Experimental Study of Partially Replacement of Cement by Prosopis Juliflora Concrete

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Abstract - The experimental investigations are carried out to study the effect of prosopis juliflora in RCC structure by partial replacement or adding on cement. 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. Prosopis juliflora is xerophytic and is adapted to many soil types under a wide range of moisture conditions. Prosopis juliflora has been used to arrest wind erosion and stabilize sand dunes on coastal areas. It is fast growing, nitrogen-fixing and tolerant to arid conditions and saline soils. Under the right conditions, Prosopis juliflora can produce a variety of valuable goods and services: construction materials, charcoal, soil conservation and rehabilitation of degraded and saline soils. But wide spread prosopis juliflora has became an invader species so removal of the plant is into necessity now. Mostly the plant is removed by uprooting and is burnt. An experimental investigation is carried out on a concrete containing waste prosopis juliflora ash in the different range weight for cement. Material was produced, tested and compared with conventional concrete in terms of workability and strength. These tests were carried out on standard beam of 700×150×150

1.INTRODUTION

The history of the first introduction of Prosopis Juliflora into India is about 130 years old. Introduction of the species was first seriously attempted in 1970. Owing to its fast growth and drought hardiness, the species has since been introduced in many other parts of India from the north-west to extreme southern parts. Prosopis juliflora is one of the most economically and ecologically important tree species in arid and semi-arid zones of the world. All parts of P. juliflora have a wide range of uses. Prosopis was introduced in India during the 1870s to meet the fuel wood demand and in Tamil Nadu the 1960s, particularly in the composite Ramanathapuram and Tirunelveli districts. In Ramanathapuram district alone, it has commanded an area of about 52,000 hectares. Prosopis juliflora is an evergreen tree with a large crown and an open canopy, growing to a height of 5-10 m. Stem green-brown, sinuous and twisted, with axial thorns situated on both sides of the nodes and branches.

Prosopis Juliflora is found especially in areas with 150-750mm mean annual rainfall and maximum shade temperatures of 40-45ºC. Bark somewhat rough; dull red. The root system includes a deep taproot. In India, P. juliflora flowers twice a year, in February-March and August-September, and is a prolific seeder. The pods from autumn flowering mature by May or early June and are dispersed before the onset of the monsoon. In drought years, autumn flowering is extremely affected, with trees often failing to flower, but these same trees flower and fruit subsequently when there is adequate rainfall. The bisexual, pea like flowers are cross-pollinated by wind and insects. The seed is disseminated and pretreated by the agency of animals that feed on the pods.

In India, original introductions are thought to have been P.juliflora from Mexico or Jamaica. Differences in plant morphology may be due to further introductions of seed material of various origins and possible hybridisation between them. Five forms of P. juliflora have been identified in India.

P.juliflora leaves have been used as feeding cattles and humans. Intoxication with plant has been reported and is characterized by neuromuscular alterations and gliosis. Plant growth and productivity are adversely affected by various abiotic stress factors. Prosopis juliflora is a hardy plant reported to be tolerant to drought, salinity, extremes of soil pH, and heavy metal stress. Every part of P.juliflora is abundantly being used in various fields. Research in developing P. juliflora for its alleopathy, medicinal and bio-pesticide is going to have a great impact on development of new drugs and pesticides. The detailed understanding of the chemistry of P. juliflora and the ability of growing in extreme conditions will ensure a rational and cost effective development.

PROSOPIS JULIFLORA

MATERIAL COLLECTION AND POWDER SYNTHESIS

- Identification of prosopis juliflora**.**

PROSOPIS JULIFLORA

- Cutting of prosopis juliflora.

- Prosopis juliflora is kept under under sunlight for 5days to the removal os moisture

- Firing of prosopis juliflora.

- Forming of powder and small pieces like coal

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- We grinding the coal until it becomes as fine powder.

2. LITERATURE REVIEW

P.Packialakshmi et al (2016) the paper discusses the effects of using hypo sludge and wood ash (prosopis juliflora ash) as a partial cement replacement in concrete. An experimental study of concrete made with Ordinary Portland Cement (OPC) and 10% of OPC, replaced by hypo sludge. The hypo sludge 10% take as constant and further adding of wood ash from 0% to 30% as cement replacement for concrete. To determine the effect of these materials on concrete properties and was compared to control M20 mix. Concrete specimens were tested for compressive strength, tensile strength, and flexural strength at age of 28 days.

