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Durability Assessment of Self Compacting, Self Curing Concrete Incorporating Crushed Rock Powder and Mineral Admixtures

Sanjay Raj A.[1,*], Shrishail B. Anadinni[2], Anand V. Shivapur[3]

Abstract

Curing plays a crucial role in achieving the desired strength, characteristics, and durability of concrete. Negligent curing practices can lead to adverse effects on hydration and mechanical properties of concrete. In recent times, self-curing concrete has gained significant attention due to its potential in reducing water loss through the use of self-curing agents. The Present Research study focus on investigation on durability characteristics of self-curing self-compacting concrete using crushed rock powder and mineral admixtures. The objective of this research is to evaluate the durability properties of SCC, for M25 and M40 grade inclusive of effectiveness of mineral admixtures and self-curing agents at varying dosages. Two self-curing agents, Polyethylene glycol (PEG-400), at dosages of 1%, 1.5%, and 2%, and Superabsorbent Polymer (SAP), at dosages of 0.1%, 0.2%, and 0.3%, respectively, were utilized. The mineral admixture dosages were based on the SCC mix design. Various standard tests, including conventional slump, T50 cm slump, J-ring, V-funnel, U-box, and L-box, as per EFNARC, were conducted on the specimens. Furthermore, the durability properties, such as water absorption, resistance against acid attack, and sulphate attack, were evaluated by comparing them with those of conventional normal concrete (CNC) as per IS 10262 and normal self-compacting concrete (NSCC) without self-curing agents. The curing process for CNC and NSCC followed conventional methods at ambient temperature under laboratory conditions, while self-compacting concrete incorporating self-curing agents underwent curing in air at ambient temperature. The results showed that the durability properties of self-curing concrete were significantly improved with the inclusion of 0.3% SAP mixtures, outperforming PEG-400 for M25 and M40 grades of concrete. Moreover, the addition of fly ash and silica fume to the cement mixture enhanced the resistance of the concrete, indicating improved pore structure and greater durability.

Keywords: Water Absorption, Acid attack, Sulphate attack, Fly ash, Silica fume and Self-Curing agents.

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INTRODUCTION

Self-Compacting Concrete (SCC) is a specialized type of concrete that can flow and compact under its self-weight without the need for external vibration, offering improved workability and placement efficiency. The key components of SCC mixes include superplasticizers, which enhance fluidity, a high content of fines for mix stability and to prevent segregation, and mineral admixtures or viscosity-improving additives (VMA) to further control flow properties. To strike a balance between deformability and segregation resistance, it is essential to limit the content of coarse aggregates in the SCC mix. This ensures adequate flow while preventing excessive segregation during placement.

Considering the growing concern over water scarcity and its impact on construction practices, there is a pressing need to optimize water usage in concrete production. Admixtures like superplasticizers can significantly increase the fluidity of concrete mixtures, enabling a reduction in the water-cement ratio without compromising workability or strength. Moreover, incorporating supplementary cementitious materials (SCMs) such as fly ash or slag can enhance durability and strength while reducing the demand for water. Efficient curing methods, such as using curing compounds or blankets, can minimize water evaporation during the curing process, allowing for the use of less water while maintaining desired concrete properties.

This experimental investigation focuses on enhancing the durability of Self-Compacting Concrete (SCC) by incorporating ultra-fine natural steatite powder (UFNSP) and fly ash as filler materials. The addition of filler materials is known to reduce atmospheric pollution resulting from cement manufacturing [1]. The study addresses the need for advanced concrete that exhibits improved durability resistivity under various environmental conditions [2]. SCC has shown good resistance to various durability factors, including chloride diffusion, oxygen permeability, mercury porosity, water absorption by capillarity, carbonation, and ammonium nitrate leaching [3–5]. Notable durability resistance has also been observed in high-performance self-compacting concrete [6]. Previous studies have explored the use of various admixtures, such as ground granulated blast furnace slag, silica fume, and metakaolin, to improve bond and durability properties in normal concrete [7–8]. Additionally, the durability properties of self-compacting concrete have been enhanced through the addition of fly ash, which improved acid resistance, saturated water absorption, and resistance to sulphate attack [9–11]. Fly ash at 10–70% replacement of cement in self-compacting concrete resulted in high strength and good durability resistance [12]. Partial replacement of cement with fly ash in SCC improved resistance to water absorption, rapid chloride penetration, and permeability [13]. In this study, the incorporation of ultra-fine natural steatite powder (UFNSP) in SCC resulted in good mechanical properties and reduced segregation up to 25% addition of steatite content. However, beyond this point, certain parameters of SCC could not be met. The optimum strength was achieved at 15% addition of steatite in SCC mix, with strength decreasing beyond 25% addition. Therefore, 25% was considered the optimum percentage of steatite as an additive for this durability study [14]. To further enhance the durability, fly ash is introduced in this investigation along with UFNSP. Fly ash is added as a filler material [15]. The study aims to evaluate various durability parameters of the developed SCC, including rapid chloride penetration, sorptivity, bulk diffusion, initial water absorption, saturated water absorption, and effective porosity.

