

The permeability at ions chlorinates as indicator of durability of concretes

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Abstract

The reinforced concrete works are exploited in environments of different degrees of aggressiveness. The durability of these works depends on nature on cement, the granular components, the formulation of the concrete and the quality of implemented.

The durability of the reinforced concrete structures can be improved by the maîtrise of the causes of degradation of the existing structures. The analysis of the indicators of durability makes it possible to conceive structures with better performances of durability for the new structures by holding account of aggressiveness of the surrounding medium in which the work is exploited. For the existing structures the indicators of durability make it possible to evaluate the state of degradation of a structure, which makes it possible to make the decisions consequences.

Our research consists to develop local cements used in the construction industry, and to study the influence of the water report/ratio on cement on some indicators of durability like the permeability to the ions chloride. For this reason we used two cements CPJ 42,5 (Chlef cement, M'Sila cement), a super-plasticizer (produced of Granitex) was introduced to have the influence of the additives on the indicators of durability.

The results of this experimentation show that the increase in the report/ratio water/cement (E/C) proclamation of the unfavorable indicators for the durability of the concrete, the reduction in this relationship with an addition of a reducing water super-plasticizer contributes to the improvement of the physic mechanical characteristics of the concretes and present of the improved indicators of durability.

The results confirm that the concretes with a report/ratio E/C reduced with an addition of a super-plasticizer are equipped with high impermeability with respect to the ions chlorinates.

Keywords: durability, concrete, ions chlorines, permeability, report/ratio W/C.

1. Introduction

The concrete is currently one building materials the most used throughout the world. The simplicity of its manufacture and of its putting at his place, his weak cost of manufacture and the mechanical and durability performances which it ensures justified its use to realize the most various works, in particular of the buildings, residential buildings, bridges, roads, etc.[2]

The lifespan of the reinforced concrete structures is conditioned by the response to the physical and chemical aggressions of the environment, like by the capacity of constitutive materials to protect from these attacks.[1]

Properties of transport of the concrete, mainly the permeability, play a key role in the evaluation and the forecast of the durability of the reinforced concrete structures. Indeed, the permeability to the ions chlorinates is a major indicator to evaluate the capacity of material to resist the penetration of aggressive chemical species.

2. Experimental methodology

The model that we propose here (figure 01 and figure 02) is carried out at the laboratory of the faculty of civil engineering of the University of Bab Ezzouar (Algers). The concretes test-tubes are cylindrical form with 100 mms in diameter and 50 mm height. The samples are made starting from an ordinary concrete with W/C different, preserved in water at a temperature of 20 °C and the permeability was given according to the ASTM.C-1202 standard.

The test consists to measure the intensity of the current engendered by a potential difference equal to 60 volts maintained constant for 6 hours by means of stainless steel electrodes between the two ends of a sample. One side of a test-tube is in contact with a NaCl solution, and the other side is in contact with a NaOH solution. The tests were carried out at the age of 28, 90 and 180 days.[5]



Fig 01: Model of the permeability test to the ions chlorinates[5]

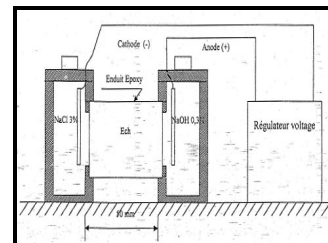


Fig 02: Diagram of the cell of permeability to the ions chlorinates (Cross-section) [5]

3. Characterization of materials

In this part, a detailed description of materials used is exposed. The raw materials are of local origin.

3.1 Cement

Cements which we used in our research are ECDE of Chlef cement and Matine cement of M' Sila.

3.1.1 Cement ECDE of Chlef

Cement CPJ-CEM II/A 42,5 is a Portland cement made up obtained by the finely crushed mixture of clinker, additions (pure calcareous) and calcium sulphate like regulator of grasp.

3.1.2 Matine Cement of M' Sila

Cement CPJ-CEM II/A 42,5 is a gray cement from high initial strengths and final , it consists of mineral oxides whose principals are lime (Ca O) with basic function, silica (Si O2) with acid character, alumina (Al2 O) and iron (Fe2 O).

3.2 Additive (super plasticizer)

The additive which one tested is MEDAPLAST SP 40 which presents a reducing effect of water high enough.

3.3 Water

We used in our research works the water of tap of university USTHB of Bab Ezzouar (Algeria). The result of this water by the chemical analysis is the inexistence from the suspended matter and a tiny quantity from dissolved salts (0,01 g/l).

3.4 Aggregates

3.4.1 Sand

Sand used is a crushed sand originating from the career of Bouzegza, Boumerdès, Algeria.

3.4.2 Gravels

The gravels used of class 8/15 and 15/25 originating from the career of Bouzegza. They are crushed gravels of silicocalcareous origin.