Etaveni Madhavi et al (2016) the objective of this research work is to reduce the cost of the construction. Now a days the industrial wastes are rapidly increasing. To utilize such materials and to reduce such type of waste in environment. The cement is replaced by the wood ash. Wood ash limited to the grain size of less than 90 micrometer is added to cement by weight percentage of 0%, 5%, 10%, 15%, 20%, 25% and 30% by the method of replacement by weight. The samples were hydrated at di�rent time intervals ranging from one hour to 4 weeks. From this research the results are much better as compared to ordinary Portland cement

Raghu K et al (2017) in this paper they are investigated about the current situation of increasing cement producing industries produces large extent of carbon dioxide to nature and due to industries the large extent of industrial by products (waste) are being accumulated to environment and economic concerns related to their disposal (land filling). Utilization of wastes materials like wood ash, risk husk ash, saw dust ash, coconut shell ash are used partial in concrete to minimize environmental and ecological problems. Mesquite wood ash is a by- product generated combustion of wood in wood-fired power plants, hotels, paper mills and other wood burning industries. The aim this projects is to minimize cost of project and to utilize the mesquite wood ash in concrete and minimize the disposal risk to nature. Here mesquite wood ash partially replaced to cement in concrete of various levels of 0%, 5%, 10%, 15%, 20% and 25%. The mechanical properties (compressive, split tensile and flexural strength) of concrete and durability properties (Acid attack and water absorption) are determined at different curing periods and were compared with control M- 30 mix.

A.Durai Murugan et al (2017) in today's world the main emphasis is on green and sustainable development. Cement industry is one of the major contributors to pollution by 0072eleasing carbon dioxide. So by partially replacing cement with pozzolanic material such as prosopis juliflora ash, the cement industry can serve both the purposes of meeting the demands of construction industry and at the same time providing a green and clean environment. Prosopis juliflora ash is difficult to decompose. So using prosopis juliflora ash is a major step towards sustainable development. Also the concrete is weak in tension, so with the addition of steel fibres it's flexural and tensile strength is also enhanced. Prosopis juliflora ash is obtained from biomass waste power plants as a waste material. Prosopis juliflora ash does not have cementitious property by itself which is responsible for strength generation. But in presence of water it reacts with free lime obtained from cement and form hydrated products (c2s and c3s) which helps in attaining the strength and also improving the durability. As the prosopis juliflora ash is very fine in structure, it fills more voids and provides superior pore structure and thereby improves its strength at later stages due to reduced permeability.

B.R.Harini et al (2017) an experimental investigation is carried out on a concrete containing waste prosopis juliflora ash in the range of 0% to 20% by weight for M-20 grade concrete. Material was produced, tested and compared with conventional concrete in terms of workability and strength. These tests were carried out on standard cube of 150*150*150 mm for 28 days to determine the compressive strength of concrete.

J.Geetanjali et al (2017) In this research initial, an attempt has been made to use wood ash as a replacement to cement in varying percentage sand natural sand is replaced with 100% crusher stone sand. The materials used in this work were powdered wood ash sourced locally from a bakery in Anathapuramu. The wood ash was passed through IS SIEVE 90 micron size. The study presents the behavior of wood ash replaced concrete. Analysis of wood ash, sieve analysis and specific gravity of wood ash and aggregate were conducted. A M20 grade mix concrete is proposed with mix proportions of 1:1.45:3.19 with water cement ratio of 0.50. Wood ash replacement is done in 0, 5, 10, 15, 20 and 25% to cement and in place of natural fine aggregate crushed stone sand has been used in the present study. 150×150×150 mm cubes and 150 mm diameter and 300mm height cylinders were cast and tested to determine the cube compressive strength and split tensile strength at 7 and 28 days curing periods respectively. Since wood ash indicates slightly pozzolanic, water demand increases as the ash content increases and the setting time of the paste increases as the ash content increases. It may be seen from this research initial that the optimum percentage replacement of cement by wood ash may be considered as 10%.

