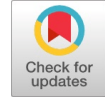# Strength and Acid Resistance of M50 Grade Self-Compacting Concrete

Ipsita Bose Roy Choudhury, V. Subbalakshmi

Abstract: Self-compacting concrete have very high strength and durability and is a fluid mixture of high performance, which is applicable in placing at difficult condition and without any vibrator in the structures with congested reinforcement. Sufficient powder along with a super plasticizer is used to make Self compacting concrete in order to flow it while the coarse aggregate are kept in a vicious suspension.M50 grade self-compacting concrete is developed using fly ash and rice husk ash which are industrial by products. The flow and strength properties of SCC in comparison with conventional concrete are investigated. Concrete is susceptibility to acid (such as nitric acid, hydrochloric acid and acetic acid) attacks because of its alkaline nature. Acid Durability Loss Factor is used to study the loss of strength, stability and weight of SCC in the influence of acid. This factor gives the performance of both strength and durability.

Keywords— Acid Resistance, Durability, SSC-Self compacting concrete, CC-Conventional Concrete, M50 grade.

I. INTRODUCTION

Scc can be produced by designing an appropriate mix proportion and then concrete properties are obtained.

SCC actually in its fresh state in practice have very high fluidity. So the ability and good properties of segregation resistance of self-compacting concrete contributes in reducing the risk of honey combing of concrete. In addition SCC also shows good compressive strength .It have low yield value which ensures high deformability and moderate viscosity with solid particles in uniform suspension.

The greater material cost of SCC in comparison with conventional concrete of similar mechanical properties is due to relatively high demand of cementitious material and High range water reducing (HRWRS) and viscosity enhancing admixtures (VEAs) and other chemical admixtures.

II. LITERATURE REVIEW

JRMCA (1998) had proposed a standardized method of mixed design to produce SCC which is a simplified version of Okamura and Ozawa (1995) where powder material and water binder is used with a large amount of ratio < 0.30. RELEM report 23 from technical committee 174 (skarendalh 2001) states deformability, flow ability and resistance to segregation are main functional requirements of a fresh SCC.

Gibbs (1999) actuates that SCC can be designed and constructed using a broad range of normal concreting material.

In the Brite-euram project, Peterson (1999) states that both natural and crushed aggregate can be successfully used in SCC as long as the attention is given to amount of paste necessary to avoid blocking of the aggregates.

Takada (1998) ,Sugamata (1999) suggests that class C and class F may be used successfully in SCC.

Tviksta (2000) found that addition of super plasticizer at later stage of mixing leads to better flow ability.

T.Cerulli, C.Pistolesi, C.Maltese, D.Salvoni(2003) have studied blast furnace slag based plaster and its durability with respect to traditional plasters.

Erntroy and Shacklock have suggested empirical graph for high strength concrete which relates arbitrary reference number to the compressive strength.

III. PROPERTIES OF MATERIALS

1. Cement: Ordinary Portland cement confirming to IS – 12269 having specific gravity 3.15
2. Fine Aggregate: Natural river sand confirming to IS-385 zone II having specific gravity 2.63(by pycnometer)
3. Course Aggregate: Crushed at granite angular aggregate of size 12.5mm specific gravity 2.675 confirming IS3812-1981 and Rice Husk Aggregates (RHA)
4. Chemical admixture/Super Plasticizer (SP): Glenium B233
5. Fly ash obtained from Vijayawada thermal power station in AP, of specific surface 4750 cm^2/bm by Blaine's apparatus.
6. RHA of specific gravity 2.3, loss of ignition 3.6% and fineness Blains =16000 cm^2/gm

IV. MIX PROPORTIONING

The major work in producing SCC is designing as appropriate mix proportion and then the properties of the concrete are evaluated and calculated.

SCC shows high fluidity in its fresh state along with its ability in self-compacting and resistance in segregation, these all contribute in reducing honey combing risk of concrete. Cement, coarse aggregate, fine aggregate, water, mineral and chemical admixture are the usual ingredients of SCC but no standard or all encapsulating method currently exist for SCC for the mixture proportions determinations.

