

## Acid Attack Test on SCC using Pozzolanic Materials

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**Abstract**— Self-compacting concrete (SCC) is one of the type of concrete which will compact by its own weight. Here in this experimental work sulphuric acid test has been concentrated with several replacements for cement and sand. The pozzolanic materials used for this research are rice husk ash and bagasse ash. Quarry dust is used as a partial replacement for sand. The replacement is made for cement is up to 30% and 70% for sand. The pH is maintained at 2.15 at every 3 days for the concentration of 2.5% sulphuric acid. The result showed that as the replacement for cement is increased the weight loss of the concrete cube decreases.

**Keywords:** Self-Compacting Concrete (SCC), OPC, PPC

### I. INTRODUCTION

The acid may be weak corrosive or strong corrosive. A portion of the weak acids are Acidic corrosive, Carboic corrosive, Carbonic corrosive, Lactic corrosive, Phosphoric corrosive, Tannic corrosive and a percentage of the strong acids are Hydrochloric corrosive, Sulphuric corrosive, Sulfurous corrosive, Nitric corrosive, Hydrofluoric corrosive. Here in this experimental work sulphuric corrosive assault test has been concentrated on. Sulphuric corrosive is a very destructive strong corrosive with an atomic equation  $H_2SO_4$  it is a sharp ethereal, color less to somewhat yellow thick fluid which is solvent in water at all concentration. The authentic name of this corrosive is oil of vitriol. Sulphuric corrosive shows diverse properties depending up on its concentration. It's destructive on other material like metals, living tissues and even for stones

### II. MATERIALS USED AND ITS CHARACTERISTICS

#### A. Cement:

Cement is the fine material which is used as a binding material. There are different types of cement are obtained in the market. Some of them are Ordinary port land cement(OPC), Portland-Pozzolana cement(PPC), Rapid hardening Portland cement, Portland slag cement, and High alumina cement. Generally OPC 43 grade is used for the investigation and construction works.

SL.NO	PHYSICAL TEST	RESULT OBTAINED	AS PER IS:8112-1989
1	Fineness (retained on 90µm IS sieve) (%)	7.25	Up to 10 maximum
2	Normal consistency (%)	32	-
3	Specific gravity of cement	3.04	3 to 3.15
4	Vicat time of setting (minutes)	79 365	30 min- 600 max

	a)Initial setting time b)Final setting time		
5	Soundness of cement(mm)	2	Up to 10 max

#### B. Fine Aggregate:

For the studies the river sand of Zone-II is used in all the references. IS: 383-1970 defines the fine aggregates as 7.25particles, which will pass through 4.75mm IS sieve and retained on 150 micron.

SL NO	PHYSICAL TEST	RESULT OBTAINED	AS PER IS:383-1970
1	Specific gravity of F.A	2.48	2.60 to 2.70
2	Fineness modulus of F.A	3.28	2.20 to 3.20
3	Bulk density of F.A a) Dense state(Kg/m <sup>3</sup> ) b) Loose state (Kg/m <sup>3</sup> )	1620.4 1445.8	- -
4	Absorption capacity of F.A (%)	1.65	Less than 2
5	Surface moisture of F.A (%)	1.3	Less than 2

#### C. Coarse Aggregate:

The coarse aggregate is defined as an aggregate most of which is retained on 4.75mm IS sieve. The aggregates are formed due to natural disintegration of rocks or by artificial crushing of the rock or gravels. The common coarse aggregates are crushed stone and gravel. The size of the aggregates generally used was 16 mm downsize.

SL NO	PHYSICAL TEST	RESULTS OBTAINED	AS PER IS:383-1970
1	Specific gravity of C.A	2.608	2.60 to 2.80
2	Bulk density of F.A a)Dense state(Kg/m <sup>3</sup> ) b)Loose state(Kg/m <sup>3</sup> )	1578.3 1393.7	- -
3	Absorption capacity of C.A (%)	0.35	Less than 0.60
4	Surface moisture of C.A (%)	0.15	-

**D. Water:**

Generally tap water is used in this experiment. The water which is used should be free from salt. It is very important ingredient in the concrete mass, as it actively participates in a chemical reaction with cement.

**E. Rice Husk Ash:**

The rice husk ash had greyish white colour. RHA was passed through IS 90 micron sieve and this was used for the research.

SL .NO	PHYSICAL TEST	RESULTS OBTAINED
1	Specific gravity	2.23
2	Bulk density in kg/m <sup>3</sup>	578.05

**F. Bagasse Ash:**

Bagasse is a sinewy matter that the remaining part, after sugarcane is crushed to extract their juices. It is utilized as a bio fuel and in production of bulb and building materials. Bagasse ash is normally obtained under controlled burning conditions in the boiler of the co-generation process. About 300 million tons of sugarcane is produced in India, in that 10 million tons of sugarcane remains unused.

SL .NO	PHYSICAL TEST	RESULTS OBTAINED
1	Specific gravity	2.38
2	Bulk density in kg/m <sup>3</sup>	1502

**G. Quarry Dust:**

Quarry dust comprises of the smaller aggregate particles, so it was sieved and quarry dust passing from 4.75mm IS sieve and retaining on 150 micron IS sieve is used for the replacement of fine aggregate.