Dixson Jeson.P et al (2017) this paper examines the possibility of using sawdust ash as replacement in fine aggregate for a new concrete. Natural sand was partially replaced (5%, 10%, and 15%) with SDA. Compressive strength and Tensile strength (cubes and cylinders) on 7, 14 and 28 days of age were compared with those of concrete made with natural fine aggregate. Fineness modulus, specific gravity, water absorption, Bulk density for sand (S) and SDA were also studied. The characteristic compressive strength of concrete is M25. The test results indicate that light weight of concrete and it is possible to manufacture concrete containing sawdust ash with characteristics similar to those of natural fine aggregate concrete provided that the percentage of sawdust ash as fine aggregate is limited to 5% respectively.

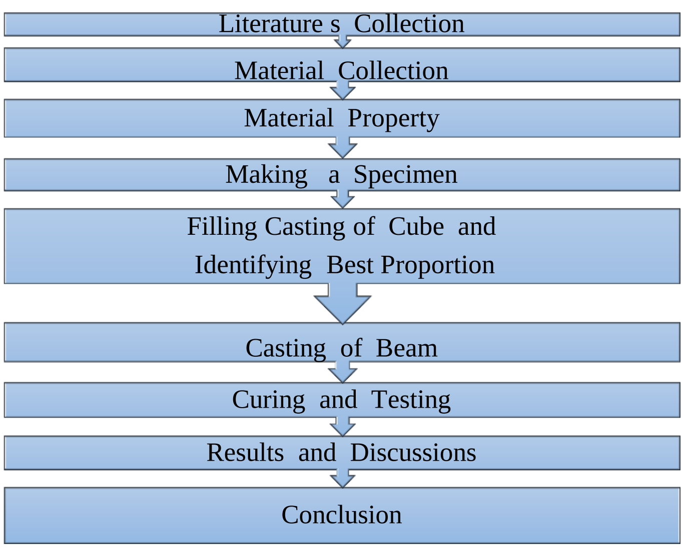
Anwar Ahmad et al (2017) Steel fibre produced as a by-product from industrial processes. The use of steel fibre has led to the improvement of the concrete mechanical properties such as material toughness in tension and also durability. Steel Fibres are generally utilized in concrete to manage the plastic shrink cracking and drying shrink cracking. The length of steel fibres is 30mm and diameter is 0.75mm and aspect ratio 40. Commercial production of steel fibres for use in concrete is also available now a day. In present investigation an attempt is made to evaluate the workability, compressive strength, , split tensile strength and flexural strength on the replacement of iron dust in the percentage of 0%,2%, 4%, 6%, 8% by the weight of cement. Then investigate the result. Fixed the percentage of iron dust in maximum result then adding the steel fibres in the percentage of 0.5%, 1%, 1.5%, 2%. Standard cube of 150X150X150mm will be cast and tested for obtaining 28-day compressive strength. Standard cylinder of 150mm diameter and 300mm height will be cast and tested for split tensile strength. Standard beam of 500X100X100 will be cast and tested for flexural strength. Then analyze all the result mathematically and graphically.

M. Dennis Kumar et al (2017) In this project, durability of the concrete can be investigated when the partial replacement of fly ash class C and quarry dust on the cement and fine aggregates this project also reported that the test results of sulphate attack on the concrete cubes in curing process with water and H2SO4 solution this experimental investigation of partial replacements of fly ash class C and quarry dust has been chemically and physically characterized with the ratio of 10%, 20%, 30% and 30% weight of the cement and fine aggregates in concretes. Fresh concrete test like as compaction factor test and hardened concrete test like as
compressive strength test ,split tensile strength test ,flexural strength test at the age of 28,60 90, days was obtained and also durability aspect of fly ash and quarry dust concrete for sulphate attack was tested the result indicates that fly ash class C and quarry dust improves concrete durability.

K.V.Boobala Krishnan This paper describes about an experimental investigation conducted to study the behavior and strength of concrete by replacing
cement with wood ash and fine aggregate with wood powder. Use of wood ash and wood powder in concrete is an interesting possibility for economy on conservation of natural resources. Cement is partially replaced by 5% of Wood Ash and Fine aggregate is partially replaced by 5%,10% and 15% of wood powder. The replacement of fine aggregate by wooden powder in concrete makes the structure light in weight. The basic test was carried out in

laboratory for various materials such as Wood powder, Coarse aggregate and Fine aggregate. The basic test includes Specific gravity test on Wood powder, Fine aggregate and Coarse aggregate. Crushing strength test and Water absorption test on Coarse aggregate. Mix Design for M25 grade concrete is prepared and workability test was carried out. Test for harden concrete is carried out by Compressive strength, Split tensile strength and Flexural strength on Cubes, Cylinders and prisms are carried out for 7 days, 14 days and 28 days strength.

