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CREEP SIZE EVOLUTION OF CEMENT PASTE PREPARED FROM PORTLAND CEMENT WITH CONTENT OF FLY ASH

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Abstract: *The cement paste is basic part of concrete and may contain various additives. Fly ash is one of materials useable as an admixture in cement paste and concrete. Changes of properties of cement paste mixed with fly ash were observed during several months. Creep of dried and saturated cement paste was measured for one complete month. The measured data was evaluated and compared with results of computational model with a creep model B3.*

Keywords: ***Cement paste, creep, shrinkage, fly ash, B3 model of creep.***

1. Introduction

Among one of the hot topic waste materials the fly ash can count as well. The power plants in the Czech Republic produce annually 8 million tons of fly ash. Fly ash is generated as the secondary product by burning brown coal in the lignite power plants. The generated quantity of the fly ash is between 10 % and 30 % of the original volume of burned coal. From the perspective of chemistry, the fly ash is an inert material; the main component is SiO_2 and Al_2O_3 and CaO and SO4, suitable for building material. Conventional fly-ash contains up to 80 % glass phase, as the main component. Sulfur content (expressed as SO_3) usually does not exceed 1 %. In the high-temperature combustion of coal, it is not necessary to add ground limestone into burnt mixture.

The basic properties of cement paste can be described by material characteristics. One of these material properties is creep – especially basic creep. On the other hand, it is important to write that basic creep is not the most important characteristic in designers work. But in many cases the size of creep is the very important feature in the design of civil structures.

This paper is focused on properties of cement paste containing fly ash as an additive, not as like an activator. The characteristics of the cement paste mixed with ash from power plants have been defined in several previous works, e.g. (Padevět & Bittnar 2009). Tensile bending strength of cement paste with addition of fly ash reaches higher values than the pure cement paste. Very good values of tensile strength in bending were achieved when the weight ratio of cements and fly ash was 1:1.

2. Specimens and their preparation

The water/cement ratio was chosen 0.4. The content of 40 % of the quantity of water in cement allows a very good workability and also no segregation of cement in the initial phase of the cement hydration. Portland cement CEM I 42.5 R was used for production of specimens (Padevět & Bittnar 2009), cement without additives. The main attention was focused to amount of fly ash added to the mixture. As described above, very good material properties were achieved with a weight ratio of fly-ash and cement 50: 50.

The experiment was conducted with two types of specimens, one month and five months old cylinders of the same type. The value of creep was measured for 32 and 36 days. The ambient temperature was controlled between 19 – 20 °C with a maximum deviation of ±1 °C.

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3. Results

In the each set of specimens were two pieces dried and two pieces saturated with water. Basic creep was determined as the difference between creep and shrinkage. Differences between sizes of creep for various aged specimens are described in figure 1 - 4.

All specimens were loaded by plumbs during whole experiments. Between Fig. 1 and 2 (3 and 4 too) is viewable difference in first days. For dried specimens is characteristic instant increasing of the deformation and slowing increasing of deformation in next days. Deformation of water saturated specimens is increases gradually from start of loading.

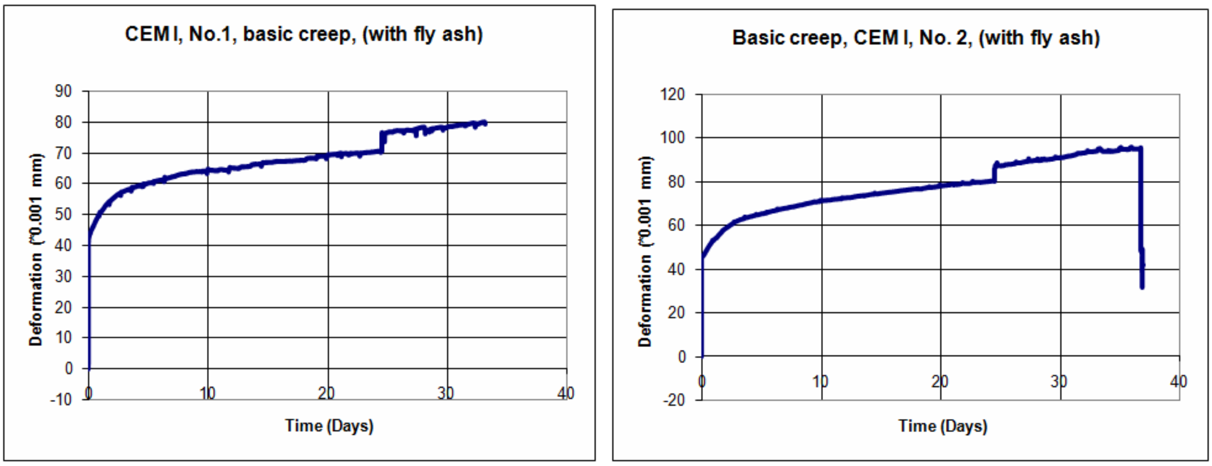

Fig. 1: Basic creep of dried specimens (in 1 month age).

