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The Experimental Investigation of Durability Test on Concrete Cubes

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Abstract— *Concrete is considered to be the most widely used and versatile material of construction all over the world. Durability and strength are two most important criteria for the design of reinforced concrete structures. These are the two requirements for the long term performance of concrete structures. In chemical industry, concrete is affected by different chemical like chloride, sulphate, carbonation of concrete etc. In this work, the characteristic strength for M30 grade of concrete and for micro concrete is checked. The cubes after 28 days of curing in water is immersed in 5% H_2SO_4 and 5% HCL of the total volume of water; separately for 28 and 56 days to evaluate the decrement in the strength as compared to normal condition.*

Keywords— *Micro concrete, M30 grade of concrete, HCL, H_2SO_4, Compressive Test*

1) INTRODUCTION

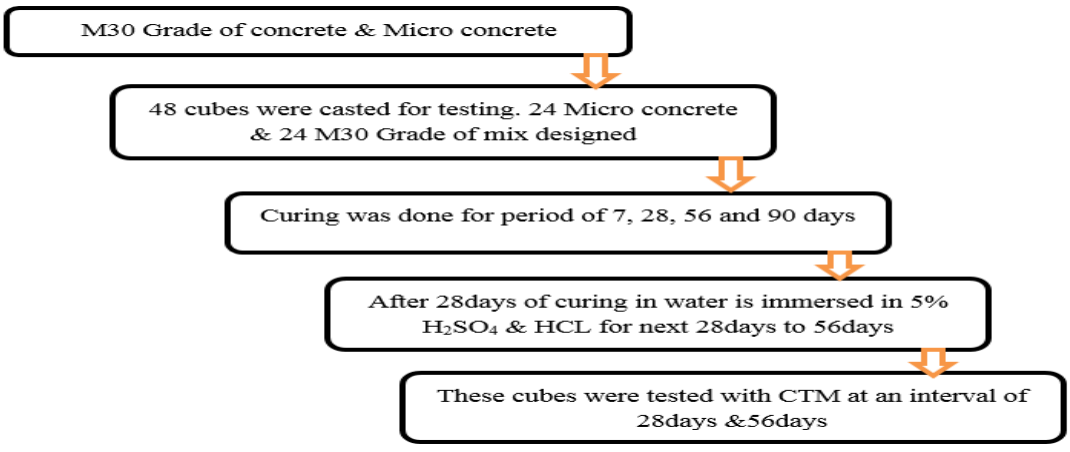
Cement concrete has clearly emerged as the material of choice for the construction of a large number and variety of structures in the world today. Durability and strength are important criteria for the design of concrete structure. Any deficiency in any of two i.e. durability and strength could make the structure unfit for the intended purpose. If the structure is not durable, but it has sufficient strength, then the strength of structure reduces with the age due to deterioration of concrete and reinforcement due to surrounding environment.

Environment plays an important role while selecting durable materials for reinforced concrete structures. For environments such as coastal areas where rate of corrosion is very high, special care is taken for the corrosion allowance of reinforcement, epoxy painting of reinforcement, required cover to reinforcement, grade of concrete to be used, water-cement ratio and quality of water for construction and compaction of concrete.

One of the main causes of deterioration in concrete structures is the corrosion of concrete due to its exposure to harmful chemicals that may be found in nature such as in industrial effluents. The most aggressive chemicals that affect the long term durability of concrete structures are the chlorides and sulphates. The chloride dissolved in waters increases the porosity of concrete and leads to loss of stiffness and strength.

The chemical resistance of the concretes was studied through chemical attack by immersing them in an acid solution. After 28 days period of curing the specimens were removed from the curing tank. The specimens were immersed in 5% H_2SO_4 and HCL solution and the pH was maintained constant throughout. The mass of specimens were measured at regular intervals up to 90 days and the mass losses were determined.

