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THE INFLUENCE OF SOME COMPOSITION FACTORS ON THE BEHAVIOR OF MICRO-CONCRETES SUBJECTED TO MAGNESIAN AGRESSIVITY

BY

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Abstract. Several micro-concrete recipes with varied composition characteristic are presented, in which the binding material is a composite cement of II/ A-S 32,5 type (Pa 35 equivalent) and their behavior in to analyse their behavior in environment with magnesian aggressivity, when the composition factor varies.

Key Words: Magnesian Corrosion; Micro-Concrete; Cement; Compression Strength.

1. Introduction

The analyses of the concrete behavior in the resistance structure of buildings subjected to aggressive magnesian actions is achieved on micro- concretes to point out the quality of the cement used and the influence of the composition factors. The obtained concrete must have strong specific resistances to the aggressive action because at least in the first period after its application when the porousness of the concrete is a bit higher, the reaction between the aggressive solution and the components of the cement rock in the concrete can lead to corrosion in the initial period with effects that are difficult to anticipate.

In the present paper we suggest three checking terms: at 90,180 and 1,000 days, to point out the action of the aggressive action. Taking into account the usual cement for the structure elements is the composite cement of II/A-S 32,5 type (Pa 35). The evolution of magnesium corrosion *versus* several compositions of micro-concretes with such cement in composition in different dosages and with different W/C ratios is studied using different concentrations of the aggressive agent.

2. General Theoretical Aspects of Magnesian Type Corrosion

The magnesian type corrosion corresponds to type II of corrosion. In this case the magnesian salts operate directly on $Ca(OH)_2$, and the basic reaction which takes place in the case of corrosion produced by the magnesian chlorine, which is investigated in this experiment, is

$$MgCl_2 + Ca(OH)_2 \longrightarrow CaCl_2 + Mg(OH)_2$$

A characteristic of this interaction is the fact that one of the reaction products, $Mg(OH)_2$, is little soluble and it is deposited in the pores, the capillaries and the micro-fissures of the cement rock. For lower concentration solutions spongy deposits are formed which can be easily penetrated by aggressive waters, while at high concentrations (5...6%), compact deposits can be formed and contribute to the improvement of the behavior at aggressive actions of the magnesium chlorine solution, which was proved by a number of previous researches.

The formation of a compact, impermeable structure of the cement rock is a basic condition, and this supposes that in the conditions of using a type of cement without high resistance characteristics at chemical aggressivity the compactness of structure should be obtained by high dosage of cement and a reduced W/C ratio.

A high cement dosage obtained after the specific reactions supposes the formation of a high volume of gel products which, in the conditions of a low W/C ratio, can lead to a compact structure.

3. Experiment Organization

To organize the experiment the present standards referring to the achievement of concrete in aggressive environments were used and they specified the composition factors limits (minimum cement dosage, maximum W/C ratio) and they also recommend even the cement type to be used depending on the exposure class of the concrete, taking into account the restrictions imposed by the standards: three recipes of micro-concrete were produced using poligranulate quarts sand as an aggregate and the composite cement of II/A-S 32,5 type for different values of the W/C ratio obtaining the composition characteristics given in Table 1.

Table 1
Composition Characteristics

Recipe	W/C	C/S	Consistency, cm
R1	0.64	0.75:3	5
R2	0.53	1.00:3	5
R3	0.35	2.00:3	5

Prismatic test tubes of $40 \times 40 \times 160$ mm were made; three prisms of each recipe were immersed in water and were kept there as witness tests until the testing time.

Three prisms of each recipe were immersed after a 28-day maturation in magnesian chlorine solutions with the following concentrations: 200, 1,500, 3,000 mg/dm^3 Mg^{2+} ions and were tested at 90, 180 and 1,000 days.

4. Experiment Results

According to the composition characteristics of the three recipes after subjecting the tests to the corrosion process, the results given in Table 2 were registered.

A graph would allow a clearer estimation of the micro-concrete behaviour subjected to the influence of sulphate aggressively (Fig. 1).

