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Experimental Investigation on Partial Replacement of Cement by Prosopis Juliflora in Self Compacting Concrete

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Abstract: ***The experimental investigations are carried out to study the effect of Prosopis Juliflora in Self compacting concrete by partial replacement on cement. In today's world the main emphasis is on green and sustainable development. Prosopis Juliflora inflorescence is small, green-yellowish spikes without any particular fragrance or attractiveness, though relished by bees. Prosopis Juliflora is one of these species that has performed much better than many native woody species. At the moment, Prosopis Juliflora provides approximately 75% of fuel wood needs of rural people in arid and semi-arid regions of India. These species has become naturalized and spread over the greater part of north-west, central, west and south India. Under the right conditions, Prosopis Juliflora can produce a variety of valuable goods and services like construction materials, charcoal, soil conservation and rehabilitation of degraded and saline soils. But wide spread Prosopis Juliflora has become an invader species so removal of the plant is into necessity now. Mostly the plant is removed by uprooting and is burnt. In order to save the environment and to save the resources we have come up with using the Prosopis Juliflora ash as the partial replacement of cement. So using Prosopis Juliflora ash is a major step towards sustainable development. Cement will produce equal amount of greenhouse gas (co2) which increase the global warming. As the amount of cement is reduced greenhouse gases also reduced. Utilization of Juliflora ash as a partial substitution for cement is one of the promising method to increase the strength in SCC. The strength parameter like Compressive strength of Self compacting concrete in M30 grade with the partial replacement of Prosopis Juliflora ash in cement are evaluated.Materials used in this project are cement, fine aggregate, coarse aggregate, Juliflora ash and water and also admixtures whenever it is required. By doing this project we would know about the using of innovative materials in construction to increase the strength of concrete to make the construction economical. The utilization of Juliflora ash in SCC solves the problem of its disposal thus keeping the environment free from pollution.***

Keywords: Prosopis Juliflora, SCC, greenhouse gases, sustainable development

1. Introduction

Due to current boom in construction industry, cement demand has escalated which is the main constituent in concrete. Also, the cement industry is one of the primary sources which release large amounts of major consumer of natural resources like aggregate and has high power and energy demand for its operation. Concrete which is being widely used in the construction industry has unlimited opportunities for innovative applications design and construction techniques. Factors such as strength, workability and durability of the ordinary concrete are continuously being modified to make it more suitable for a specified construction purpose. It is well known that cement is a costly material and its production involves consumption of limestone which is a natural resource. CO_2 is emitted in large quantity during the production of cement which is a pollutant. Energy resources like coal and oil are decreasing as they are used in the production of cement. Researchers are searching for cheap and easily available Pozzolanic materials from the industry. This has become more realistic due to the advancement of technology. It has become essential to lower the construction cost without much compromise as far as strength and durability of the structure is concerned. The lowering of cost can be brought about in number of ways. Among all the methods available the most optimum at our disposal is the use of waste material as substitute. Hence, incorporating the usage of Juliflora ash as replacement for cement in SCC is beneficial for the environmental point of view as well as producing low cost construction entity thus leading to a sustainable relationship. Prosopis Juliflora (Seemai Karuvelam in Tamil) grows tremendously and spreads due to its mechanism to overcome adverse conditions of like drought and salt. This is facilitated by its high 'proline' content under stress conditions, which helps the plant to thrive where other species die. With deep penetrating roots, it can draw water from deeper layers. Though the species has played a role in changing land use and the livelihood security of huge populations of the world, due to poor management practices, it has colonized many important ecosystems, creating a negative pressure on biodiversity. Prosopis Juliflora being invasive with negative impact to biodiversity and inhabitants, it has useful attributes also. Therefore Prosopis Juliflora ash is partially replaced by 10%, 15%, 20%, 25% and 30% in place of cement.