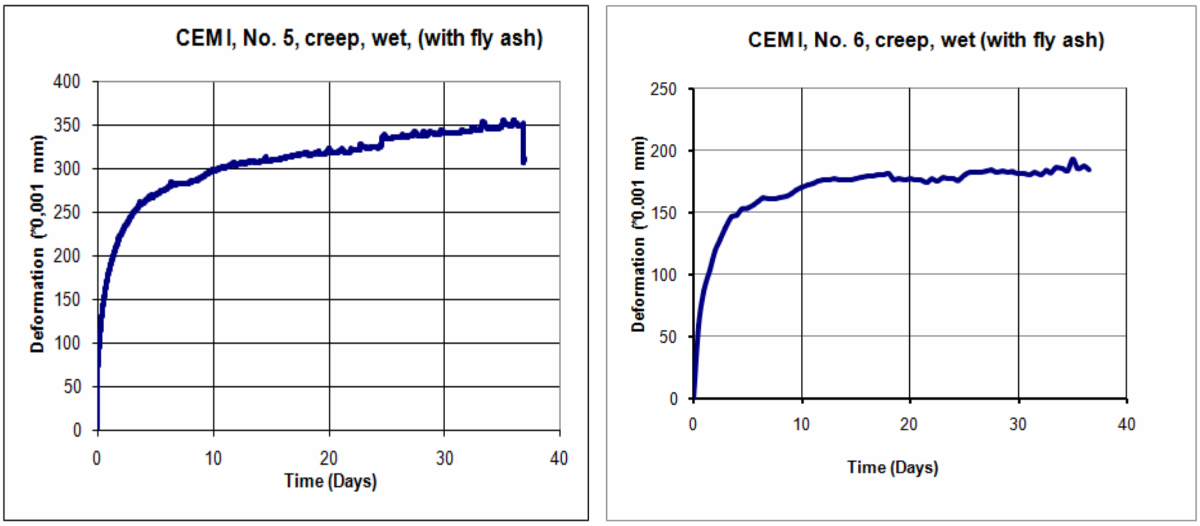

Fig. 2: Creep of water saturated specimens (in 1 month age).

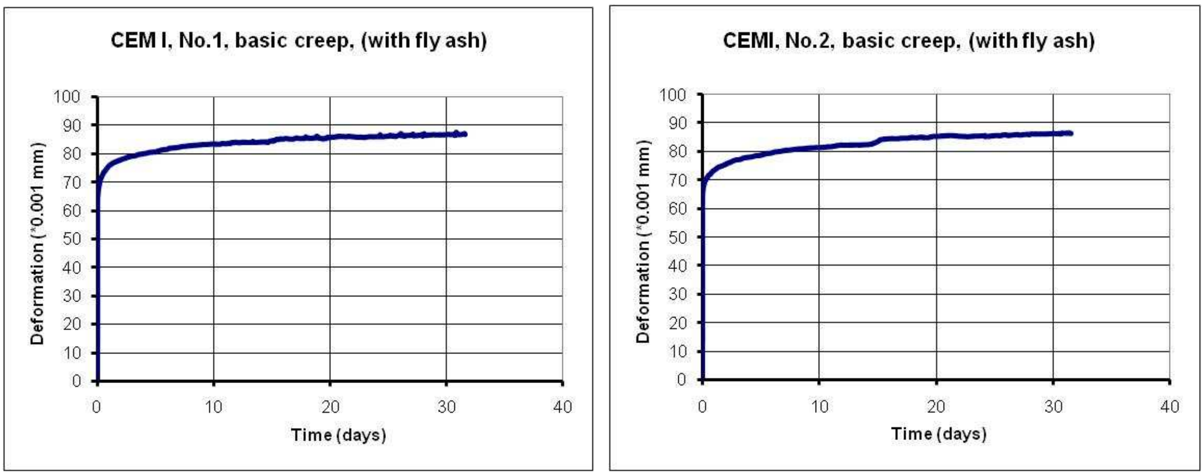

Fig. 3: Basic creep of water saturated specimens (in 5 month age).