3. METHODOLGY



4. MATERIAL TEST

A. Cement:

Ordinary Portland Cement (OPC) of 53 grade was used in which the composition and properties is in compliance with the Indian standard Organization. Cement can be defined as the bonding material having cohesive % adhesive properties which makes it capable to unite the different construction material and from the compacted assembly. Ordinary/Normal Portland Cement is the one of the most widely used type of Portland cement. The name Portland cement was given by Joseph Aspdin in 1824due to its similarity in colour and its quality when it hardens like Portland stone. Portland stone is white grey limestone in island of Portland, Dorset**.**

B.Fine Aggregate:

Sand is a naturally occurring granular material composed of finely divided rock and mineral particles. It is defined by size, being finer than gravel and coarser than silt. Sand can also refer to a textural class of soil or soil type; i.e., a soil containing more than 85 percent sand-sized particles by mass**.**

C. Coarse Aggregate:

The aggregate which pass through 75mm IS sieve and retain on 4.75mm IS sieve are known as coarse aggregate.The research work is restricted to sand collected from the river. The sand was collected to ensure that there was no allowance for deleterious materials contained in the sand and the size of 5mm. In this research, granite of 20mm maximum size was used.

D. Water

Water plays an important role in concrete production (mix) in that it starts the reaction between the cement, pozzolan and the aggregate. It helps in hydration of the mix. In this research, the water used was distilled water

6. MIX DESIGN

Design mix stipulation according to IS 10262-1982

Grade Designation = M-20

Fine Aggregate = Zone-I

Sp. Gravity Cement = 3.15

Fine Aggregate = 2.60

Coarse Aggregate (75mm) = 2.66

Minimum Cement (As per contract)= 383 kg /m³

Maximum water cement ratio = 0.50

7. MIX PROPORTION

Water: cement: F.A.: C.A. = 0.50: 1: 1.5: 3

	Water (lit)	Cement (Kg)	Fine Aggregate (Kg)	Coarse Aggregate (Kg)
For per m³	191.6	383	574.5	1149
Cube	0.647	1.293	1.94	3.88
Beam	3.03	6.05	9.077	18.75

MIX PROPORTION FOR CUBE :

	Water (lit)	Cement (Kg)	Prosopis Juliflora Ash (Kg)	F A (Kg)	C A (Kg)
For per m³	191.6	383	1.293	574.5	1149
Cube 5%	0.647	1.228	0.065	1.94	3.88
Cube 10%	0.647	1.163	0.13	1.94	3.88
Cube 15%	0.647	1.099	0.194	1.94	3.88
Total	1.941	3.49	0.389	5.82	11.64

MIX PROPORTION FOR BEAM :

	Water (lit)	Cement (Kg)	Prosopis Juliflora Ash (Kg)	F.A (Kg)	C.A (Kg)
For per m³	191.6	383	6.05	574.5	1149
Beam 5%	3.03	5.474	0.303	9.077	18.75
Beam 10%	3.03	5.445	0.605	9.077	18.75
Beam 15%	3.03	5.14	0.91	9.077	18.75
Total	9.09	16.059	1.818	27.231	56.25

TOTAL MATERIAL:

Water = 11.031 lit

Cement = 19.549 kg

Prosopis juliflora = 2.207 Kg

Fine Aggregate = 33.051 kg

Coarse Aggregate = 67.89 kg

7. PREPARATION OF MATERIALS

MIXING:

Hand mixing (Mixing Concrete without a Mixer):

Hand mixing is the process of mixing the various materials of concrete manually. Mixing concrete without a mixer is used only for small works. Mixing of materials shall be done on masonry platform or flat iron sheet plates

Machine Mixing (Mixing Concrete with a Mixer):

While hand mixing is a quite good process to ensure the quality of concrete, in larger projects where large masses of concrete are required, it is neither feasible nor advisable. Hand mixing also doesn't ensure the consistent homogeneity of concrete. Also, the demands for short mixing time and consistency, homogeneous quality of concrete are increasing day by day, which cannot be satisfied by hand mixing. Machine mixing can satisfy all the demands mentioned above. Nowadays various types of concrete mixers are available which are either petrol/diesel or electrically powered.

