THE INFLUENCE OF COMPOSITION FACTORS ON THE BEHAVIOR OF MICRO-CONCRETES IN AGGRESSIVE MAGNESIAN ENVIRONMENTS

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1. INTRODUCTION

The analyzes 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 concrete obtained 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 1000 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). I studied the evolution of magnesium corrosion over several compositions of micro-concretes with such cement in composition in different dosages and with different A/C ratios 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:

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

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, a fact that 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 A/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 A/C ratio can lead to a compact structure.

3. EXPERIMENT ORGANISATION

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 A/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 A/C ratio obtaining the fallowing composition characteristics:

Recipe Index	W/C Ratio	C/S Ratio	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 $40\times40\times160$ 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 fallowing concentrations: 200, 1500, 3000 mg/dm^3 Mg^{2+} ions and were tested at 90, 180 and 1000 days.

4. EXPERIMENT RESULTS

According to the composition characteristics of the three recipes after subjecting the tests to the corrosion process, the following results were registered and presented here briefly:

Recipe Index	Conc. in mg/dm^3 SO_4^{2-}	A/C Ratio	Resistance at Compression, N/mm^2		
			to 90 days	to 180 days	to 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	*$MgCl_2$, 1500*	*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	*$MgCl_2$, 3000*	*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*

A graph would allow a clearer estimation of the micro-concrete behaviour subjected to the influence of sulphate aggressively, as it follows:

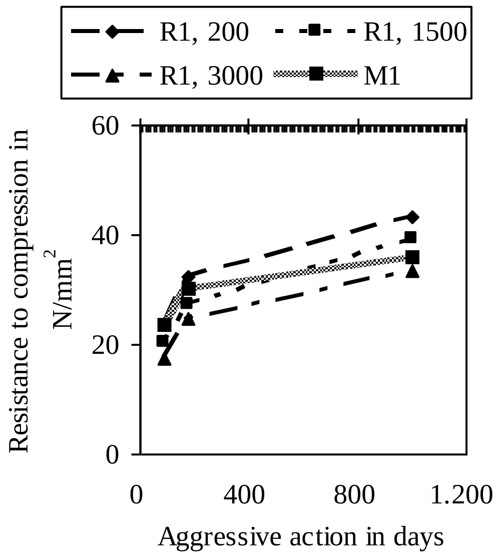

Figure 1. The variation of resistance at compression for recipe 1 in magnesian corrosion condition, 200, 1500 and 3000 mg/dm^3.

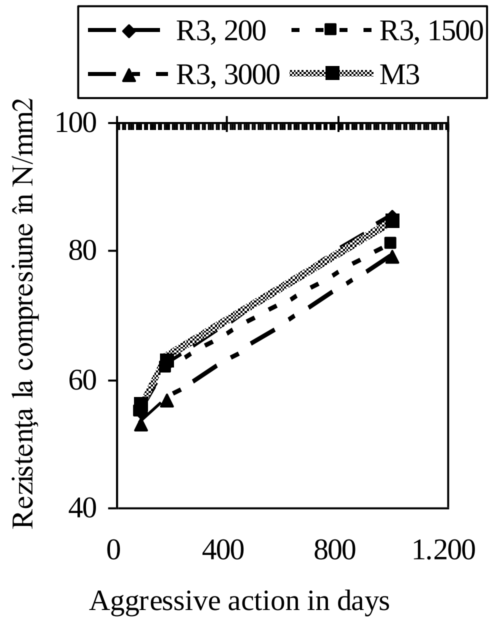

Figure 2. The variation of resistance at compression for recipe 2 in magnesian corrosion condition, 200, 1500 and 3000 mg/dm^3.

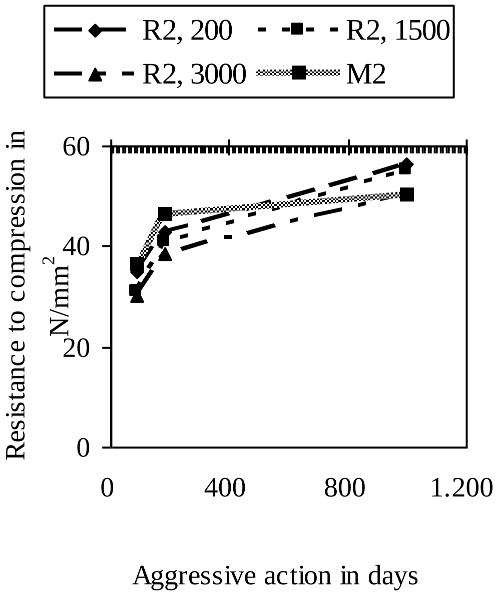

Figure 3. The variation of resistance at compression for recipe 3 in magnesian corrosion condition, 200, 1500 and 3000 mg/dm^3

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 1500 mg/dm^3 for long periods of corrosion, but proves itself unsatisfying for maximum concentration indifferent to the period of corrosion using a high A/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 1500 mg/dm^3 magnesium ions, recipe 2 gives resistances close to the witness test for maximum concentration, and I consider it to have the best behavior in the conditions of the present experiment;

4. Recipe 3 presents an unsatisfying 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 A/C ratio; this could be explained through the fact that after reactions with cement compounds, results some soluble compounds in sufficient high quantities that confers to the cement rock a reduced resistance, so a reduced resistance of micro-concrete.

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