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Table1: SCC proportions of materials and its Limitation

	High Fines	VMA	Combination
Cementations, lb/yd3(kg/m3)	750-1000 (450-600)	650-750 (385-450)	650-750 (385-450)
Water/cementations material	0.28-0.45	0.28-0.45	0.28 – 0.45
Fine aggregate/mortar %	35-40	40	40
Fine aggregate/total aggregate %	50-58	-	-
Coarse aggregate/total mix %	28-48	45-48	28-48

EFNARC-Proposals

In designing the mix the relative proportions of the key components by volume is useful rather than by mass.

Water/powder ratio by volume 0.8-1.10

Total powder content-160 to 240 (400-600kg) per cubic meter

Coarse aggregate content normally 280 to 35% by volume of the mix

Water cement ratio is selected based on requirements in EN 206.

Typically water content does not exceed200lt/m3

The sand content balances the volume of other constituents.

Generally design should be done conservatively so that the capability of the concrete despite variation in raw materials in maintaining its specified fresh properties is ensured.

Design of M50 grade concrete (trial mix)

Specified 28 days cube strength: 50Mpa

Degree of control: very good

Control Fa: 0.8

Degree of Workability: very low

Type of cement: ordinary Portland cement

Type of C.A.: crushed granite

Type of F.A: natural sand

Specific gravity of Cement: 3.15

Specific gravity of F.A: 2.63

Specific gravity of C.A:2.675

Target mean strength (fck):

σ/control factor50/0.85=58.85N/mm2

From chart for the required strength reference no is 15.

From chart for obtained reference no and for very high workability the w/c ratio is 0.34

The aggregates are obtained by analytical and graphical method. So that 30% of the material passes through 4.75mm IS sieve.

Ratio of fine to total aggregate =35%

Cement: FA: CA: water

 =1:0.98:35/100x28:65/100x2.8:0.34

Weight of cement required for m3 of concrete

 =C+0.98C+1.82C+0.34C=1000

Or, 1.706C=1000kg/m3

C=585.13 Kg/m^3

W=198.9 Kg/m^3

FA=573.4 Kg/m^3

CA=1064.9 Kg/m^3

Let the cement quantity is fixed to 600 Kg/m^3

The modified quantities are: Water = 190 Kg/m^3

Cement=600 kg/m3, water = 190 kg/m^3,

 FA=840 kg/m^3,

 CA =800Kg/m^3

 The final mix proportion is 0.34:1:1.4:1.33.

V. OPTIMIZATION OF MIX PROPORTION

To arrive at suitable mix proportion for conventional concrete **(CC) & SCC**, extensive trials are conducted at laboratories.

A. *Table2: Trial mix to optimize water content*

Designation	Cement (Kg/m^3)	Water (Kg/m^3)	F.A (Kg/m^3)	C.A (Kg/m^3)
RC1	425	144.5	604.5	1125.6
RC2	450	160	604.5	1125.6
RC3	510	177	604.5	1125.6
RC4	550	185	604.5	1125.6
RC5	660	190	604.5	1125.6

B. *Table3: Trial mix with RHA*

Designation	Cement (Kg/m^3)	RHA (Bwp)	Water (Kg/m^3)	F.A (Kg/m^3)	C.A (Kg/m^3)
RC1	425	1%	144.5	604.5	1125.6
RC2	450	3%	160	604.5	1125.6
RC3	510	5%	177	604.5	1125.6
RC4	550	7%	185	604.5	1125.6
RC5	660	10%	190	604.5	1125.6

C. *Table4: Trial Mix with SP*

Designation	Cement (Kg/m^3)	SP (Bwp)	Water (Kg/m^3)	F.A (Kg/m^3)	C.A (Kg/m^3)
RC1	480	0.25%	177	604.5	1125.6
RC2	480	0.5%	177	604.5	1125.6
RC3	480	0.75%	177	604.5	1125.6
RC4	480	1.0%	177	604.5	1125.6
RC5	480	1.25%	177	604.5	1125.6

