Study the Behavior of Alccofine on Bacterial Concrete

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Abstract- *Bacterial impregnated Concrete is a self- healing concrete in which bacteria pre added into the concrete matrix. Microbial concrete achieve more attention is because it is crack free and corrosion free in turn result in strength increment. The bacteria and its precipitates modify the microstructure of concrete thereby improve the impermeability of concrete. In this study, durability and crack healing behaviour of bacterial impregnated concrete using bacillus pasteurii bacteria was conducted. Experimental results showed a better durability performance by bacterial impregnated concrete compared to conventional M40Concrete. Bacterial concrete exhibited crack width reduction when immersed in water which strengthens self-healing property of it.*

Keywords- Microbiologically Induced Calcite Precipitation Bacterial Self Healing,Bacillus pasteurii, compressive strength test.

I. INTRODUCTION

Concrete became more versatile component of construction industry. But concrete structures shows damage before the end of their service life. Main reason behind this problem is cracking. Cracking enhance passage of deleterious substances into the concrete thereby corrosion and weakening of structure takes place. To avoid this problem, construction industries conduct regular maintenance and repairing works. Sometimes go for traditional repairing methods also eg; Epoxy based repairing methods.

Repairing at tunnel structures, nuclear power plant, marine structures etc. are very difficult to conduct and also it consumes more money and time. Traditional repairing methods also have drawbacks like cost, environmental problem and variation in thermal expansion coefficients etc. Because of these difficulties new method is needed to extend the serviceability of structures. Self-Healing concrete is a new era of construction industry and it make concrete structure crack free.

In self-healing concrete, pre-add the healing agent with in the concrete matrix thereby arresting of micro cracks takes place before they appear as large cracks. Bacterial impregnated concrete is a self-healing concrete in which bacteria act as healing agent. In bacterial impregnated concrete, bacteria incorporated at the time of mixing. When crack appear on the bacterial impregnated concrete it releases healing agent with in the concrete and flow into the cracks to seal the cracks from inside to outside. Self –healing concrete can restrain early age cracks to develop to large cracks.

1.1. Objective of the study

i. To introduce bacteria in fresh concrete as a bio concrete.
ii. To introduce bacteria in hardened concrete as a self healing agents .
iii. To check the effects of Alccofine on engineering properties of self healing concrete.
iv. To check the effects of Alccofine on durability properties of Bacterial concrete.

1.2. Scope of the study

Bacterial concrete, as the name suggest is an improvisation provided to cement using living microbes which are capable of doing so. Using microbes such as Bacillus and some compound which has properties of bio calcification can secrete calcium carbon ate as an extra cellular product thus filling the pores and the cracks internally making the structure more compact and resistive to see page. As the texture becomes more compact the compressive streng this also considerably increased. Thus, this process can reduce the see page permanently.

II. EXPERIMENTAL DETAILS

i. Cement

ISI marked OPC53cement used in this study Ordinary Portland cement that satisfies the requirements of Indian standardsIS12269:1987.

ii. Coarse Aggregate

The coarse aggregates obtained from the locally available quarries with maximum size of 20 mm and satisfying the grading requirements of BIS (IS: 383-1970) is use during this work.

iii. Fine Aggregate

The Size of aggregate 4.75 mm and smaller is called fine aggregate.IS:383-1970 has divided the fine aggregate in to four grading zones. The grading zones become progressively finer from grading zone I to grading zone IV. Zone III used during this work.

iv. Water

Portable drinking water having H value of 7 and conforming to IS 456-2000 IS used for concreting as well ascuring of specimens.

v. Alccofine

Alccofine 1203 is proprietary low calcium silicate based mineral additive. Controlled granulation process results in unique particle sized is tribution. Its latent hydraulic property and pozzolanic reactivity results in enhanced hydration process. Addition of Alccofine 1203 improves the packing density of paste component. This results in lowering water demand, admixture osage and hence improving strength and durability parameters of concrete at all ages.