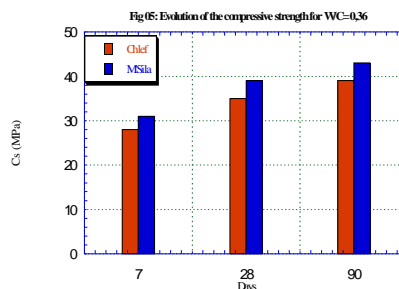
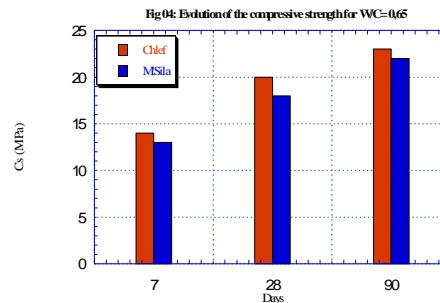
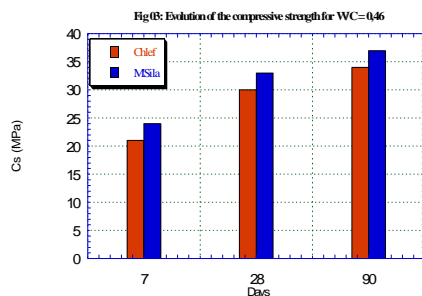
4. Test results

4.1 Compressive strength

The results of the mechanical resistances to the compression of the various types of concrete are recapitulated on following table (table 01) and (figure03, figure 04, figure 05):

Table 01: Compressive strength of the concretes at various ages

E/C	Concrete at base of Cement Chlef (MPa)			Concrete at base of Cement M'Sila (MPa)		
	7 days	28 days	90 days	7 days	28 days	90 days
0,46	21	30	34	24	33	37
0,65	14	20	23	13	18	22
0,36	28	35	39	31	39	43



4.2 Permeability to the ions chlorinates

The results of the permeability to the ions chlorinates for different types of concretes carry at: the electric charge Q (Coulomb) which crossed the sample at term of the test (6 hours), (table 02, figure 06 and figure 07).

Table 02: Electric charge Q (Coulomb)

The ratios W/C	Type of concrete	Shelf life in days		
		28	90	180
0,46	Chlef Cement	4813,2	4641,2	4520,3
	M'Sila Cement	4588,0	4472,4	4410,5
0,65	Chlef Cement	7102,5	6983,3	12029
	M'Sila Cement	6959,7	7422,0	8981,2
0,36	Chlef Cement	3512,4	3388,5	3248,5
	M'Sila Cement	3181,5	3065,7	2924,1

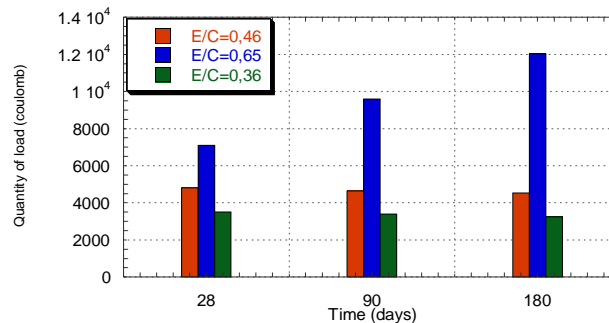


Fig 06: Variation of the load of current at different ages (Chlef Cement)

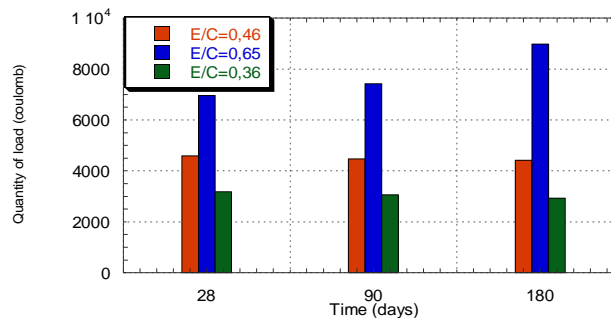


Fig 07: Variation of the load of current at different ages (M'Sila Cement)

5. Interpretations and discussions

One remarks that the increase in the resistance of the concrete with E/C=0,36 is remarkable, as a result of the addition of the super-plasticizer which condenses the cement matrix and fills the pores and the capillaries, what has consequence to increase the mechanical resistance and improve resistance facing to aggressiveness of the medium.

The results of the permeability tests to the ions chlorinates on the different types of concretes at different ages displayed that the diminution in the ratio of water to cement (w/c), it makes possible to reduce in a considerable way the electric charge moved throughout the sample.

These results show that the values of the electric charge for the concrete with W/C=0,36 are too reduced. Obviously, this reduction is due to the filling of the pores by the addition of super plasticizer. We can also say that the reduction of ratio W/C it makes possible not only to decrease the total volume of the capillary pores but also it makes possible to reduce their diameter. For feebler ratio W/C capillary porosity is constituted of a network of pores finer and discontinuous.

This test also showed greater increase in the permeability to the ions chlorinates for the concretes whose ratio W/C=0,65 because if ratio E/C is larger, there is more water to hydrate completely all cement. After that cement all right hydrated oneself, this surplus of water will remain in capillary pores it makes possible to increase so much the penetration of the ions chlorinates that the electric charge displaced throughout the sample.

6. Conclusion

Our study made it possible to check if the differences in composition between the two types of concretes according to cement used with various ratios W/C had a major influence on certain durability properties physicochemical. On this

subject, the concretes with $W/C=0,36$ proved that they possess behaviors different to those from the concretes with $W/C=0,65$ and $W/C=0,46$ relating to the different properties of the transfer studied. The permeability to the ions chlorinates concretes with $W/C=0,36$ showed oneself widely lower to the permeability of the concretes with $W/C=0,65$ and $W/C=0,46$.

The results drawn from our experimental tests display that the concretes with $W/C=0,36$ have characteristics of durability improved to the one of the concretes with $W/C=0,65$ and $W/C=0,46$.

In general, it is preferable that the network of capillary pores is constituted of pores the smallest possibles because the degree of inter-connect is weaker. The permeability of the paste finds some then considerably decreased because there is very few preferential roads for the passage of the liquids, gases or the potentially aggressive ions.

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