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Experimental Study on Mechanical Properties of Silica Gel Incorporated Concrete

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ABSTRACT:
Outer water relieving is perhaps the most ordinary and notable applied to restore technique to moderate the autogenous shrinkage anyway once the slender pores depreciate, giving satisfactory outside water to curing will be more troublesome. So scientists moved their regard for inside relieving, another restoring strategy that may extraordinarily upgrade the restoring impact on concrete. Inward relieving infers the presence of a restoring specialist into substantial that will give this additional dampness. Inside restoring has been demonstrated as a successful strategy for alleviating the early age compound shrinkage for the explanation that they step by step delivered the assimilated water and augment the hydration interaction. The principal objective of this study is to inspect a couple of mechanical properties by interior restoring as a supplement to outside relieving in traditional cement. Inward restoring was accomplished by really retentive polymer (SAP) and the trial boundary was the level of SAP replacement to solidify. Sodium silicate (SAP) was utilized as self relieving specialist and supplanted by volume of water as 0%, 2.5%, 5%, 7.5% and 10%. The consequences of compressive strength following 28 days of restoring demonstrated an expansion in the strength. SAP trap the dampness inside the construction and keep it from vanishing which happens because of the hydration.
KEYWORDS: *Inward relieving, Retentive polymer, Sodium Silicate, Dampness, Shrinkage*.

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I. Introduction

Concrete curing determines the longevity, strength and behaviour throughout its life process. Optimizing the arrangement of pores in concrete by reducing the pore is a necessary measure for increasing the strength and durability of concrete. If the water cement ratio is relative low, the inner structure of concrete has a finite porosity. The hydrating products absorbs some range of water which is chemically bonded during hydration, further amount of water get adsorbed at the surface of hydrating product when the rest of water remains in micro pores. The unhydrated cement present in concrete has consequences of decrease in internal moisture with increase in autogenous shrinkage of concrete. If the autogenous shrinkage is not mitigated, the internal tensile stress occurs at early stage which maximizes the tensile strength of concrete. Excessive self desiccation lead to premature cracks, thereby reducing the durability of concrete structure.

In order to compensate for loss of moisture during hydration, the most common method applied to maintain adequate moisture is external curing. But once depercolation occurs in the micro pores, it complicates the regular hydration process, thereby opening up a new way for the introduction of internal curing of concrete. This internal relieving can be achieved by usage of saturated light weight aggregate or super absorbent polymers. In this study inward relieving is achieved by using super absorbent polymer(SAP) which traps moisture inside the structure and releases when required throughout the hydration process therefore mitigating the autogenous shrinkage. The foremost objective of this experiment is to analyse the mechanical (physical) properties of concrete incorporated with sodium silicate as a super absorbent polymer to entrap and release free water.

A. LITERATURE REVIEW

Langhe G et al, studied the physical and Mechanical properties of super absorbent polymer incorporated concrete at 7,14 and 28 days of curing.They concluded that concrete with added SAP showed increase in strength depending on amount of SAP added. Increase in strength was found at 0.5% to 1% addition of SAP.

Dadaji B. Jadhav et al, conducted workability and compressive strength tests on concrete which is incorporated with Poly ethylene glycol 4000 as a selfcuring agent and made comparative studies with plain concrete. Desired dosage of PEG 4000 is found to be 0.1%.
Ravindra D. Warkhade et al, concluded that concrete with dosage of SAP Showed desirable variation in strength while conducting compressive and flexural strength tests and compared with normally cured concrete.
Mohammad Sameer et al, replaced by PEG 400 and sodium silicate as self curing agents at various dosage levels and conducted different tests such as compressive, flexural and split tensile tests.Concrete dosed with curing agents showed increase in strength when results were studied with conventional concrete.

A. MATERIALS

1) Binding material:

In this experiment the commonly provided ordinary Portland cement 53 is used. According to the confirming IS 269:2015, the specific gravity of cement was tested which have obtained value of 3.15.