The present study aims to develop cost-effective SCC by incorporating crushed rock powder (CRP) (M-Sand) and mineral admixtures. The research focuses on assessing the mechanical and durability properties of SCC while investigating the effectiveness of mineral admixtures and self-curing agents at various dosages. The self-curing agents utilized in the study include polyethylene glycol (PEG-400) at dosages of 1%, 1.5%, and 2%, and superabsorbent polymer (SAP) at dosages of 0.1%, 0.2%, and 0.3%, based on the SCC mix design [19]. The aim is to explore sustainable methods to produce high-quality SCC while reducing water consumption and enhancing concrete properties.

EXPERIMENTAL INVESTIGATION

Material Properties

The materials used in this study to produce the SCC were OPC 53 grade cement fit in with the limits specified in IS: 8112-2013 [16] with the specific gravity of 3.15. class F fly ash collected from Raichur Power Station Karnataka India, with the specific gravity of 2.07, and Silica Fume is purchased from locally available distributor which has a specific gravity 2.25 two are mineral admixture used in this study. Apart from this Coarse aggregate of size ranges from 10 mm to 12.5 mm with the specific gravity 2.7 and for fine aggregate locally available river sand with the specific gravity of 2.65 in CNC and SCC and crushed rock powder with the specific gravity of 2.60 [18]. To improve the flow properties sand to enhance the durability by means [4] of reducing the water, chemical admixtures like glenium B233 super plasticizer was used. The Physical properties were given in Tables 1 and 2.

Mix Design, Production and Sampling

For producing the self-compacting concrete trial and error method based on European guidelines (EFNARC) [17] was used to achieve SCC and Mix design was done as per Nan-su method. The 1st few trials end up with the negative results whereas after adopting the recommended guidelines in the 4th trial SCC was produced successfully and the mix proportions were obtained accordingly. The control specimen of Self-Compacting concrete was produced with the total cement content of 361 kg/m^3 and 395 kg/m^3 for M25 grade and M40 grade concrete respectively. For test specimen mineral admixtures are added with cement in 30% and Self-Curing agents are added with respect to percentage of cement as shown in Tables 3 and 4.

Table 1: Physical properties of ordinary portland cement (OPC).

S.N.	Characteristics	Test Results obtained	Requirements as per IS: 8112-2013
1.	Fineness (%)	3	10 maximum
2.	Normal Consistency (%)	31	-
3.	Specific gravity	3.15	2.99–3.15
4.	Initial setting time (min)	65	30 bare minimum
5.	Final setting time (min)	362	600 upper limit
6.	Compressive Strength (N/mm^2) (a) 7-days (b) 28-days	 33.75 54.81	Shall not be less than (a) 33 N/mm^2 (b) 53 N/mm^2

Table 2. Physical properties of coarse aggregate, fine aggregate and crushed rock powder.

