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FLY ASH ADDITION AND ITS INFLUENCE ON COMPRESSION AT CONCRETE WITH BELITIC TYPE CEMENT COMPOSITE

BY

MIRCEA RUJANU*

“Gheorghe Asachi” Technical University of Iaşi
Faculty of Civil Engineering and Building Services

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Abstract. It is known the fact that the thermo-electric power plants ashes which is introduced in the composition of some concrete contributes to its impermeability increase. Knowing the fact that the ashes addition contributes to the cement dosage decrease it results that the hydrotechnical concretes can be cheaper and under these circumstances there is important to analyse the influence of the ashes addition on the important characteristics of the concrete.

Key words: admixture; blast furnace slag; compression; cement.

1. Introduction

Concrete works require big material consumption and, respectively, corresponding economical efforts, a fact which determines the development of some advanced characteristics of the concrete, from all points of view. In this respect a hydrotechnical concrete with resistance exigency can be made using active addition with the mention that fine part in big quantity involves certain measures regarding composition and technology.

* *e-mail*: mrujanu@yahoo.com

The link between resistance and concrete structural characteristics – compactness, porosity is already known and the compositional factors have a determinant importance. By using active addition at an experimental level there was observed that the obtained resistances on construction concrete with addition were close to those of concretes without addition. Therefore it is necessary that for each mixture of hydrotechnical type concrete to be studied the resistance to compression and especially its evolution in time and to choose the alternatives with the best overall behavior.

2. General Aspects Regarding the Influence of Ashes Addition on Concrete Compression Resistance

The cement, as a binder influences the forming of the concrete structure by its nature and through the used dosage when making the mixture. The composite hydrotechnical cements, which are used in producing the hydrotechnical concretes, have in their composition 6%…20% *furnace basic slag* which has the role of increasing the compactness and thus of the structural characteristics.

The furnace slag as an addition produces changes in forming the cement stone structure and on the characteristics of the newly formed structure and, consequently, on the overall behavior of the binder used in concrete mixtures.

From the point of view of the chemical reactions mechanism the furnace basic slag is hydrated in the presence of the calcium hydroxide solution which results from the reaction with the water of the cement clinker. On a macrostructural level, while the hardening takes place, the cement paste becomes rigid, the viscosity around the slag particles increases, leading to the slowing of the diffusion processes. At first the slag undergoes a process of superficial colloidation and then there will take place the hydrosilicates, hydroaluminates and complex hydro compounds forming. The hydrosilicates will favour the volume increase of gel like formations which lead, following the hardening process, to a more intense process of microfissure. Under these circumstances, in order to prevent contractions there is recommended that the concrete should be maintained in a moist or under water environment until it is hard. Previous studies made by certain researchers emphasized on the fact that the mechanical resistances, although increase slowly, at the end they have close values to the cements without addition and in the case of bigger periods for hardening there can be surpassed the without addition cement resistances.

Other previous researches which used as addition thermo-electric power station ashes and cements with addition of furnace basic slag, that means the same type of addition, did not surpass the addition percent of 30%…40%. After performing the experiments there could be made the following observations:

a) There is the tendency, determined by the high content of mixture water imposed by the addition content (which is fine part with big specific surface), to move the dimension of the pores of 0.5…1 mm to bigger dimensions;

b) The volume increase of capillary pores by increasing the addition volume from the concrete mixture.

There can be appreciated that these modifications are unfavourable to the formation of the concrete structure and influences in a negative way its structural characteristics, a fact which determines a very strict correlation of the fine part content from the mixture.

This means that the ash dosage has to consider the cement dosage so as the fine part not to surpass certain limits and, at the same time, there has to be taken into consideration the fact that the mixture water dosage and the balance that is made between the water and the fine part to be kept in reduced limits. Unlike concretes which use alitic cements those of belitic type will give more conclusive results at bigger ages,that means over 90 days from casting.

3. Experiment Organisation

When organizing the experiment there were taken into consideration the present norms which refer to producing concrete in different working conditions and which stipulate certain limits for composition factors (minimum cement dosage, maximum W/C dosage) and which, at the same time, recommends, the concrete exposure class, and even the cement type which should be used.

Table 1
Composition Characteristics

Recipe indicative	Component dosage			W/C+Ce	Consistency class, [cm]
	Cement-C kg/m^3	Ash-Ce kg/m^3	Water-W L/m^3		
B1	100	200	223	0.74	C3(8,5)
B2	200	200	215	0.55	C3(8,5)
B3	300	150	216	0.49	C3(8,5)

Making use of the experience in this field and the norms restrictions we made three concrete recipes using river aggregate with a maximum dimension of 16 mm, cement composite type H II/A-S 32.5 and, as an addition, thermo-electric power station ashes harvested in dry way, all these for different values of the component dosages and we obtained the compound characteristics indicated in Tables 1 and 2.

There were made cubic test pieces with an angle side of 14.1 cm, three from each recipe were kept in standard conditions and then tested at compression at the age of 7, 90 and 360 days.

Table 2
Mechanical Characteristics at Different Ages

Recipe indicative	Ratio W/C+Ce	Resistance at 7 days, [N/mm^2]	Resistance at 90 days, [N/mm^2]	Resistance at 360 days, [N/mm^2]
B1	0.76	3.2	11.9	10.5
B2	0.55	9.4	26.0	25.2
B3	0.49	11.5	33.0	31.2

A graphic interpretation would allow a more clear correlation between the composition characteristics of the concrete and its resistance to compression, obtained in laboratory conditions (Fig. 1).