TABLEI PropertiesofCement

1.	Specific gravity	3.15
2.	Fineness	7%
3.	Consistency	31.25%
4.	Initial setting time	30 minutes
5.	Final setting time	10 hours

2)Aggregate:

The fine aggregate which is used in this study is foundry sand. According to IS383-1970 the aggregate infiltrating 4.75 mm sieve and retaining of 150 micron have the specific gravity and fineness modulus of 2.47 and 3.19 respectively.

TABLE IISieve Analysis of Foundry Sand

SI. No	Size of Sieve	Weightretained [ingms]	Cumulative weightretained	%Retained	% Passing
1.	4.75mm	3.88	0	0.194	99.806
2.	2.36mm	1.95	5.83	0.2915	99.70
3.	1.18mm	8.72	14.55	0.7275	99.27
4.	600µ	16	30.55	1.5275	98.473
5.	300µ	560	590.55	29.52	70.48
6.	150µ	1220	1810.55	90.52	9.48
7.	75µ	146	1956.55	97.82	2.18
8.	Pan	22.6	1979.15	98.95	1.05

TABLE III PropertiesofFoundry Sand

1.	specificgravity	2.47
2.	finenessmodulus	3.19
3.	Bulk density	1.48
4.	Moisture content	1.62

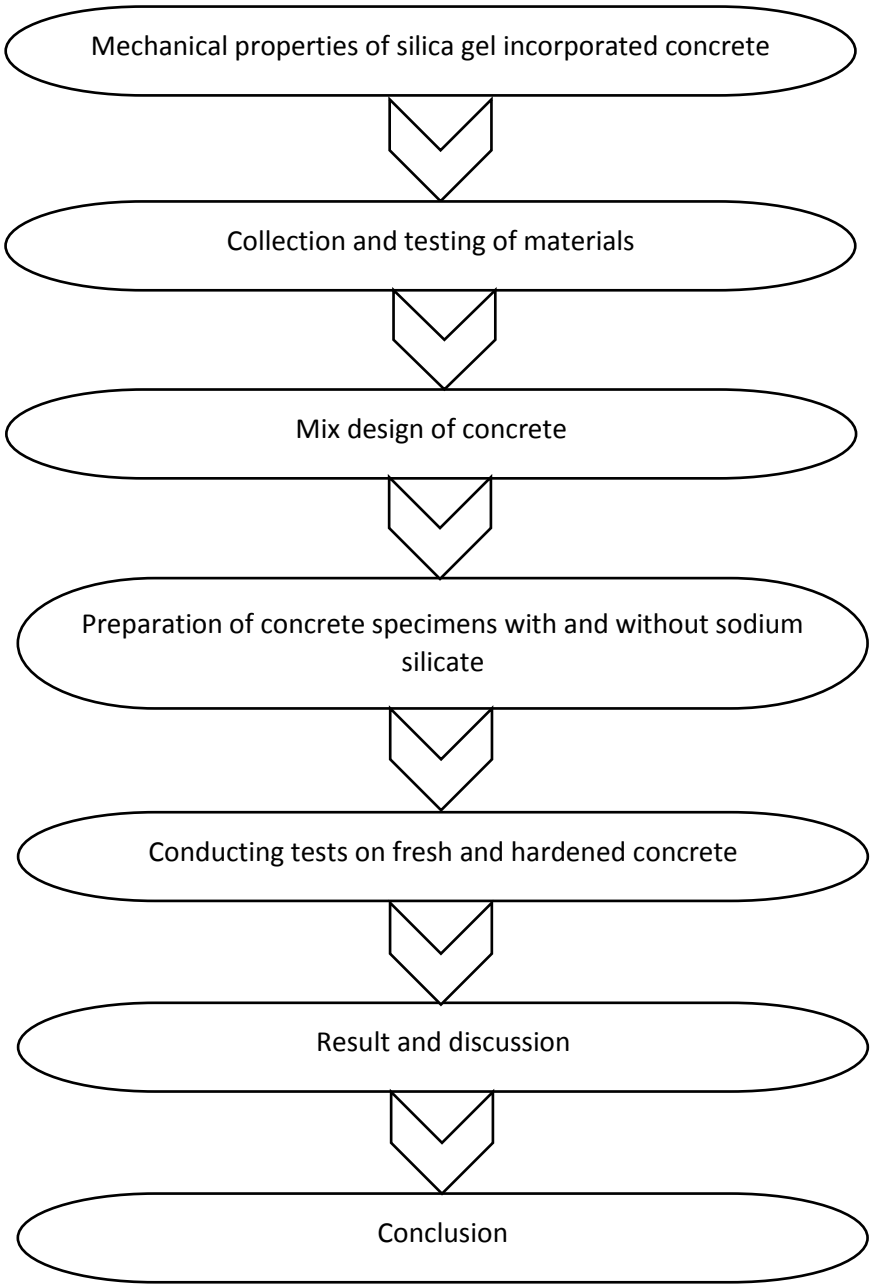
As for the coarse aggregate, the 20mm size is used and tested as per IS2386-1963part3 has the specific gravity of 2.69 and fineness modulus of 5.8 respectively.