Physical Properties of Coarse Aggregate			
S.N.	***Tests conducted***	***Results obtained***	***Requirements as per IS: 383-1970***
1.	Specific Gravity	2.67	2.85 Max.
2.	Bulk density (kg/m^3) (a) Dense state (b) (b) Loose state	 1383.23 1238	 - -
3.	Water Absorption Test (%)	0.1%	0.6 Max.
4.	Packing factor	1.139	-
Physical Properties of Fine Aggregate			
1.	Specific Gravity	2.5	2.75 maximum
2.	Bulk density (kg/m^3) (a) Dense state (b) b) Loose state	 1415 1359	 - -
3.	Water absorption test (%)	0.2	2 maximum
4.	Packing Factor	1.087	-
Physical Properties of Crushed Rock Powder.			
1.	Specific gravity	2.60	IS-2386 (part III)-1963
2.	Bulk density (kg/m^3)	1415	IS-2386 (part III)-1963
3.	Water Absorption (%)	0.3%	IS-2386 (part III)-1963
4.	Moisture content (%)	Nil	IS-2386 (part III)-1963
5.	Fine particles less than 0.075 mm (%)	15	IS-2386 (part III)-1963

Table 3. Mix Proportion of M 25 normal conventional concrete as per IS 10262: 2009

	Cementitious Materials		**Fine Aggregate (kg/m^3)**	**Coarse Aggregate (kg/m^3)**	**Water (kg/m^3)**
Quantities (kg/m^3) M-25	***Cement***	***Fly Ash and Silica Fume***	***M-Sand***		
	315	0	958	1016	158
Ratio	1	0	3.04	3.22	0.5
M-40	365	0	944	956	157
Ratio	1	0	2.85	2.90	0.43

Table 4. Mix proportions for M-25 grade concrete using fly ash and silica fume.

Grade of Concrete	**Quantities in Kg/m^3**	**Poly Ethylene Glycol (PEG-400)**			**Super Absorbent Polymer (SAP)**		
		1%	**2%**	**3%**	**0.1%**	**0.2%**	**0.3%**
M 25 Grade Using FA	Cement	361	361	361	361	361	361
	FA	846	846	846	846	846	846
	CA	709	709	709	709	709	709
	FA	112	112	112	112	112	112
	Water	236	236	236	236	236	236
M 25 Grade Using SF	Cement	361	361	361	361	361	361
	FA	846	846	846	846	846	846
	CA	709	709	709	709	709	709
	SF	116	116	116	116	116	116
	Water	239	239	239	239	239	239
M 40 Grade Using FA	Cement	395	395	395	395	395	395
	FA	846	846	846	846	846	846
	CA	709	709	709	709	709	709
	FA	114	114	114	114	114	114
	Water	221	221	221	221	221	221
M 40 Grade Using SF	Cement	395	395	395	395	395	395
	FA	846	846	846	846	846	846
	CA	709	709	709	709	709	709
	FA	118	118	118	118	118	118
	Water	219	219	219	219	219	219

PRODUCTION OF SCC

To produce controlled mix, the following steps were taken during the batching process and Mixing process.

- All the materials were kept ready inside the laboratory one day prior to casting.
- The fine aggregate was tested for moisture content before the time of casting, and if there any change in moisture content corresponding correction was made in required water/powder ratio to produce the mix.
- And to reduce the temperature effects the mixing of concrete was done in the early morning.
- By using this method, the mix developed was noted to be highly workable and does not shows bleeding or segregation. And the cement paste is also found to be blended well with the coarse aggregate is followed for producing homogeneous mixes. As per this procedure initially the aggregates were mixed homogeneously in pan mixture for 0.5 min then form the entire water content 50% is added and mixed for another 1 min. Followed by that the aggregates were allowed to absorb water without disturbing for another minute. Afterwards, the total powder content was

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added and mixed for another 1 min finally the higher end superplasticizer was added with the remaining 50% of water is added to the pan mixture and mixed for another 3 more minutes and left undisturbed for another 2 min and the mixing is continued for final 2 min to obtain the SCC.

SAMPLING

Standard steel mould is used to produce the test specimen for the durability study. For each test three samples per mix were casted, cured, and tested the average value of the three specimens were considered for each test. Cube specimens of 150 mm size were casted for various test like water, acid and sulphate test absorption. CVC and SCC mixes were cured at laboratory at ambient temperature by conventional curing method and self-curing specimens were cured by air at ambient temperature.

DURABILITY TESTS OF HARDENED CONCRETE

Water Absorption Test

Cube specimens, measuring 150 mm, are cast and their weight is measured after drying in a 105°C oven. After cooling to room temperature, the specimens are immersed in water. At regular intervals, the specimens are removed from the water and weighed. This process is repeated until the material is completely saturated or reaches a constant weight. The Saturated Water Absorption (SWA) is calculated by subtracting the weight of fully saturated samples from the weight of oven-dried samples. The saturation water absorption is determined using the following formula.