2) EXPERIMENTAL PROGRAM



1. Test Specimen

Standard cube specimens (150 mm x150 mm x 150 mm) were cast using the procedure described in IS: 516–1959. Twelve cubes of micro concrete and twelve cube of M30 grade of concrete (3 for 7-days+3 for 28-days+3 for 56-days+3 for 90-days) with varying in a curing tank, after 28days six cube of micro and six cubes M30 grade of concrete (3 for 56-days+3 for -90days) 5percentage of H2SO4 and HCL are added in water.

Casting of cubes for M30 grade of concrete				
	7 Days	28 Days	56 Days	90 Days
Curing in Water	3	3	3	3
Curing in H2SO4 after 28days	-	-	3	3
Curing in HCL after 28days	-	-	3	3

Table 1: Curing for M30 grade concrete cubes

Casting of cubes for Micro concrete				
	7 Days	28 Days	56 Days	90 Days
Curing in Water	3	3	3	3
Curing in H2SO4 after 28days	-	-	3	3
Curing in HCL after 28days	-	-	3	3

Table 2: Curing for Micro concrete cubes

2. Material used in present study

Cement (OPC 53 Grade)

Ordinary Portland cement of 53 grade satisfying all the requirements of IS12269-1987 was used in making the concrete cubes in the experimental work, and the specific gravity of cement was found to be 3.12.

Sr. No.	1	2	3	4	5	6
Properties	Specific gravity	Soundness	Initial setting time	Final setting time	Normal consistency	Fineness
Values	3.12	1.20mm	167 minute	255 minute	31%	320m^3/kg

Table 3: Physical property of cement

No.	Grade of concrete	M30
1	Cement kg	45
2	Fine aggregate kg	69.45
3	Coarse aggregate kg (10mm & 20mm)	44.39
4	Grit kg	54.06
5	Water litter	19.55
6	Water cement ratio	0.43

Table 4: Quantity of material for M30 Mix Design

Cubes size	150 mm x150 mm x 150 mm
No. of cubes	25 Nos.
Quantity	0.0843 m^3
Density of micro concrete	2000 kg/m^3
Total weight of micro concrete	168.75 kg

Table 5: Quantity of Material for Micro Concrete

3. Compression Test

The compression test was perform using CTM. Compressive strength test is the most common test conducted on concrete, because it is easy to perform and most of the desirable characteristic properties of concrete are quantitatively identified to its compressive strength. Compressive strength was determined by using Compression Testing Machine (CTM) of 2000 KN capacity.

Figure 1: Testing of cubes in CTM

The compressive strength of concrete was tested using 150 x150x150 mm cube specimens. The test was carried out by placing a specimen between the loading surfaces of a CTM and the load was applied until the specimen fails. Three specimens should cast and to measure the compressive strength for each test conditions and average value was considered.

3) RESULT AND DISCUSSION

In this research work, mix design has been done for M30 grade of concrete as per the Indian standard code specifications (IS 10262-2007). The compressive strength of concrete is found out according to IS 516: 1959. The test results 7, 28, 56 and 90 days of compressive strength of concrete are reported here in.

	Peak load (KN)	Compressive Strength of M30 (N/mm^2)	Average compressive strength of M30 (N/mm^2)
After 7 days of curing	535.6	23.56	22.8
	502.9	21.95	
	530.5	22.89	
After 28 days of curing	750.2	38.15	38.68
	883.5	38.72	
	735.9	39.17	
After 56 days of curing	985.7	44.75	44.03
	1005	43.15	
	1023.3	44.2	
After 90 days of curing	1265	53.25	53.99
	1271	54.13	
	1284	54.59	

Table 6: Compressive strength test result of M30 grade of concrete

	Weight (kg)	Loss Weight (kg)	Compressive Strength of M30 (N/mm^2)	Average compressive strength of M30 (N/mm^2)
Total 56days cube After 28 days of curing in HCL	8.73	8.52	31.25	32.7
	8.65	8.28	34.51	
	8.62	8.43	32.44	
Total 56days cube After 28 days of curing in H2SO4	8.62	8.19	30.75	30.98
	8.35	7.99	31.95	
	8.71	8.22	30.24	