Table5: Quantities of materials for M50 grade of conventional concrete

Grade	Cement (Kg/m^3)	RHA (Kg/m^3)	Water (Kg/m^3)	SP (bwp)	F.A (Kg/m^3)	C.A (Kg/m^3)
M50	**480**	**24**	**16.5**	**0.5%**	**604.5**	**1125.6**

Table6: Quantities of materials for M50 grade of self-compacting concrete (SCC)

Grade	Cement (Kg/m^3)	Fly Ash (Kg/m^3)	RHA (Kg/m^3)	Water (Kg/m^3)	SP (bwp)	F.A (Kg/m^3)	C.A (Kg/m^3)
M50	**480**	**62.4**	**41.6**	**178.16**	**1.75%**	**865.2**	**865.2**

Table7: Mix proportions for M50 grade of conventional concrete and SCC

Grade	Conventional Concrete by ES Method	SCC by ES Method
M50	**0.34:1.0:1.2:2.2**	**0.34:1.0:1.71:1.71**

VI. TESTING

Test on Fresh Concrete: To find the Filling ability, passing ability and segregation resistance on fresh SCC, we performed Slump test, V-Funnel and L-Box tests. As per the EFNARC specifications, the prescribed limits of the tests are as follows.

Table8: Fresh Properties of SCC

Grade	Slump Flow		L-Box			V-Funnel	
	Slump (mm)	T50 (sec)	T20 (sec)	T40 (sec)	H2/H1	T0 (sec)	T5 (sec)
M50	700	3.9	3.0	7.7	0.9	7.3	13.6

Test on SCC & CC in Hardened State: 100mm size cubes are taken to carry out Compressive strength tests on compression testing machine of 1000KN capacity as per IS 516:1959. 150mm diameter and 300mm height cylinders were taken on a compression testing machine of 1000KN capacity as per IS 516:1959 to carry out Split tensile strength tests. Prisms of size 100x100x500mm were taken to carry out Flexural strength tests on flexural testing machine of capacity 100KN as per IS 516:1959.

Table 9: M50 grade Hardened Concrete strength properties Comparison.

Property	Strength at 3 days			Strength at 7 days			Strength at 28 days		
	CC	SCC	% Increase decrease	CC	SCC	% Increase decrease	CC	SCC	% Increase decrease
Comp. Strength (N/mm²)	30.82	29.00	-5.67	37.57	36.34	-3.3	54.82	56.76	3.53
Split Tensile Strength (N/mm²)							5.48	5.64	+2.8
Flexural Strength (N/mm²)							5.72	5.91	+3.2

VII. CHEMICAL ANALYSIS

Sample Calculation: Volume of Sulphuric acid and HCL required for complete immersion of cubes in the tray =75 Lts.

A. *Preparation of 2% H₂SO₄*

Sulphuric acid (Merck sample, GR grade) specific gravity 1.84is used to prepare 1 liter of 2% H_2SO_4 20 ml of conc. H_2SO_4 is to be dissolved in 980 ml of distilled water. Proportionately to prepare 75 lit of 2% H_2SO_4, 1.5 lit of con H_2SO_4 is dissolved in 73.5 lit of distilled water.

V_0 = Volume in liters of concentrated H_2SO_4 present in 7.5 lit of solution =1.5lit

B. *Preparation of 5% H2SO4*

The same sulphuric acid described above, is used to prepared 1litre of 5% H_2SO_4 is to be dissolved in 950ml of distilled water. Proportionately, to prepare 45 litre of 5% H_2SO_4, 2.25 lit of conc. H_2SO_4 is dissolved in 42.75 lit of distilled water.