2. Material Properties

A. Properties of cement

Cement is a powdery substance made by calcining lime and clay, when mixed with water and allowed to set has good binding property and strength. In the current study ordinary Portland cement was used. Many tests were conducted on cement, some of them are specific gravity test, initial and

final setting time test, consistency test etc. the test results are tabulated in table below

Table 1: Properties of cement (OPC43 grade) IS 12269-1970

S. No	*Property Test*		*Obtained Values*
1	Specific Gravity		3.15
2	Standard Consistency		31%
3	Setting Time	Initial	30 min
		Final	600 min
4	Fineness Test		1.75%
5	Soundness Test		1 mm

B. Properties of Fine aggregate

The fraction ranges 4.75mm to 150µ are termed as fine aggregate. The test conducted on fire aggregate are fineness, specific gravity and water absorption are tabulated in table

Table 2: Properties of fine aggregate

S. No	*Property Test*	*Obtained Values*
1	Specific Gravity	2.65
2	Fineness Modulus	3.25
3	Water Absorption	3.45%

C. Properties of Coarse aggregate

The crushed aggregate of size 20mm was used and tested as per IS 2386-2016 Part 5.

Table 3: Properties of coarse aggregate

S. No	*Properties*	*Obtained Values*
1	Maximum Size	20 mm
2	Fineness Modulus	3.74
3	Specific Gravity	2.7
4	Water Absorption	2.4%

D. Prosopis Juliflora Ash

A Juliflora ash is the waste product of the material. They are replaced in to cement to give high compressive strength. 90 Microns sieve size Juliflora ash is to be used.

Table 4: Physical Properties of Prosopis Juliflora Ash

S.NO	*Properties*	*Obtained Result*
1	Color	BLACK
2	Particle Size	Less Than 90 Micron
3	Specific Gravity	2.3

E. Super plasticizers

For the better workability and to control the water content in SCC, CONPLAST SP430 was used. Conplast SP430 is a chloride free, super plasticising admixture based on selected sulphonated naphthalene polymers. It is supplied as a brown solution which instantly disperses in water.

F. Mix Proportion and Mix Detail

M30 grade of concrete is designed as per the guidelines specified in IS10262-2009 & IS456-2000 is used. Mix design obtained is [1:5:10]. Prosopis Juliflora ash partially replaced with cement by 10% ,15%,20% 25% and 30% respectively. This is given in the table below:

Table 5: Mix Design for M30 Grade Concrete

% OF PJA	Cement [Kg/m^3]	PJA [Kg/m^3]	FA *[Kg/m^3]*	CA [Kg/m^3]	WC [Litres]
10	397.8	44.2	975	737	190
15	375.7	66.3	975	737	190
20	353.6	88.4	975	737	190
25	331.5	110.5	975	737	190
30	309.4	132.6	975	737	190

3. Workability

The level of fluidity of the SCC is governed chiefly by the dosing of the Super plasticizer. However overdosing may lead to the risk of segregation and blockage. Consequently the characteristics of the fresh SCC need to be carefully controlled .So as per the EFNARC guidelines which is found in 2001 for SCC and updated in 2002.The workability test are conducted as per the EFNARC guideline and the results are tabulated as below.

Table 6: Workability Test Results of SCC

Mix Proportion	*Slump Flow Test Diameter (mm)*	*V Funnel Test*		*J-Ring Test*	*L-Box Test*
		T_0 (SEC)	*T_2 (SEC)*		
Mix 1 (10% Prosopis Juliflora ash +90% cement)	680	8	9	4	0.86
Mix 2 (15% Prosopis Juliflora ash +85% cement)	685	9	9	5	0.87
Mix 3 (20% Prosopis Juliflora ash +80% cement)	689	8	8	6	0.87
Mix 4 (25% Prosopis Juliflora ash +75% cement)	695	9	10	7	0.88
Mix 5 (30% Prosopis Juliflora ash +70% cement)	698	10	11	8	0.89

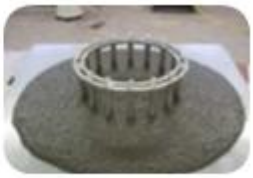
The workability test results founded are within the average range of values as per the EFNARC guidelines so the SCC mix prepared will have good workability properties.