Water absorption = [W1-W2/W1]* 100

W1 = Weight of Oven dried sample

W2 = Weight of fully Saturated sample

Acid Resistance and Sulphate Resistance Test

Cube specimens measuring 150 mm were cast and cured for 28 days. Afterward, the cube specimens were removed and allowed to air dry for 24 hours before being weighed. For assessing sulphate resistance, a 5% dilute H_2SO_4 (sulphuric acid) solution and NaOH (sodium hydroxide) solution were utilized. The intention was to submerge the cube specimens in the solution for durations of 28, 56, 90, and 180 days, while maintaining the concentration of the acid and sulphate solutions. Subsequently, the surfaces of the cube specimens were cleaned and their weights were recorded. The compression testing machine, in accordance with IS 516, was employed to evaluate the cube specimens. It was determined how much weight and strength were lost due to exposure of the specimens to acidic and sulphate environments.

Loss in Weight = ((W1-W2)/W1) ×100

W1 = Weight of specimen before immersion in acid.

W2 = Weight of specimen after immersion in acid.

Loss in strength = (fc -fc 1)/fc) × 100

fc = Compressive Strength in N/mm^2 at Measured Days

fc 1 = Compressive Strength Measured in N/mm^2 at Testing Age.

RESULTS AND DISCUSSIONS

Figures 1–2and Tables 5–7 present the water absorption characteristics of different concrete mixes, including conventional concrete (CVC), self-compacting concrete (SCC), and self-compacting self-curing concrete (SCSCC), over varying curing ages. A notable trend observed in the data is a significant reduction in water absorption with an increase in curing age. This phenomenon can be attributed to the pozzolanic reaction facilitated by the presence of mineral admixtures in the concrete mixes, leading to a reduction in capillary action compared to control concrete (CVC) and self-compacting concrete (SCC) mixes.

Table 5. Water absorption test results.

Title of the Test	Days for the Test	NCC	NSCC	PEG-400 1%	PEG-400 1.5 %	PEG-400 2%	SAP 0.1%	SAP 0.2%	SAP 0.3%
M-25 Grade Concrete Using Fly Ash									
% of Weight Loss	28	5.56	4.95	3.81	3.76	3.96	3.6	3.6	3.7
	56	4.85	4.65	3.25	3.33	3.78	2.98	2.81	2.85
	90	3.98	3.75	2.95	2.98	3.18	2.33	2.32	2.21
M-25 Grade Concrete Using Silica Fume									
% of Weight Loss	28	5.565	4.95	3.54	3.33	3.67	2.78	2.68	2.78
	56	4.85	4.65	2.97	3.27	3.57	2.23	2.33	2.43
	90	3.98	3.75	2.87	2.67	2.53	1.8	1.7	1.79
M-40 Grade Concrete Using Fly Ash									
% of Weight Loss	28	5.45	4.78	4.05	3.53	4.13	3.18	3.13	3.18
	56	4.85	4.85	3.85	3.37	3.85	3.23	3.08	3.27
	90	3.65	2.95	3.42	2.87	2.78	3.05	2.7	2.79
M-40 Grade Concrete Using Silica Fume									
% of Weight Loss	28	5.45	4.78	4.1	3.6	4.2	3.2	3.15	3.18
	56	4.85	4.85	3.9	3.4	3.9	3.3	3.1	3.27
	90	3.65	2.95	3.5	2.9	2.8	3.12	2.8	2.8

Table 6. Acid attack Test Results.