C. *Preparation of 2% HCL*

HCL of (Qualigens AR grade),sp, gr. 1.18 is used to prepare 1lit of 2% HCL 20ml of conc. **HCL** is to be dissolved in 980ml of distilled water. Proportionately to get 75 liters of 2% HCL, 1.5 lit of conc.HCL is dissolved in 73.5 lit of distilled water.V_0 = Volume in liters of concentrated HCL present in 7.5 liters of solution is 1.5liters.

D. *Preparation of 2% HCL*

HCL described above is used to prepare 1lit of 5% HCL 50ml of conc. **HCL** is to be dissolved in 950ml of distilled water. Proportionately to get 75 liters of 5% HCL, 3.75 lit of conc.HCL is dissolved in 71.25 lit of distilled water.

V_0 = 3.75liters.

E. *Preparation of sodium hydroxide (NaOH) solution:*

Sodium Hydroxide (fine chemicals) of L.R grade is used. 3 gm of the sample is weighed out in a beaker and it is dissolved in 100mlof distilled water. The solution is thoroughly shaken with a glass rod to get uniform solution.

Standardization of NaOH

Ox, Acid to NaOH or, N1V1 = N2V2

Or, 1.5 x 1 = N2 x 2.15, N2 = 1.5 x ½.15 = 0.6977N

Concentration of NaOH = 0.6977 N

Tray No. with 2% **HCl**	NaOH consumed for ml of acid in the tray	Acid = NaOH N1V1= N2V2 N1=N2V2/V1	Co Moles/Lit.
1	0.20 ml	0.6977x0.2/1	0.13954
5	0.25 ml	0.6977x0.25/1	0.1744
9	0.20 ml	0.6977x0.2/1	0.13954
12	0.25 ml	0.6977x0.25/1	0.1744
15	0.25 ml	0.6977x0.25/1	0.1744

Tray No. with 5% **HCl**	NaOH consumed for ml of acid in the tray	Acid = NaOH N1V1= N2V2 N1=N2V2/V1	Co Moles/Lit.
2	0.50 ml	0.6977x0.5/1	0.34885
6	0.55 ml	0.6977x0.55/1	0.38373
10	0.65 ml	0.6977x0.65/1	0.45351
13	0.75 ml	0.6977x0.75/1	0.52327
16	0.65 ml	0.6977x0.65/1	0.45351

Tray No. with 2% H_2SO_4	NaOH consumed for ml of acid in the tray	Acid = NaOH N1V1= N2V2 N1=N2V2/V1	Co Moles/Lit.
3	1.20 ml	0.6977x1.20/1	0.41862
7	1.15 ml	0.6977x1.15/1	0.401175
11	1.15 ml	0.6977x1.15/1	0.401175
14	1.10 ml	0.6977x1.10/1	0.383735
17	1.05 ml	0.6977x1.05/1	0.366295

Tray No. with 5% H_2SO_4	NaOH consumed for ml of acid in the tray	Acid = NaOH N1V1= N2V2 N1=N2V2/V1	Co Moles/Lit.
4	2.80 ml	0.697x 2.80/1	0.97678
8	2.80 ml	0.6977x 2.80/1	0.97678
18	2.85 ml	0.6977x 2.85/1	0.994225

Standardization of NaOH

$N_1 = N_2V_2/V_1 = 1.5 \times 1/2.25 = 0.6667N$

Concentration of NaOH = 0.6667 N

Tray No. with 2% HCl	NaOH consumed for ml of acid in the tray	Acid = NaOH N1V1= N2V2 N1=N2V2/V1	C_{15} Moles/Lit.
1	0.05 ml	0.6977x0.05/1	0.03333
5	0.05 ml	0.6977x0.05/1	0.03333
9	0.05 ml	0.6977x0.05/1	0.03333
12	0.05 ml	0.6977x0.05/1	0.03333
15	0.05 ml	0.6977x0.05/1	0.03333