Table 7: Compressive strength test result of M30 after 28 days in chemical

	Weight (kg)	Weight Loss (kg)	Compressive Strength of M30 (N/mm^2)	Average compressive strength of M30 (N/mm^2)
Total 90days cube After 56 days of curing in HCL	8.37	8.11	22.5	23.13
	8.44	8.27	23.74	
	8.41	8.22	23.17	
Total 90days cube After 56 days of curing in H2SO4	8.76	8.02	21.11	20.8
	8.45	7.87	20.44	
	8.51	7.83	20.87	

Table 8: Compressive strength test result of M30 after 56 days in chemical

Figure 2: Tested Sample of M30 of concrete

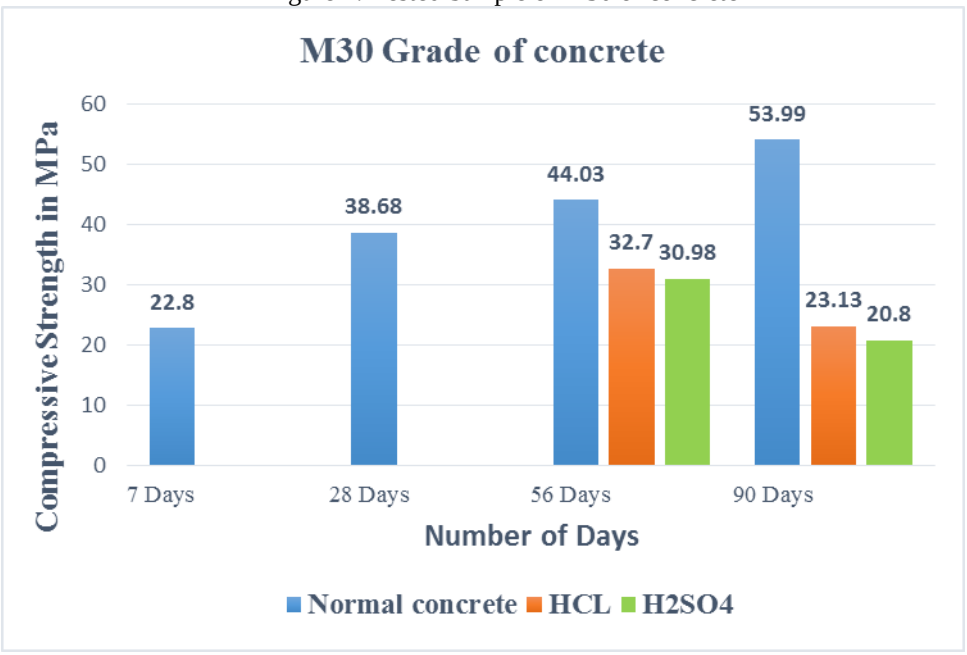


Figure 3: Bar chart for compressive strength of M30 grade of concrete

	Peak load (KN)	Compressive Strength of Micro Concrete (N/mm^2)	Average compressive strength of Micro Concrete (N/mm^2)
After 7 days of curing	887.6	36.98	37.08
	898.2	37.23	
	890.5	37.05	
After 28 days of curing	1140.1	47.85	48.35
	1207.3	48.03	
	1285.6	49.17	
After 56 days of curing	1420.1	59.17	59.89
	1350.7	60.48	
	1401	60.03	
After 90 days of curing	16.03	66.39	65.58
	15.90	65.01	
	15.97	65.35	

Table 9: Compressive strength test result of Micro concrete

	Weight (kg)	Loss Weight (kg)	Compressive Strength of Micro Concrete (N/mm^2)	Average compressive strength of Micro Concrete (N/mm^2)
Total 56days cube After 28 days of curing in HCL	8.23	7.29	47.35	45.26
	8.39	7.69	44.43	
	8.34	7.63	44.01	
Total 56days cube After 28 days of curing in H2SO4	8.41	8.29	42.02	41.94
	8.37	8.13	43.65	
	8.33	8.19	40.15	

Table 10: Compressive strength test result of Micro concrete after 28 days in chemical