The acceptance value as per the EFNARC guidelines are discussed below in the table

Table 6: Acceptance Value as Per EFNARC Guidelines

S. No	*Method*	*Unit*	*Typical Range*	
			MIN	*MAX*
1	Slump flow test (Filling ability)	mm	650	800
2	T50cm slump flow (Filling ability)	sec	2	5
3	V-funnel test (Filling ability)	sec	6	12
4	J-ring (Passing ability)	mm	0	10
5	L-Box (Passing ability)	-	0.8	1.0
6	V-T50 (Segregation Resistance)	sec	8	15

Slump Cone Test



J Ring Test

Figure 1: Workability Test Pictures

3.1 Mechanical Properties of Concrete

A. Compressive Strength Test

This test is done to determine the cube strength of concrete mix prepared. The specimen is tested by compression test machine after 7, 14 and 28 days curing. The load should be applied gradually till specimen fails. Loads or the failure divided by area of specimen given the compressive strength of concrete.

Compressive strength = P / A (N/mm^2)

Where P is the load in which the concrete fails
A is the Area of the concrete specimen

Table 7: Test Results of Compressive Strength Test

Mix Proportion	Compressive Strength		
	7 Days	14 Days	28 Days
Mix 1 (10% Prosopis Juliflora ash +90% cement)	16.12	18.57	24.58
Mix 2 (15% Prosopis Juliflora ash +85% cement)	18.73	20.56	27.62
Mix 3 (20% Prosopis Juliflora ash +80% cement)	22.66	28,33	34.02
Mix 4 (25% Prosopis Juliflora ash +75% cement)	18.73	20.56	27.62
Mix 5 (30% Prosopis Juliflora ash +70% cement)	17.41	23.61	28.17

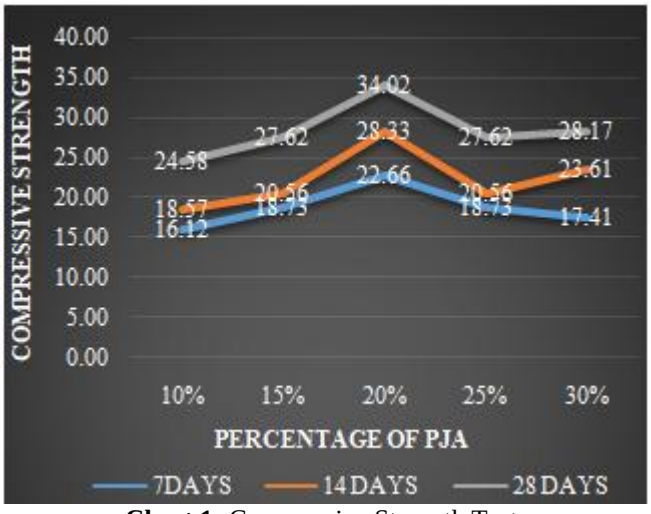


Chart 1: Compressive Strength Test

4. Conclusion

From the results found I conclude that the Prosopis Juliflora ash can be replaced in the percentage of 10%, 15%, 20%,25% and 30% with cement in the self-compacting concrete and also the mechanical strength of concrete has greater strength when 15% and 20% Juliflora ash replacement with cement in self compacting concrete. By using the innovative materials like (i.e. Juliflora ash) in construction to increase the strength of concrete and also to make the construction economical. Self-compacting concrete is a recent development that shows potential for future applications. It meets the demands placed by the requirements of speed and quality in concrete construction. The utilization of bagasse ash in SCC solves the problem of its disposal thus keeping the environment free from pollution.

References

[1] Shikha Tyagi (2015), "An experimental investigation of self-curing concrete incorporated with polyethylene glycol as self-curing agent", International Research Journal of Engineering and Technology (IRJET), Vol 2, pp. 113-135.
[2] R. Udhayan (2017), "Experimental Study of Self Compacting Self Curing Concrete", International Journal of Civil Engineering and Technology (IJCIET), Vol 8, Issue-4, pp. 638–643.
[3] Oladipupo S. Olafusi, Adekunle P. Adewuyi, Abiodun I Otunla, Adewale O Banalola (2015), "Evaluation of Fresh and Hardened Property of Self Compacting Concrete", Open Journal of Civil Engineering, Vol 5, pp. 1-7.
[4] Mohammad Karamloo , Moosa Mazloom, Gholamhasan Payganeh (2016), "Effects of maximum aggregate size on fracture behaviours of self-compacting lightweight concrete", Construction and Building Materials, Vol 1, pp. 508–515.
[5] Aditya Verma, Abhishek Kumar, Ashish Mishra, Arjit Verma, Pond ash as partial replacement of cement, International Research Journal of Engineering and Technology, 2016,03, 511-515