Tray No. with 5% HCl	NaOH consumed for ml of acid in the tray	Acid = NaOH N1V1= N2V2 N1=N2V2/V1	C_{15} Moles/Lit.
2	0.15 ml	0.6977x0.10/1	0.0.6667
6	0.10 ml	0.6977x0.10/1	0.0.6667
10	0.10 ml	0.6977x0.10/1	0.0.6667
13	0.10 ml	0.6977x0.10/1	0.0.6667
16	0.10 ml	0.6977x0.10/1	0.0.6667

Tray No. with 2% H_2SO_4	NaOH consumed for ml of acid in the tray	Acid = NaOH N1V1= N2V2 N1=N2V2/V1	C_{15} Moles/Lit.
3	0.30 ml	0.6977x0.30/1	0.100005
7	0.30 ml	0.6977x 0.30/1	0.1
11	0.25 ml	0.6977x0.25/1	0.08333
14	0.35 ml	0.6977x0.35/1	0.11667
17	0.30 ml	0.6977x0.30/1	0.1

Tray No. with 5% H_2SO_4	NaOH consumed for ml of acid in the tray	Acid = NaOH N1V1= N2V2 N1=N2V2/V1	C_{15} Moles/Lit.
4	0.65 ml	0.6977x0.65/1	0.216675
8	0.65 ml	0.6977x0.65/1	0.216675
18	0.65 ml	0.6977x0.65/1	0.216675

For 2%HCL Acid Replacement on 15Th Day,

2% HCL acid is used in each tray – 12 lit
= 0.24 lit HCl + 11.76 lit water = Vo =0.24 lit.

Tray No.	C_o Moles/Litre	C_{15} Moles/litre	Acid Consumed $(C_0-C_{15})V_0/C_0$
1	0.13954	0.03333	182.67
5	0.17440	0.03333	194.13
9	0.13954	0.03333	182.67
12	0.17440	0.03333	194.13
15	0.17440	0.03333	194.13

For 5%HCL Acid Replacement on 15Th Day,

5% HCL acid is used in each tray – 12 lit
= 0.6 lit HCl + 11.76 lit water = Vo =0.6 lit.

Tray No.	C_o Moles/Litre	C_{15} Moles/litre	Acid Consumed $(C_0-C_{15})V_0/C_0$
2	0.34885	0.06667	485.3
6	0.38373	0.06667	498.72
10	0.45351	0.06667	511.79
13	0.52327	0.06667	523.55
16	0.45351	0.06667	511.79

For 2% H_2SO_4, V0 = 0.24 lit H_2SO_4 + 11.76 lit water

Tray No.	C_o Moles/Litre	C_{15} Moles/litre	Acid Consumed $(C_0-C_{15})V_0/C_0$
3	0.41862	0.1	182.67
7	0.401175	0.1	180.18
11	0.401175	0.08333	190.15
14	0.383735	0.11667	167.03
17	0.366295	0.1	174.47

For 5% H_2SO_4, V0 = 0.60 lit H_2SO_4 + 11.40 lit water

Tray No.	C_o Moles/Litre	C_{15} Moles/litre	Acid Consumed $(C_0-C_{15})V_0/C_0$
4	0.97678	0.216675	466.9
8	0.97678	0.216675	466.9
18	0.994225	0.216675	469.24

Weight Loss Calculation

Percentage weight loss = (Initial Weight – Final Weight) X 100 / Initial weight

Weight Loss Calculation

Percentage strength loss = (Initial Strength – Final Strength) X100 / Initial weight.

Calculation of Acid durability Factor (ADF) = Sr N/M

Calculation of Acid Attack Factor (AAF)

For each of the two cubes the extent of deterioration in terms of acid diagonals (in mm) at each corner of the struck face and the opposite face is measured and acid attack factor (AAF) per face is calculated.

