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" The Advantages of Using Self Compacting Concrete for Reinforced Concrete Structures in an Aggressive Marine Environment"

KEYWORDS durability, concrete, marine environment

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ABSTRACT *Achieving sustainable constructions, durable, exploited in aggressive chemical environments, in the marine environment, involves the development of materials capable of having appropriate behavior based on a thorough knowledge. The durability of the utilized concrete in structural elements exploited in the marine environment can be improved by monitoring and influencing variation of strength and also of mass variations of the concrete. In this paper, the authors develop research results through a comparative analysis of samples tested in two different environments, in distilled water and in sea water taken from the Black Sea. The authors monitored the variation of strength and mass concrete in the two environments at different ages.*

Based on these results the authors present the advantages of using self-compacting concrete in the reinforced concret structure located in the area of marine aggressiveness.

INTRODUCTION

A decisive role in the design composition of concrete used for construction works operated in areas with natural aggressiveness it has the degree of compactness and impermeability of concrete.The most common method used to compacting traditional concrete is vibrating. The method is based on the balance between viscosity forces, internal friction and inertial forces of all components, concrete compacting it when balance is destroyed by increasing the strength of the vibrating force. Defects that involve improper compaction usually is discovered when the structural element is demoulding. Usually follows repear affected concrete, without significantly improve the quality and poorly compacted concrete area. All the deficiencies related to compaction and vibration can be eliminated by using self-compacting concrete. Self –compacting concrete has a relatively recent history, the concept was introduced in 1980 in Japan , by Okamura. The main property of this type of concrete is to move under its own weight, filling intricate spaces and achieving full compaction even in thick reinforcement areas. Self compacting concrete has a high workability providing a superior finishing and durability degree for construction works. The first self-compacting practical applications were made in the early 1990's in Japan, and after this, several major companies developing their own recipes for self compacting concrete.

THE OBJECTIVES WORK OF AUTHORS

The objectives of the work has been:

To identify the advantages using self –compacting concrete for structures located in the marine environement, by studying the behavior of fresh self compacting concrete.

To identify the mechanism for transport of aggressive substances in concrete through comparative studies on the behavior of normal vibrated concrete and self compacting concrete in aggressive marine environement.

MATERIALS , TEST METHODS

The first step was the selection of raw materials needed to manufacture specimens and prefabricated elements, selecting samples of seawater from the Black Sea . It was created artificial conditions of the marine environement, by filling pools with seawater were the concrete cubes were maintained. At the same time , two tanks were filled with distilled water, were the comparative samples were maintained.

Selected raw materials entered into the composition of the concrete was:

- Crushed aggregates quarry in granitic rocks, from Cerna career, Tulcea, and meeting the conditions of admissibility laid down by SR EN 1260:2003
- The cement used was Portland Cement with fly ash, CEM II/AV42,5R supplied by Lafarge Ciment (Romania), Medgidia Plant, respecting the admissibility criteria set out in EN 197-1:2002.
- Limestone filler , whose main component is calcium carbonate obtained by fine grinding of limestone rocks. Sources: Lafarge Aggregates Concrete SA, Hoghiz Plant, Brasov.
- Admixture Glenium 115, supplied by Basf SA.

In the first stage of research were screened fresh concrete properties and subsequently cured state.Tests were conducted in the following test laboratories:

Lafarge Agregates Concrete Laboratory: making and keeping specimens, tests on fresh concrete, compressive strength, depth of carbonation.

ICH Constanta Laboratory: bending tensile strength, permeability test and gelevity.

Comparisons were made for SCC(self-compacting concrte) and TVC(traditional vibrated concrete), class C30/37 , with the following characteristics:

CONCRETE CLASS C30/37	SCC	TVC
Dosage cement [kg]	390	390
Filer limestone [kg]	135	-
Admixture Glenium 115 [kg]	-	2.09
Admixture Optima 203 [kg]	8.58	-
Ratio W/C	0.48	0.48

Table 1. Concrete recipe SCC and TVC

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In order to evaluate the properties of concrete fresh test the representative was to determine the spread of compaction, resulting in a spread of about 700 mm as compared with the TVC where for the concrete C30/37 , class consistency S5, sample test was aprox.230mm, were found visible segregation and the appearance of fillies.

Fig.01 Slamp-flow test

In order to determine the flow capacity of the SCC was performed O'Funel test who achieved a flow time about 11 sec, between the time of opening the hatch and the total flow of the concrete.