TABLE IV PropertiesofCoarseAggregates

1.	sizeofaggregate	20mm
2.	specificgravity	2.69
3.	finenessmodulus	5.8
4.	waterabsorption%	0.56%
5.	Moisture content%	0.23%
6.	Bulk density	1.65

3)Water:Ordinarywaterwasusedformixingofconcrete.
4) Super absorbent polymer: Sodium silicate was used.

B. METHODOLOGY



C. MIX DESIGN

1) Stipulations for proportioning:

A.	Grade Designation	M25
B.	Type of cement	OPC 53
C.	Size of aggregate	20mm
D.	Maximum W/C ratio	0.50 (Table 5-IS456)
E.	Workability 75mm (Slump)	
F.	Mix Ratio	1:1.84:3

TABLE V Mix Proportion

SI .No.	**MATERIALS**	**QUANTITY**
1	Cement	380 kg/m^3
2	FineAggregate	700 kg/m^3
3	CoarseAggregate(20mm)	1149kg/m^3
4	water	190 L/m^3

.TABLEVI Mix Designfor Modified Gradeofconcrete

MixID	**Cementin kg**	**FineAggregateinkg**	**CoarseAggregate inkg**	**Waterin Litre**	**% ofSodiumSilicate added**	**SodiumSilicate**
M0	380	700	1149	190	0	0
M1	380	700	1149	142.5	2.5	47.5
M2	380	700	1149	95	5	95
M3	380	700	1149	47.5	7.5	142.5
M4	380	700	1149	0	10	190

II.RESULTSANDDISCUSSION

TableVII and Table VIII belowshowstheaveragecompressivestrengthsand split tensile strengths fordifferent%addition ofsodium silicate at7and28days respectively.Resultsshowsthatthereisvariation incompressiveand split tensile strengthat2.5%, 5%, 7.5% and10%replacementascomparedwith0%replacement with and without curing.

Maximumcompressiveand split tensile strengthwasobservedat5%afterfurtheraddition thestrengthwasfoundreduced.

TABLE VII Compressive Strength Results

%ofsodiumsilicate	**7Days(N/mm^2)**	**28Days (N/mm^2)**
0%withcuring	18.58	28.84
0%withoutcuring	16.25	25.82
2.5%	18.18	28.30
5%	20.89	31.15
7.5%	19.08	28.73
10%	18.15	27.70