AAF = (Loss in mm on eight corners of each of 2 cubes)/4

VIII. EXPERIMENTAL RESULT

Table10: Weight loss and compressive strength loss for M50 – Conventional concrete

Acid %	%WT. and % CS Loss	Days					
		15	30	45	60	75	90
2% H_2SO_4	% wt. Loss	2.26	5.20	6.48	8.28	10.28	19.20
	% CS Loss	0.85	1.12	2.53	3.12	4.72	6.78
5% H_2SO_4	% wt. Loss	3.45	6.79	9.28	11.28	13.20	15.75
	% CS Loss	0.96	1.54	3.12	4.85	5.91	7.72
2% HCL	% wt. Loss	1.39	3.21	5.49	7.78	10.79	14.72
	% CS Loss	0.36	1.34	2.79	5.24	6.4	7.59
5% HCL	% wt. Loss	1.38	3.45	5.56	7.76	11.79	13.72
	% CS Loss	0.89	1.49	3.23	4.32	5.25	7.72

Table11: Weight loss of M50 – SCC and its compressive strength loss

Acid%	%WT. and % CS Loss	Days					
		15	30	45	60	75	90
2% H_2SO_4	% wt. Loss	0.56	1.28	1.76	2.38	4.84	7.68
	% CS Loss	0.74	1.00	2.36	2.79	3.56	4.67
5% H_2SO_4	% wt. Loss	0.64	1.36	3.49	5.72	6.01	7.73
	% CS Loss	0.81	1.23	2.83	3.73	4.89	6.75
2% HCL	% wt. Loss	0.28	0.96	1.97	2.98	4.77	6.72

	% CS Loss	0.3	1.12	2.12	4.36	5.92	6.42
5% HCL	% wt. Loss	0.3	1.20	1.98	4.28	5.46	7.36
	% CS Loss	0.66	1.32	2.56	3.42	4.39	6.39

Table12: Acid Durability Factors and Acid Attack Factors

Age	Factors	M-50 CC		M-50 SCC	
		2% H_2SO_4	5% H_2SO_4	2% HCL	5% HCL
15	Sr	98.15	99.04	99.26	99.19
	ADF	14.02	14.15	14.18	14.17
	AAF	0.12	0.20	0.10	0.15
30	Sr	97.88	98.45	99.0	98.77
	ADF	27.96	28.13	28.28	28.22
	AAF	0.25	0.29	0.16	0.21
45	Sr	96.47	96.88	97.64	97.17
	ADF	41.34	41.52	41.84	41.64
	AAF	0.42	0.53	0.24	0.36
60	Sr	96.88	95.15	97.26	96.27
	ADF	55.36	54.37	55.57	55.01
	AAF	0.78	0.89	0.41	0.72
75	Sr	95.28	94.09	96.44	95.11
	ADF	68.05	67.20	68.88	67.93
	AAF	1.41	1.20	0.60	0.80
90	Sr	93.22	92.28	95.33	93.25
	ADF	79.90	79.09	81.71	79.92
	AAF	1.18	1.38	0.78	1.12

Acid Durability Factor
M-50 CC 2% H2SO4   M-50 CC 5% H2SO4
M-50 SCC 2% HCL   M-50 SCC 5% HCL
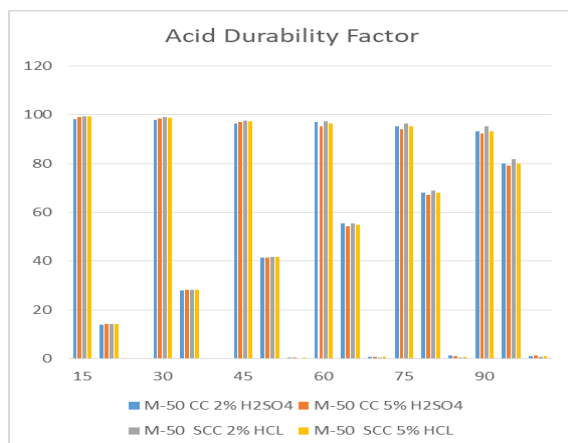
IX. DISCUSSION OF RESULTS

Table 8 gives the properties such as filling ability, passing ability etc. of the SCC mixes in the fresh state. EFNARC specifications indicates that this values in the mix possess the self-compacting characteristics.