Title of The Test	Days for the Test	NCC	NSCC	PEG-400 1%	PEG-400 1.5 %	PEG-400 2%	SAP 0.1%	SAP 0.2%	SAP 0.3%
M-25 Grade Concrete Using Fly Ash									
% of Weight Loss	28	3.64	2.85	1.98	2.27	3.35	2.6	1.68	3.14
	56	4.35	3.89	3.79	3.533	3.85	3.86	3.54	4.12
	90	8.65	7.36	8.78	9.13	9.98	7.16	6.95	7.83
	180	13.78	11.85	12.2	11.59	12.2	10.6	11.12	12.23
% of Strength Loss	28	6.38	5.36	5.63	5.57	5.73	5.58	5.38	5.84
	56	7.43	6.63	8.38	9.33	10.0	7.06	6.87	7.56
	90	9.68	8.73	10.7	9.83	11.2	8.63	8.47	9.13
	180	14.89	12.78	13.8	14.23	12.1	12.8	11.86	12.53
	M-25 Grade Concrete Using Silica Fume								
% of Weight Loss	28	3.15	2.64	1.85	2.13	3.18	2.4	1.55	2.98
	56	4.13	3.65	3.63	3.33	3.53	3.54	3.13	3.88
	90	7.95	7.36	8.12	6.13	7.87	6.28	5.24	6.82
	180	12.73	10.78	11.8	11.33	11.6	9.89	10.77	11.23
% of Strength Loss	28	5.86	4.95	5.13	5.43	5.33	4.96	5.16	5.45
	56	6.83	7.13	8.56	9.45	9.96	6.87	6.45	7.23
	90	9.68	8.73	10.2	8.89	10.6	7.89	8.45	9.05
	180	13.54	12.58	13.8	13.93	11.8	12.0	11.86	12.53
	M-40 Grade Concrete Using Fly Ash								
% of Weight Loss	28	2.77	1.92	1.76	2.13	2.28	1.84	1.63	1.25
	56	3.43	2.98	3.12	3.83	3.44	2.66	3.23	3.05
	90	7.78	6.95	6.14	6.47	7.78	7.85	6.85	7.17
	180	12.58	11.95	12.1	11.86	12.7	12.6	11.23	12.84
% of Strength Loss	28	4.84	4.28	4.68	4.13	4.84	3.98	4.05	4.84
	56	7.83	8.23	6.88	6.15	7.23	8.02	7.63	7.95
	90	9.23	8.83	9.65	8.65	9.13	9.63	8.14	9.13
	180	13.23	12.89	13.0	12.65	13.4	12.8	12.47	13.13
	M-40 Grade Concrete Using Silica Fume								
% of	28	2.77	1.72	1.76	2.13	2.28	1.7	1.23	1.31

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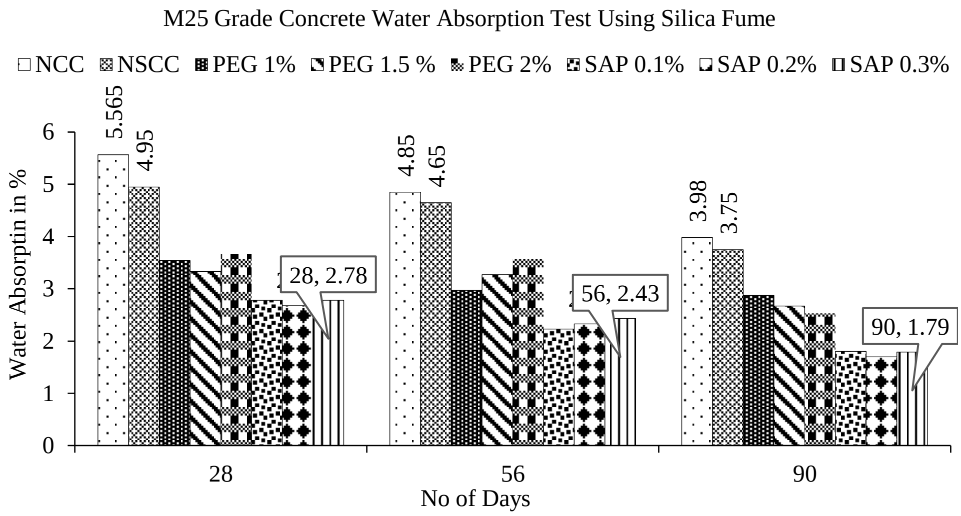
Title of The Test	Days for the Test	NCC	NSCC	PEG-400 1%	PEG-400 1.5 %	PEG-400 2%	SAP 0.1%	SAP 0.2%	SAP 0.3%
Weight Loss	56	3.13	2.78	3.12	3.23	3.44	3.56	3.18	3.98
	90	7.16	6.13	6.14	7.87	7.78	6.05	6.67	7.05
	180	11.98	11.13	12.1	11.83	12.7	11.9	10.97	12.23
% of Strength Loss	28	4.38	8.56	4.68	6.89	4.84	5.98	6.52	7.12
	56	6.14	7.98	6.88	7.87	7.23	8.1	6.98	7.56
	90	9.83	9.23	9.65	8.98	9.13	9.52	9.05	9.89
	180	12.85	12.05	13.0	12.98	13.4	11.3	11.85	12.98

Table 7. Sulphate attack test results of M-25 grade concrete using fly ash.