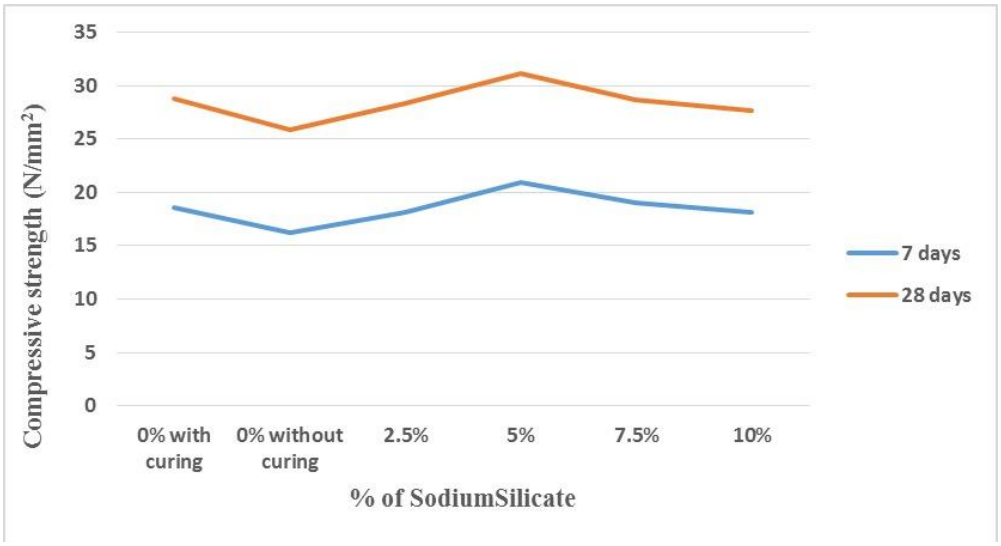


Fig.1 Compression test results for specimens with different % of Sodium Silicate

TABLE VIII Split Tensile Test Results

%of sodiumsilicate	7Days(N/mm^2)	28Days(N/mm^2)
0%withcuring	2.58	3.39
0%withoutcuring	1.49	2.81
2.5%	2.23	3.19
5%	2.80	3.98
7.5%	1.80	2.88
10%	1.03	2.22

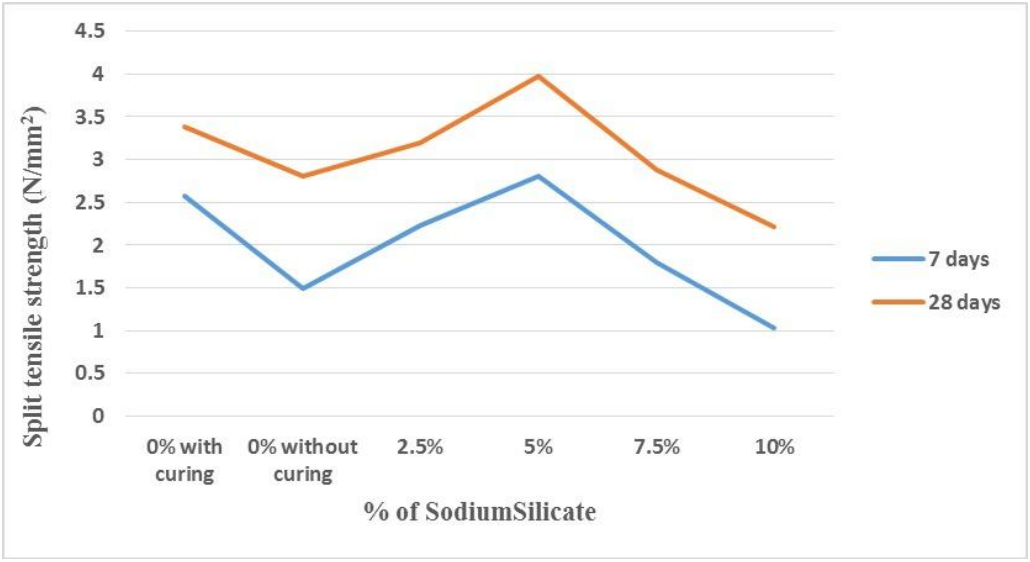


Fig.2 Split Tensile Test results for specimens with different % of Sodium Silicate

III. CONCLUSION

- This practice leads to eagerly await and preservation of environment toescapefromclimatedisasters.Sodium silicate was used as aselfcuringagentandreplacedbyvolumeofwateras0%,2.5%,5%,7.5%,and 10%.
- Thespecimenswith5%ofsodiumsilicateachieved the desired design strength of 31.15 N/mm^2 (Compressive strength)and 3.98 N/mm^2(Split tensile strength) at 28 days.
- Ifthereplacementofwaterbysodiumsilicatewasaboveand below 5%thestrength was found decreased.

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