Compressive Strength: It is observed that the compressive strength of SCC (M50) decreases by 5.67% and 3.3% than the conventional concrete for 3 and 7 days respectively. Addition of fly ash has given this reduction. The compressive strength of SCC increases by 3.53% than conventional concrete after 28 days as in table 9.

Tensile strength: It is observed that by conducting split tensile test of mixes on standard cylindrical specimen and also three point load test on standard prism,the results are tabulated in table 9, where Tensile strength of SCC (M50) increases by 2.8% than conventional concrete.

Flexural strength are obtained by conducting three point load test on standard prism of mixes and is expressed as

modulus of rupture which is higher by 15-20% than the values obtained by relationship $f_b = 0.7f_{ck}$ for normal concrete of similar strength.

Acid Attack: The SCC specimens in sulfuric acid for 15 weeks show moderate attack, while the CC specimens show deterioration ranging from very severe attack to total disintegration. The specimens in addition turn into a white pulpy mass to peeling. These reactions in the concrete binder resulted from expansive reactions. In addition sulphates react with hydrated calcium silicate phase, there by forming gypsum (Ca_2SO_4) present in all Portland cement which reacts with C_3A to form ettringite and monosulphoaluminate.

Thus a substantial expansion and peeling from the resulting reactions take place which after cleaning and removing the deteriorated layers with a steel wire brush, lead to an increase in mass loss each week.

The chlorides react with hydrated calcium silicate (in Portland cement) phase a slightly greater with the SCC mix than CC mix, thereby forming $CaCL_2$ which reacts with C_3A to form ettringite and chloroaluminate. The SCC and CC specimens' mixes shows moderate attack, but overall degree of attack in sulphuric solution tended to be more severe than the degree of attack in hydrochloric solution.

Mass Loss: The mass loss of SCC and CC mixes in water at 15 weeks' time is Zero. The CC mix in terms of mass loss suffered the most deterioration when immersed in 2% and 5% H2SO4solutions.The mass loss was 15.50% and 20% respectively. The time for 10% mass loss due to acid attack was mentioned in table 10 & table11.The weight loss of CC specimen reaches 10%level within 75 days of immersion in 2% H_2SO_4 and 45 days of immersion in 5% H_2SO_4. CC specimen reaches 10% mass loss within 75 days of immersion in 2% HCL and 60 days of immersion in 5% HCL. The SCC mix shows very good resistance to acid attack. Only less than 9.5% mass loss is observed in SCC mix immersed in both H2SO4 and HCL solution.

Acid Durability Factor and Acid Attack Factors

Table12 show the ADF and AAF of CC and SCC immersed in 2% and 5% of H_2SO_4 and HCL solutions. The relative strength and durability factors were increased in SCC mix immersed in both the solutions. The ADF decreases when immersed period increases for SCC as compared to CC in both the solutions

X. CONCLUSION

SCC is less affected than that of CC immersed in H_2SO_4 and HCL solution. The presence of RHA and FA offered the resistance against permeability and prevents the entry of acidic solutions.

In SSC the flow properties developed is satisfying, within recommended values.

The resistance against segregation of SCC is also good.

The optimum dosage was found 1.75% by weight of powder of the super plasticizer

Durability studies through acid attack test done by the investigation show that SCC in terms of acid durability factor as compared to conventional concrete of same grade is more durable. Acid consumpion is also less.

In SCC the Percentage weight loss and percentage strength loss is less as compared to conventional concrete of same grade. The percentage weight loss and strength loss of CC and SCC mixes increases corresponding to time after immersing in 2% and 5% H_2SO_4 and HCL solutions. The mass loss with SCC was obtained nearly 10% in sulfuric solution at 15 weeks while CC mix at 8 weeks. In hydrochloric solution at 15 weeks the same loss with SCC was obtained. After 15 weeks, in SCC the mass loss is 40% less than CC.

The investigation indicates better acid resistance of the ternary blended concrete (SCC) performance than binary blended

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