Figure 1 Bacillus pasteurii

III. MIX DESIGN OF M-40 CONCRETE

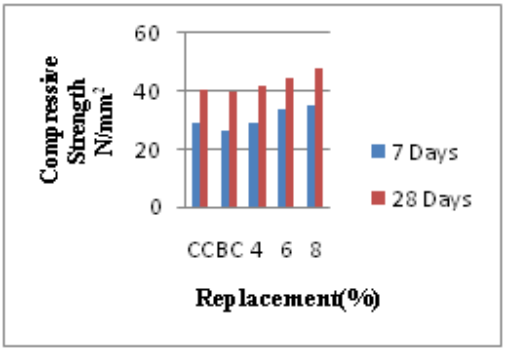
Proportion	Water	Cement	Fine aggregate	Coarse aggregate
By weight (kg/m^3)	157.6	415	771.9	1157.8
Weight	0.40	1	1.86	2.78

IV. RESULTS AND DISCUSSION

4.1. Compressive strength test results.

Result of Compressive Strength for Replacement of Cement with Alccofine

Type of Concrete	7 Days		28 Days	
	Compressive Strength N/mm^2	Average Compressive Strength N/mm^2	Compressive Strength N/mm^2	Average Compressive Strength N/mm^2
Conventional Concrete(M_{40})	29.01	29.07	38.45	40.12
	30.45		40.69	
	27.77		41.23	
bacterial concrete	25.06	26.09	39.16	39.78
	27.01		38.93	
	26.20		41.25	
bacterial concrete with4%, Alccofine	29.29	29.26	42.03	42.03
	29.57		40.96	
	28.93		43.10	
bacterial concrete with6% Alccofine	34.04	33.52	45.86	44.56
	33.12		43.69	
	33.40		44.13	
bacterial concrete with8%, Alccofine	35.12	34.80	48.07	47.71
	34.48		45.98	
	34.80		49.08	



Graph 1 Compressive Strength for Replacement of Cement with Alccofine for 7 & 28 days

4.2. Sorptivity test results.

Calculations :Sorptivity is measured
$S= (I/\sqrt{t})$ Where;
S= sorptivity in mm,
t= elapsed time in minute.
$I=\Delta w/Ad$
Δw= change in weight = W2 ─ W1
W1 = Oven dry weight of cube after coating in grams
W2 = Weight of cube after60 minutes capillary suction of water in grams.
A= surface area of the bottom side through which water penetrated.
d= density of wate

Sample Calculation :

Δw = change in weight = W2 ─ W1 = 8230 – 8190 = 40 gm

W1 = Oven dry weight of cube after coating in grams = 8190gm

W2 = Weight of cube after60 minutes capillary suction of water in grams = 8230gm

A= surface area of the bottom side through which water penetrated = 0.0225 m

d=density of water = 1 gm/cm3

t= time in minutes = 60 min

I=Δw/Ad = 40/ (0.0225 × 102 × 1) = 17.77 m

Hence, S = I/√t = 17.77 /√60 = 2.29

Figure 2 Compressive Strength Test

Result of sorptivity test for Replacement of Cement with Alccofine

Type of conctrete	Dry wt. in grams	Wet wt. in grams	Change in wt in grams	Sorptivity value in m.s-1/2	Average Sorptivity Value in m.s-1/2
Conventional Concrete(M_{40})	8227	8266	39	2.24	2.25
	8233.31	8270.31	37.12	2.12	
	8229.96	8271.96	42.03	2.41	
bacterial concrete	8235.17	8271.29	36.12	2.07	2.12
	8239.06	8278.18	39.12	2.24	
	8237.12	8273.09	35.96	2.06	
bacterial concrete with4%, Alccofine	8230	8266.04	36.04	2.06	2.01
	8242	8283	41	2.1	
	8247	8279.37	32.37	1.86	
bacterial concrete with6% Alccofine	8238	8267.13	29.37	1.47	1.54
	8241	8272.09	31.09	1.78	
	8225	8249.21	24.21	1.38	
bacterial concrete with8%, Alccofine	8240	8261.21	21.03	1.2	1.21
	8234	8257.21	23.21	1.33	
	8228	8247.18	19.18	1.10	

Discussion on compressive strength

1. In conventional as well as Replacement Accofine the compressive strength at 7 days and 28 days are found out and results are tabulated.
2. The maximum value of compressive strength obtained is 47.71 N/mm2 for M40 grades of concrete respectively when the cement is replaced by 8% Alccofine.
3. The required strength of M40 concrete is achieved for 4%,6%,8% replacement in the case of M40 grade concrete.

Discussion on Sorptivity Test

1. Durability of bacterial concrete is high compare to convetional concrete.
2. Durability is increase with the 4%,6%,8% replacement in the case of M40 grade concrete.

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