Title of the Test	Days for the Test	NCC	NSCC	PEG-400 1%	PEG-400 1.5%	PEG-400 2%	SAP 0.1%	SAP 0.2%	SAP 0.3%
M-25 Grade Concrete Using Fly Ash									
% of Weight gain	28	1.3	1.3	2.0	1.3	1.4	1.6	1.7	1.4
	56	2.4	3.3	2.8	2.5	2.9	2.9	2.6	3.1
	90	3.5	4.4	3.7	3.2	3.9	3.2	3.9	3.8
	180	8.7	7.9	7.2	6.5	6.3	6.7	6.1	6.2
% of Strength Loss	28	8.38	6.4	6.6	6.6	6.8	6.6	7.4	7.8
	56	8.43	7.6	8.4	9.4	11.1	9.1	8.8	8.6
	90	10.68	9.7	11.8	11.8	13.2	9.6	9.5	10.1
	180	15.89	13.9	15.8	14.2	15.8	13.9	12.9	13.5
	M-25 Grade Concrete Using Silica Fume								
% of Weight Loss	28	1.15	1.6	1.85	1.13	1.18	1.4	1.55	1.87
	56	2.12	2.53	2.63	2.43	2.53	2.54	2.13	2.36
	90	3.95	3.36	3.12	3.26	3.87	3.28	3.24	3.82
	180	5.73	5.78	5.88	5.23	5.53	5.89	5.67	5.83
% of Strength Loss	28	6.86	4.95	5.13	5.43	5.33	4.96	5.16	5.45
	56	7.83	7.13	8.56	9.45	9.96	6.87	6.45	7.23
	90	10.65	8.73	10.23	8.89	10.68	7.89	8.45	9.05
	180	14.35	12.58	13.86	13.93	12.89	12.05	11.86	12.53
	M-40 Grade Concrete Using Fly Ash								
% of Weight Loss	28	1.77	1.92	1.36	1.13	2.44	1.84	1.63	1.15
	56	2.45	2.98	2.12	2.83	3.44	2.66	2.23	2.05
	90	3.78	3.95	3.14	3.47	3.78	3.85	3.77	3317
	180	4.58	4.96	5.13	5.86	5.78	5.66	4.23	3.84
% of Strength Loss	28	6.85	5.26	6.7	6.2	6.9	5.8	5.35	5.84
	56	8.73	9.33	8.9	8.2	8.23	8.72	8.03	8.95
	90	11.13	9.48	10.58	10.65	10.23	10.65	10.23	10.25
	180	15.33	13.98	14.1	13.7	13.43	12.83	12.47	13.13
	M-40 Grade Concrete Using Silica Fume								
% of Weight Loss	28	2.77	1.72	1.76	2.13	2.28	1.7	1.23	1.31
	56	3.13	2.78	3.12	3.23	3.44	3.56	3.18	3.98
	90	4.16	4.13	5.14	5.87	5.88	5.05	5.46	5.65
	180	5.98	5.13	5.13	4.87	4.78	4.98	4.97	5.23
% of Strength Loss	28	4.38	4.56	4.68	4.18	4.38	4.08	4.02	5.12
	56	6.14	7.98	6.88	6.07	7.23	8.1	6.08	7.56
	90	10.86	10.23	10.63	10.98	10.13	10.52	10.05	10.89
	180	12.85	12.05	13.01	12.98	13.43	11.35	11.85	12.98