	Weight (kg)	Loss Weight (kg)	Compressive Strength of Micro Concrete (N/mm^2)	Average compressive strength of Micro Concrete (N/mm^2)
Total 90days cube After 56 days of curing in HCL	8.35	8.12	35.37	36.14
	8.55	7.95	36.3	
	8.42	8.23	36.75	
Total 90days cube After 56 days of curing in H2SO4	8.64	7.14	30.12	30.93
	8.55	7.46	30.97	
	8.76	7.92	31.72	

Table 11: Compressive strength test result of Micro concrete after 56 days in chemical

Figure 4: Tested sample of Micro concrete

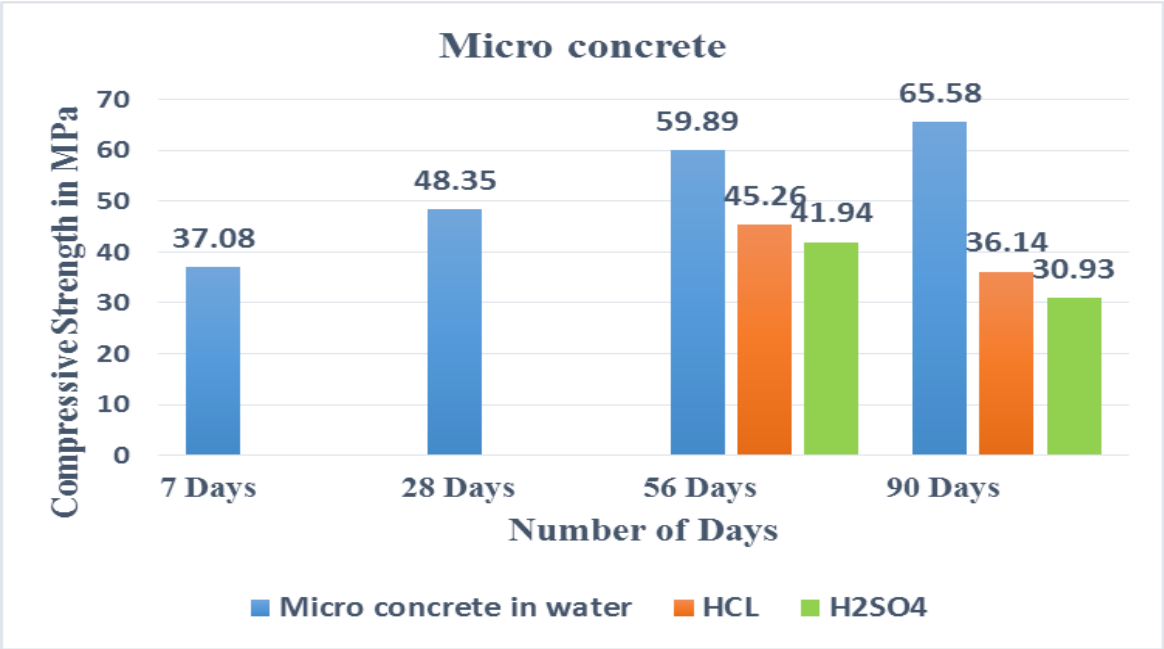


Figure 5: Bar chart for compressive strength of Micro concrete

4) CONCLUSION

- We can see that result of M30 Grade of concrete and Micro concrete after 28 days of curing in chemical; Compressive strength of M30 grade of concrete is 32.7 N/mm^2 in HCL and 30.98 N/mm^2 in H_2SO_4.
- After 28 days of curing in chemical, Compressive strength of Micro concrete is 45.26 N/mm^2 in HCL and 41.94 N/mm^2 in H_2SO_4.
- After 56 days of curing in chemical, Compressive strength of M30 grade of concrete is 23.13 N/mm^2 in HCL and 20.8 N/mm^2 in H_2SO_4. After 56 days of curing in chemical, Compressive strength of Micro concrete is 36.14 N/mm^2 in HCL and 30.93 N/mm^2 in H_2SO_4.
- The compressive strength is reduced slightly more at immersing in H_2SO_4 as compared to HCL.

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