	1844 ± 19
IV	40	60	1749 ± 32
V	30	70	1650 ± 29

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3. Experiment results

Graphic summary of measured figures is shown in Fig. 1where development of compressive strength over time is shown. Fig. 2 displays tensile strength in bending over time.

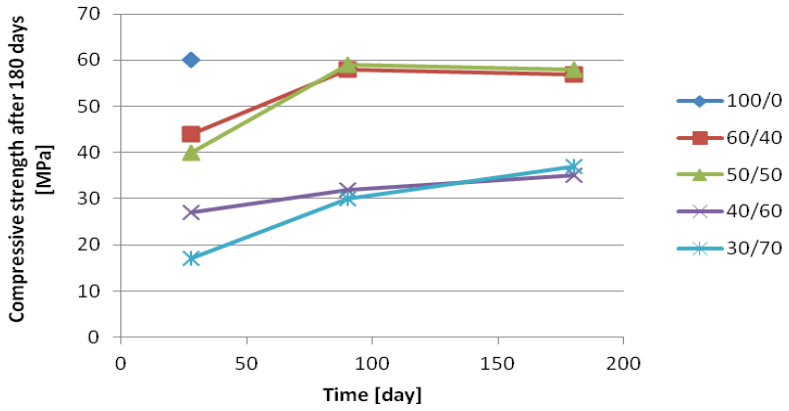

Fig. 1: Average compressive strength of cement pastes after 180 days

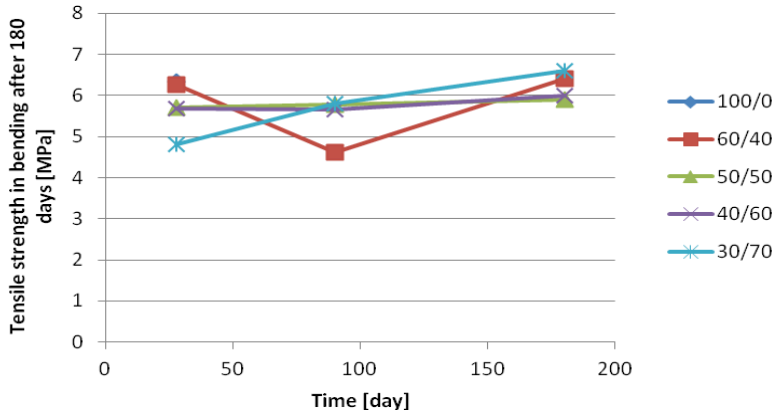

Fig. 2: Average tensile strength in bending of cement pastes after 180 days

4. Conclusions

Another aim of our work is to further observe the development of material properties over time and focus on other properties such as statistical flexibility module, heat of hydration, fracture energy etc. We would like to pay attention to material structure at micro level as well.

Acknowledgement

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References

Fečko, P. (2003) *Fly Ash*, VSB - Technical Univerzity of Ostrava.

Bittnar, Z., Padevět, P., Zobal, O. (2011) Dam Orlik - concrete with addition fly ash after 50 years, In: *18. Concreting Days 2011*. Prague: CBS in Czech.

Schmidt, R., Fast, P. A. (2000) *High volume fly ash concrete usage for skytrain stations*, Technical report.

Němeček, J., Šmilauer, V., Němečková, J., Kopecký, L. (2010) Nanoindentation of alkali-activated Fly Ash. In: *Nanotechnology in Cement and Concrete*. Washington: Transportation Research Board.