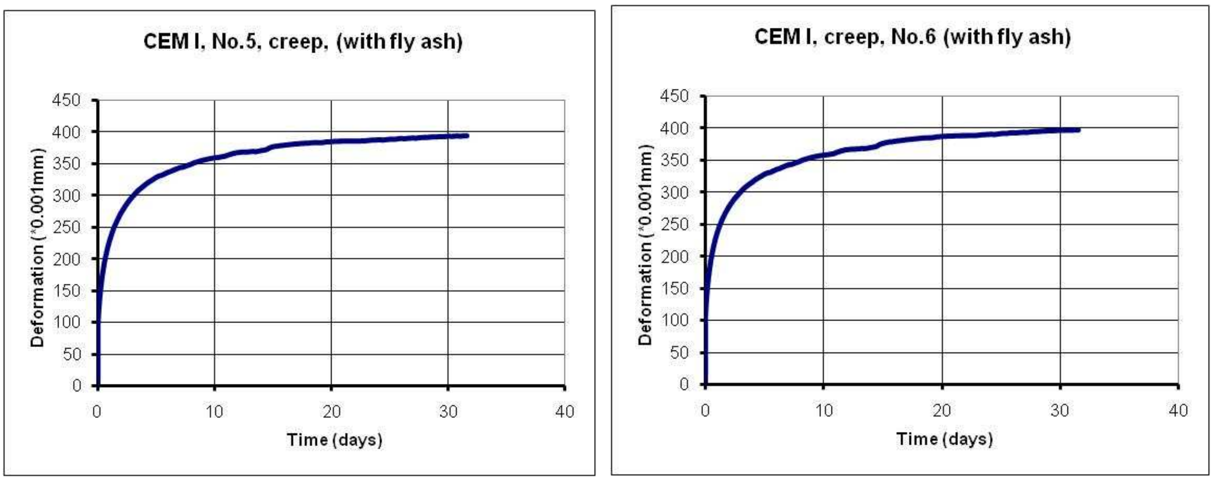

Fig. 4: Creep of water saturated specimens (in 5 month age).

Fig. 1:Basic creep of dried specimens (left – in 5 months age, right – in 1 month age).

Tab. 1: Size of creep (in microns) after 25 days.

Condition	1 month old specimens	5 month old specimens
dried	27	16
dried	37	17
saturated	225	225
saturated	130	220

4. Conclusions

The graphs show that the basic creep range is from value 25 to 30 microns over 25 days.

Water-saturated specimens (Van Mier 1997) reach very high values of creep size. Creep of these specimens (without the influence of shrinkage) reached values between 130 to 225 microns after 25 days. The age of the specimens has a significant influence on the size of creep at the initial stage of measurement. Basic creep of dried specimens shows differences in its size. This size depends on the age of cement paste. Size of creep is reduced with increasing age. In all cases, measurements of deformation solids, the increase was steepest during the first 5 days.

In the past, compliance tests were conducted by simulations of creep of the pure cement paste model B3 (Bažant, Baweja 1995). By simulation of the creeping cement paste mixed with the fly ash it is possible to achieve a good agreement between the model and the real measurements, although simulation is designated for concrete primary.

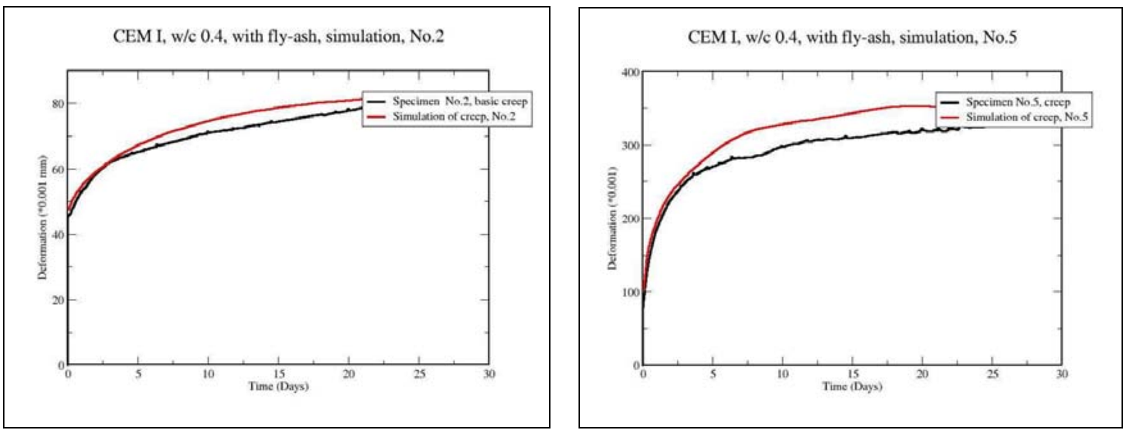

Fig. 5: Simulation of basic creep of specimen No.2 and creep of water saturated specimen No.5.

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