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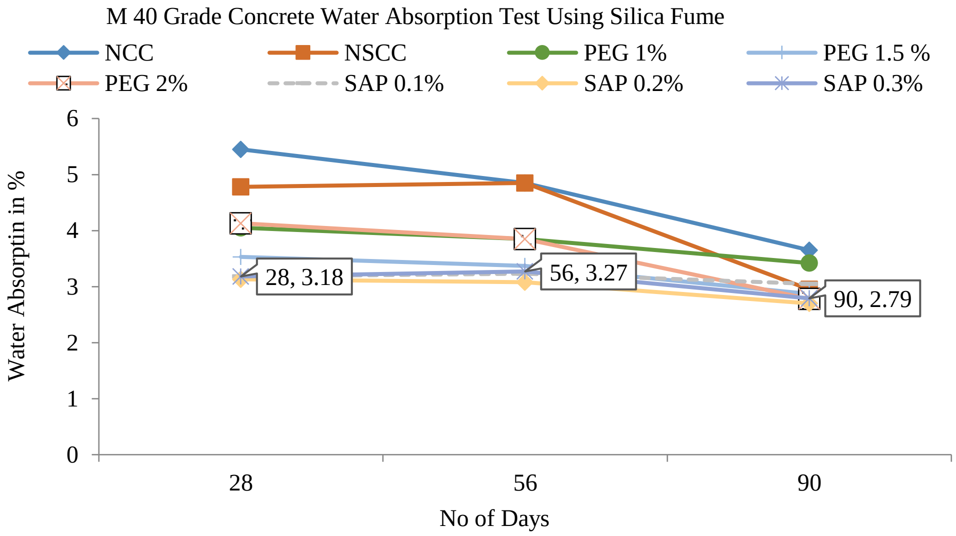
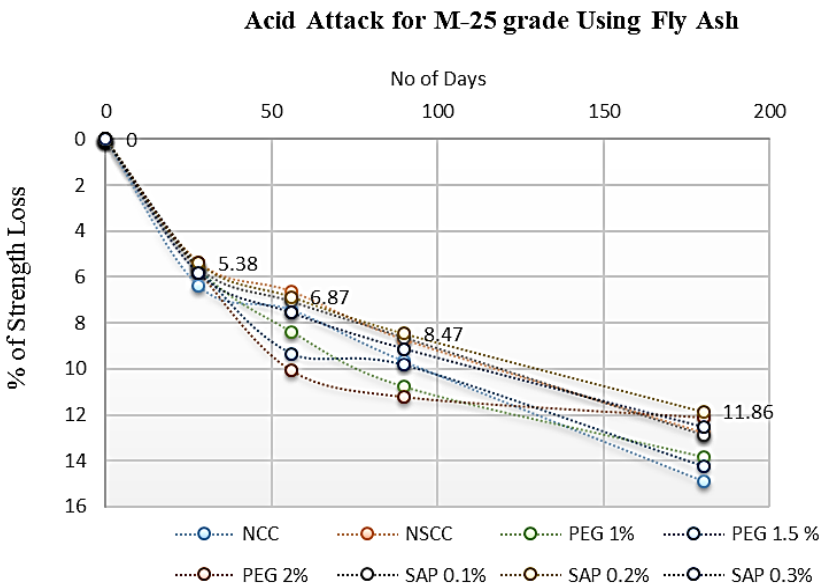


(b)

Figure 1. (a-b) M-25 and M-40 grade water absorption using test using silica fume at various at 28, 56 and 90 Days.



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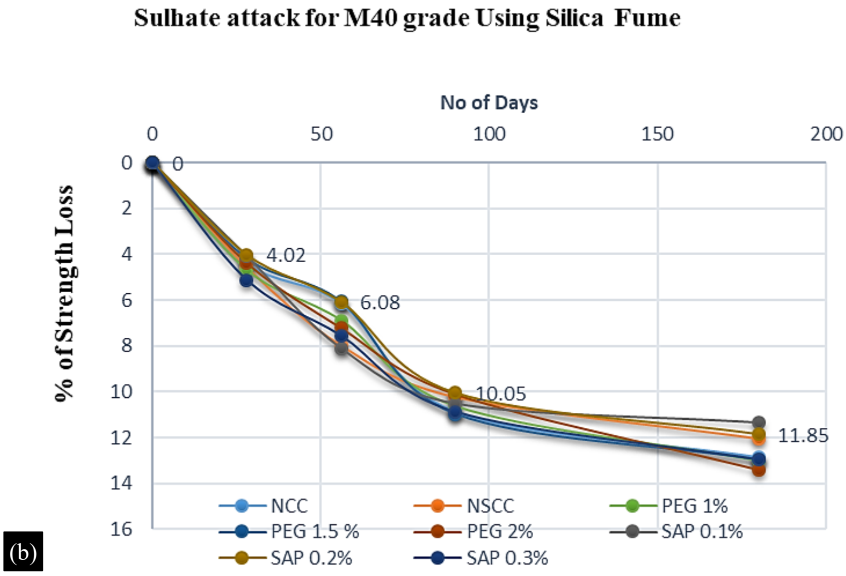