Fig .2 O'Funel test

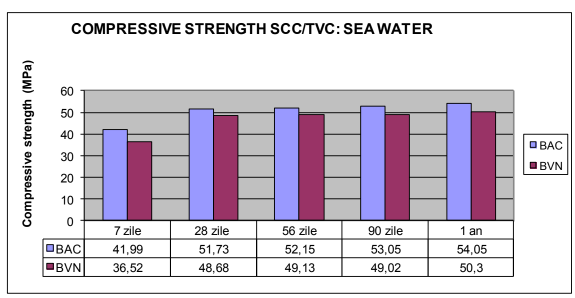
To determine the flow and passing ability, to detect visual the ability to flow of the concrete, the testing method used was LBox. The result was 1,concrete fits in PA2, concrete with good carryieng capacity.

Fig.03 LBox Test

To determine the passing ability were used J-Ring Test. The result obtained it was 800 mm.

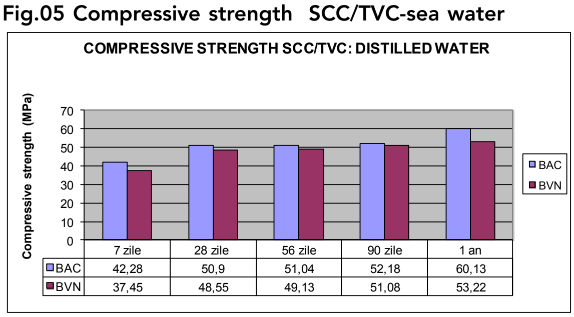
Fig.04 J-Ring Test

To determine the mechanical strength of concrete specimens and study of behavior of the concrete under the influence of sea water were made 17 samplles concrete of TVC and 31 samples of SCC. Interpretation of the results is shown in the charts bellow.



	7 zile	28 zile	56 zile	90 zile	1 an
BAC	41,99	51,73	52,15	53,05	54,05
BVN	36,52	48,68	49,13	49,02	50,3

Fig.05 Compressive strength SCC/TVC-sea water



	7 zile	28 zile	56 zile	90 zile	1 an
BAC	42,28	50,9	51,04	52,18	60,13
BVN	37,45	48,55	49,13	51,08	53,22

Fig.06 Compressive strength SCC/TVC-distilled water

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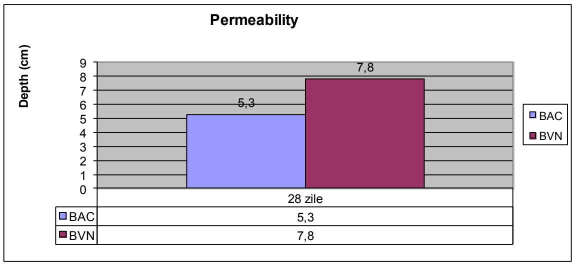

Fig.7 Water Permeability SCC/TVC

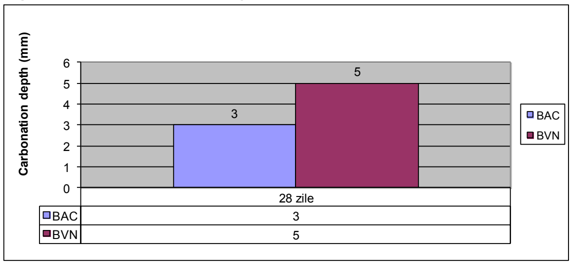

Fig.8 Carbonation SCC/TVC

Then it started to manufacture precast element, to study the behavior of self compacting concrete in horizontal and in vertical elements. The precast element obtained were consistent yield expectation, were obtained perfectly smooth faces without being vibrated concrete.

Fig.. 9 SCC Prefabricated elements

CONCLUSIONS

For the fresh concrete test were taken as reference values set out in The Europen Guidelines for self compacting concrete.

Studied the self-compacting concrete results have allowed its classification as follows:

Test	Unit	Result	EFNARC class
Slamp flow	mm	700	SF2
V-funnel	sec	6	VS1/VF1
L-Box		1	PA2
J-Ring	mm	7	

Table 2 Results of fresh SCC

Results research showed that workability, coesion and homogeneity of self compacting concrete are superior compared vibrated concrete, for the same strength class.

The use of limestone filler in concrete composition gives it a structure denser, more compact.

By using BAC for execution concrete structures shall be eliminated vibrating equipment needed for fresh concrete, leading to a number of advantages: reducing noise pollution, particularly in precast industry, reducing electricity consumption, decreasingthe number of workers.

The precast elements, after stripping, had plane suffaces, wich recomanded it to use successfully to achieve the most complex shapes.

The durability of a structure largely depends on the permeability of the surface layer wich is responsablle for the penetration of aggressive substances. Lake of a good compaction of the surface layer of the usually vibrated concrete can be one of the causes of premature degaradation of concrete in aggressive environemments.

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