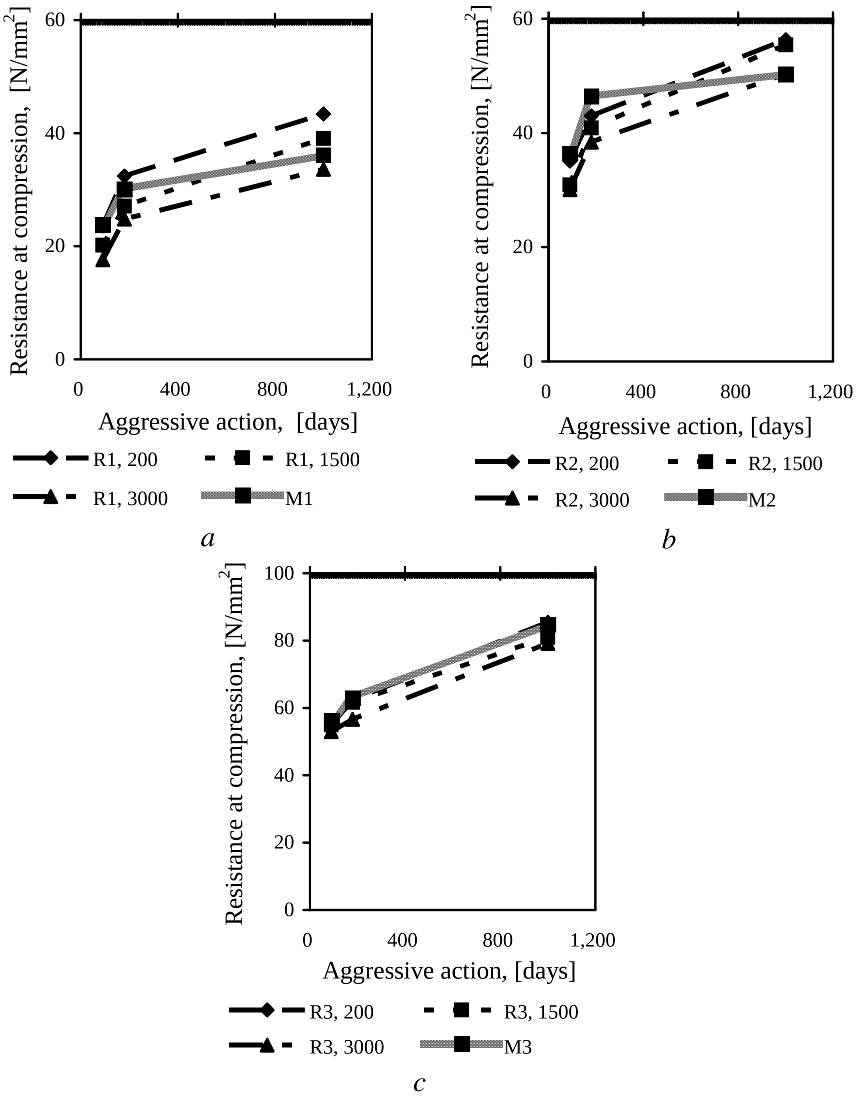

Fig. 1. – The variation of resistance at compression in magnesian corrosion condition; 200, 1,500 and 3,000 mg/dm^3: *a* – for recipe 1; *b* – for recipe 2; *c* – for recipe 3.

Table 2
Composition Characteristics

Recipe	Concentr. mg/dm^3 SO_4^{2-}	W/C	Resistance at compression, [N/mm^2]		
			after 90 days	after 180 days	after 1000 days
R1	$MgCl_2$, 200	0.64	23.6	32.4	43.4
R2		0.53	35.1	43.0	56.3
R3		0.35	54.9	62.4	85.4
R1	$MgCl_2$, 1,500	0.64	20.2	27.1	39.1
R2		0.53	30.9	40.9	55.4
R3		0.35	55.0	61.7	81.0
R1	$MgCl_2$, 3,000	0.64	17.6	24.8	33.6
R2		0.53	30.1	38.4	50.3
R3		0.35	53.6	56.7	79.2
R1	Drinking water	0.64	23.8	30.1	36.1
R2		0.53	36.4	46.4	50.3
R3		0.35	56.3	63.0	84.8

5. Conclusions

The analysis of testing values completed with graphs leads to the following conclusions:

1. Can be observed a slow decalcification to edges and corners of prisms, and this manifests from early ages.
2. Recipe 1 has a good constant behavior for the concentration of 200 mg/dm^3 magnesium ions, presents increases of resistance for the concentration of 1,500 mg/dm^3 for long periods of corrosion, but proves itself unsatisfactory for maximum concentration for any period of corrosion, using a high W/C ratio and obtaining therefore reduced compactness.
3. Recipe 2 has a good general behavior if we refer at long terms of corrosion, presenting high increases of resistance for the concentrations of 200 mg/dm^3 Mg^{2+} ions, and for the concentration of 1,500 mg/dm^3 magnesium ions, recipe 2 gives resistances close to the witness test for maximum concentration; consequently in this case may have the best behavior in the conditions of the present experiment.
4. Recipe 3 presents an unsatisfactory behavior to the three terms of trial, excepting the concentration of 200 mg/dm^3 magnesium ions giving resistances close to the witness test in conditions of a high cement dosage and the lower W/C ratio; this could be explained through the fact that after reactions with cement compounds some soluble compounds result in sufficient high quantities

that confer to the cement rock a reduced resistance, and, consequently, a reduced resistance of micro-concrete.

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REFERENCES

1. Neville A.H., *Proprietăţile betonului* (transl. from English). Edit. Tehnică, Bucureşti, 2002.
2. Moskvin V.M., *Korrozia betona v agressivnâh sredah*. Stroiizd., Moskva, 1971.
3. Dascălu V., *Variaţia agresivităţii apelor subterane din municipiul Iaşi şi influenţa acestora asupra durabilităţii betonului*. A-XII-a Conferinţă de betoane, vol. II, Iaşi, 1984.
4. Moldovanu M., *Comportarea betonului sub influenţa sărurilor de magneziu*. A-XII-a Conferinţă de betoane, vol. II, Iaşi, 1984.
5. Rujanu M., *Contribuţii privind influenţa unor caracteristici structurale asupra comportării la coroziune a mortarelor şi betoanelor cu lianţi minerali*. Ph.D. Diss., "Gheorghe Asachi" Techn. Univ., Iaşi, 1993.

INFLUENŢA UNOR FACTORI COMPOZIŢIONALI ASUPRA COMPORTĂRII MICROBETOANELOR LA AGRESIVITATE MAGNEZIANĂ

(Rezumat)

Se prezintă mai multe reţete de microbeton cu parametri compoziţionali diferiţi, în care liantul este un ciment compozit tip II/A-S 32,5 (echivalent Pa35) şi se analizează comportarea lor în medii cu agresivitate magneziană, în condiţii de variaţie a unor factori de compoziţie.