Figure 2. (a-b) M-25 and M-40 grade water absorption using test using fly ash and silica fume at various at 28, 56 and 90 days.

Figure 3. (a-c) Testing and tested samples after immersion for 90 days–sulphate attack.

Specimens containing 0.2% superabsorbent polymer (SAP) exhibited the lowest water absorption at each age for both M25 and M40 grade concrete [Figure 2]. This reduction in water absorption can be ascribed to the filling of most pores with mineral admixtures, as well as the chemical reaction between the fly ash and silica fume components with the hydration products of cement. These findings underscore the beneficial effects of mineral admixtures and self-curing agents in decreasing water absorption and enhancing the durability of the concrete. Furthermore, they underscore the importance of optimizing the dosage of SAP to achieve the desired reduction in water absorption properties.

The observed percentage of strength loss and weight reduction during acid attack is attributed to the formation of Friedel's salts as shown in Figure 3. The inclusion of Silica Fume and Fly Ash in the concrete mix improves the pore structure and reduces permeability, resulting in enhanced resistance against acid attack. This improved acid resistance is evident in both SCC mixtures and self-cured specimens. Overall, the findings underscore the importance of proper material selection and proportioning, including the use of self-curing agents and mineral admixtures, to significantly enhance the acid resistance of concrete structures

During sulphate attack, the percentage of strength loss is attributed to the deposition of salts and efflorescence action. In environments rich in sulphates, the mortar surrounding the coarse aggregate undergoes leaching, weakening the adhesion between the aggregate and mortar. This can lead to spalling and an increase in weight due to salt deposition. However, the inclusion of Silica Fume and Fly Ash in the concrete improves its pore structure and reduces permeability, resulting in enhanced resistance against sulphate attack. This improved resistance is observed in both SCC mixes and self-cured specimens.

The study demonstrated that the incorporation of self-curing agents, such as SAP, can contribute to improved acid and sulphate attack resistance in concrete. The addition of mineral admixtures, such as Silica Fume and Fly Ash, further enhances the durability and performance of the concrete.

CONCLUSIONS

The research findings demonstrate the effectiveness of incorporating self-curing agents, such as SAP and PEG-400, in self-consolidating concrete (SCC) mixes. These additives improve flow properties, early age strength, and mechanical properties, while also enhancing acid and sulphate resistance. The addition of mineral admixtures, like fly ash and silica fume, further enhances the performance and durability of SCC. Overall, this research provides valuable insights for the development and implementation of self-curing concrete technology, showcasing its potential to improve the performance and longevity of concrete structures.

Specific Technical conclusión can be drawn from the research:

1. Mix Proportions:
   - The optimal dosage of SAP in SCC specimens was found to be 0.2% for both M25 and M40 grade concrete.
   - Specimens with 1.5% PEG-400 exhibited increased strength and met the target strength at all ages for both grades of concrete.
   - The addition of fly ash and silica fume contributed to strength improvements in both M25 and M40 grade concrete.
2. Acid and Sulphate Resistance:
   - Specimens containing SAP demonstrated better resistance to acid attack compared to normal concrete mixes, attributed to pore structure filling and reduced capillary action.
   - The inclusion of silica fume and fly ash improved the acid and sulphate resistance of SCC, likely due to improved pore structure and reduced permeability.
   - The addition of fly ash and silica fume improved pore structure and reduced permeability, enhancing resistance against acid and sulphate attacks.
   - In conclusión, the incorporation of self-curing agents, such as SAP and PEG-400, along with mineral admixtures, like fly ash and silica fume, in SCC mixes significantly improves flow properties, durability. The research findings provide valuable insights for the development and implementation of self-curing concrete technology, highlighting its potential for enhancing the performance and longevity of concrete structures.

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