SL NO	PHYSICAL TEST	RESULT OBTAINED
1	Specific gravity of QD	2.20
2	Fineness modulus of QD	2.45
3	Bulk density of QD	1740
	a) Dense state (Kg/m <sup>3</sup> )	
	b) Loose state (Kg/m <sup>3</sup> )	1495
4	Absorption capacity of QD (%)	1.2
5	Surface moisture of QD (%)	0.2

**H. Chemical Admixture:**

There are water-soluble components added primarily to control setting and hardening of concrete or to reduce its water requirement. The grouping of chemical admixtures is being done depends on their applications such as super plasticizers, retardants, accelerations, water reducing agents. The admixture used here is "SIKA VISCOCRETE 5231 NS".

**III. TEST RESULTS AND DISCUSSION**

**A. Trial Mixes:**

SL.NO	SP (%)	RATIO	SLUMP (mm)
1	0.2	1:1.9778:1.622	290
2	0.2	1:1.9778:1.622	345
3	0.3	1:1.9778:1.622	370

4	0.3	1:1.9778:1.622	420
5	0.3	1:1.9778:1.622	470
6	0.4	1:1.9778:1.622	520
7	0.4	1:1.9778:1.622	545
8	0.4	1:1.9778:1.622	590
9	0.5	1:1.9778:1.622	620
10	0.5	1:1.9778:1.622	645
11	0.5	1:1.9778:1.622	651 (Stable)
12	0.6	1:1.9778:1.622	675 (bleeding)

**B. Notations for Several Replacements:**

Mix ingredients Replacement	Notation	W/C	Admixture
0%	M1	0.45	0.5
10%RHA & BA, 30%QD	M2	0.51	0.6
10%RHA & BA, 50% QD	M3	0.55	0.6
10%RHA & BA, 70% QD	M4	0.55	0.65
20%RHA & BA, 30%QD	M5	0.6	0.55
20%RHA & BA, 50% QD	M6	0.64	0.6
20%RHA & BA, 70% QD	M7	0.65	0.6
30%RHA & BA, 30% QD	M8	0.625	0.65
30%RHA & BA, 50% QD	M9	0.645	0.7
30%RHA & BA, 70% QD	M10	0.695	0.65

**C. Fresh Properties of SCC:**

Sl . No	Notation	Slump flow in mm	T <sub>50CM</sub> SLUMP FLOW IN SEC	J RING DEPTH IN mm	V FUNNEL TIME in sec	L BOX RATIO OF DEPTH
1	M1	651	3	8	12	0.83
2	M2	649	3	8.5	11	0.87
3	M3	610	4	11	13	0.87
4	M4	693	3	8	10	0.93
5	M5	590	4	13	14	0.85
6	M6	645	3	9	10	0.82
7	M7	650	3	10	10	0.89
8	M8	613	4	12	12	0.86
9	M9	654	3	8	11	0.82
10	M10	652	3	9	10	0.80

**D. Discussion:**

The fresh concrete property is obtained better for M4 i.e. 10% partial replacement of RHA and BA to cement and 70% of quarry dust to fine aggregate when compared to all other replacement as well as 0% replacement.

#### IV. ACID ATTACK TEST ON CONCRETE

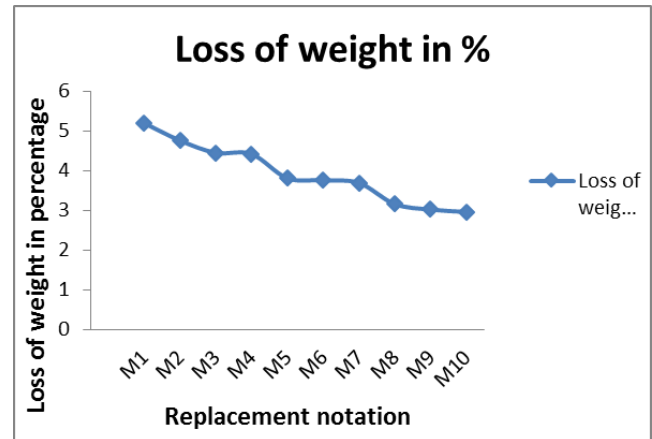
Acid attack test is carried out by casting cube size 75mm \* 75mm \* 75mm. After curing these cubes for 28 days dry weight is noted, then the same cubes are immersed in acid solution for 28 days and once again weight is noted. The loss in weight is calculated in percentage.

##### A. After The Cubes Immersed in Acid Solution



##### B. Below Table Showing the Test Results

Sl. No	Notation	Mean weight of the cubes		Loss of weight in %
		After 28 day water curing and before immersing in acid solution	After 28 day water curing and after 28 day immersing in acid solution	
1	M1	2447	2320	5.20
2	M2	2373	2261	4.76
3	M3	2393	2286	4.45
4	M4	2612	2497	4.42
5	M5	2370	2280	3.81
6	M6	2394	2304	3.76
7	M7	2351	2265	3.69
8	M8	2332	2258	3.16
9	M9	2388	2315	3.02
10	M10	2325	2256	2.96



##### C. Discussion

From the above table, it shows that as the percentage of RHA and BA in place of cement and quarry dust in place of sand is increased the loss of weight of cube is decreased. This shows that more the replacement for cement and sand, better the durability of concrete.

#### V. CONCLUSION

- 1) The fresh concrete property is obtained better for M4 i.e. 10% partial replacement of RHA and BA to cement and 70% of quarry dust to fine aggregate when compared to all other replacement as well as 0% replacement.
- 2) From the acid attack test we can conclude that as the percentage of replacement for cement is increased and also as the replacement for fine aggregate is increased, the acid attack on concrete is decreased i.e. the loss of weight is decreased as the percentage is increased.

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