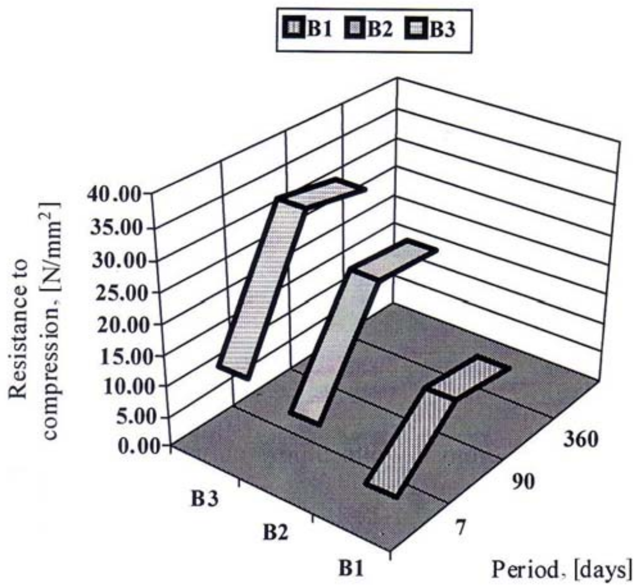

Fig. 1 – Resistance to compression evolution in days.

4. Experimental Results

According to the composition characteristics of the three recipes, after the sample trials, there were registered the results which are presented synthetically in Table 3.

Table 3
Resistance Evolution Compression Reported to the Cementing Material Dosage
(Specific growth Δ)

Recipe Indicative	Cementing material content, C+Ce, [kg]	Specific growth Δ at 7 days $(N/mm^2/kg)\times 1,000$	Specific growth Δ at 90 days $(N/mm^2/kg)\times 1,000$	Specific growth Δ at 360 days $(N/mm^2/kg)\times 1,000$
B1	100+200	10.67	39.67	35.00
B2	200+200	23.5	65.00	63.00
B3	300+150	25.56	73.33	69.33

A graphic interpretation would allow a more clear correlation between the composition characteristics of the concrete and its resistance to compression, obtained in laboratory conditions (Fig. 2).

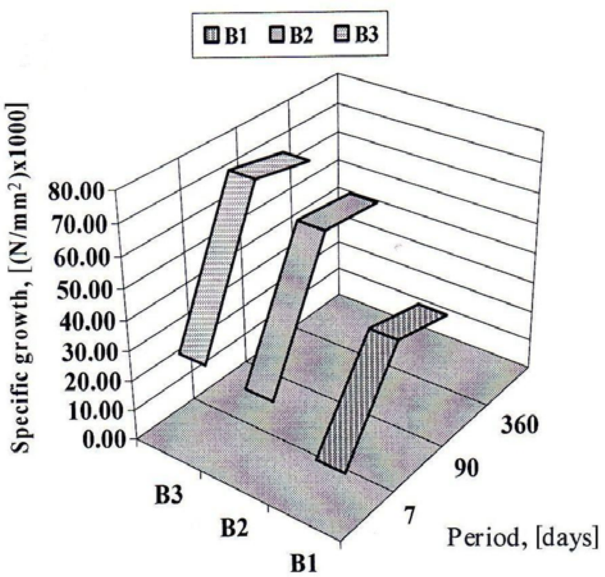

Fig. 2 – The time variation of the specific growth according to the recipe.

5. Conclusions

The analysis of the experimental values completed with the graphic interpretation allows the presentation of the following conclusions:

a) A general remark refers to the fact that in the case of all tested recipes the resistances at 360 days were slightly smaller than at 90 days.

b) Recipes 2 and 3, with cement dosages of 200 and, respectively, 300 kg/m^3, in the conditions in which the ashes dosage is of 200, respectively, 150 kg/m^3, present, from the resistance to compression and specific growth point of view, an almost identical behaviour, in the conditions in which in general there were practically kept the same consistency characteristics but not the same ratio W/C+Ce.

c) Recipe 1 presents a weaker behavior in the conditions in which the cement dosage is of only 100 kg/m^3 and the ashes dosage represents 200% in comparison with the cement dosage. Under these circumstances there can be observed that the concrete resistance at 7 days is much less reduced in comparison with the dosage of the used cement while at periods of over 90 days its value will be in accordance to the used cement dosage and the specific growths will be more consistent than at recipes 2 and 3.

d) It is considered that recipe B3 presents very good characteristics in hardened shape, a fact which recommends it from the point of view of resistance.

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ADAOSUL DE CENUŞĂ DE TERMOCENTRALĂ ŞI INFLUENŢA SA ASUPRA REZISTENŢEI LA COMPRESIUNE LA BETOANE CU CIMENT COMPOZIT DE TIP BELITIC

(Rezumat)

Este cunoscut faptul că cenuşa de termocentrală, introdusă în compoziţia unor betoane, contribuie la mărirea impermeabilităţii acestuia. Cunoscând faptul că adaosul de cenuşe realizează reducerea dozajului de ciment, rezultă că şi betoanele de tip hidrotehnic pot fi mai ieftine şi, în aceste condiţii, este important de analizat influenţa adaosului de cenuşe asupra caracteristicilor importante ale betonului.