8.SLUMP TEST

This test is carried out with a mould called slump cone whose top diameter is 10cm, bottom diameter is 20 cm and height is 30 cm. the test may be performed in the following steps:

1. Place the slump mould on a smooth flat and non-absorbent surface.
2. Mix the dry ingredients of the concrete thoroughly till a uniform colour is obtained and then add the required quantity of water.
3. Place the mixed concrete in the mould to about one-fourth of its height.
4. Compact the concrete 25 times with the help of a tamping rod uniformly all over the area.
5. Place the concrete in the mould about half of its height and compact it again.
6. Place the concrete up to its three fourth height and then upto its top. Compact each layer 25 times with the help of tamping rod uniformly. For the second subsequent layers, the tamping rod should penetrate into underlying layers.
7. Strike off the top surface of mould with a trowel or tamping rod so that the mould is filled to its top.

8.1 SLUMP SETUP

Slump for the given sample= 28.5 mm. True slump.

9. COMPRESSIVE STRENGTH

Strength tests are required for one or both of the following purposes:

- To check the potential strength of the concrete under controlled conditions against the desired strength; and

- To establish a strength-age relationship for the concrete under job conditions as a control for construction operations or the opening of the work.

Tests made for the first purpose are referred to as standard tests and those for the second purpose are referred to as control tests. For uniform and comparable results, follow a standard and consistent procedure in making all of the test specimens whether they are used either for standard or for control tests.

Compressive strength = ultimate load (N) / sectional area (mm^2)

On an atomic level, the molecules or atoms are forced apart when in tension whereas in compression they are forced together. Since atoms in solids always try to find an equilibrium position, and distance between other atoms,forces arise throughout the entire material which oppose both tension and compression. The phenomena prevailing on an atomic level are therefore similar.

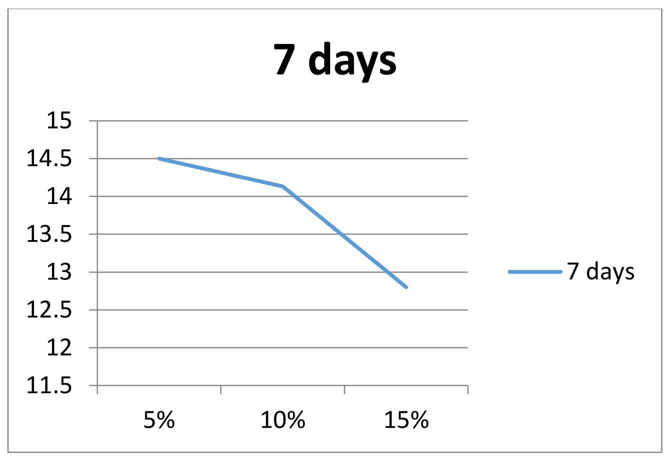
The "strain" is the relative change in length under applied stress; positive strain characterises an object under tension load which tends to lengthen it, and a compressive stress that shortens an object gives negative strain. Tension tends to pull small sideways deflections back into alignment, while compression tends to amplify such deflection into buckling. Compressive strength is measured on materials, components, and structures.

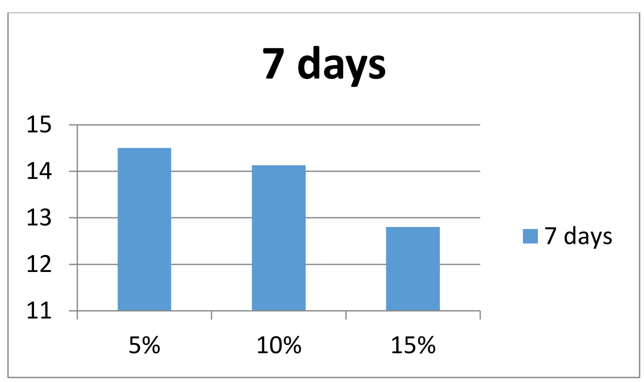
By definition, the ultimate compressive strength of a material is that value of uniaxial compressive stress reached when the material fails completely. The compressive strength is usually obtained experimentally by means of a compressive test. The apparatus used for this experiment is the same as that used in a tensile test. However, rather than applying a uniaxial tensile load, a uniaxial compressive load is applied. As can be imagined, the specimen (usually cylindrical) is shortened as well as spread laterally.

9.1 COMPRESSIVE STRENGTH TEST

Dimension of Specimen in mm – 150 x 150 x 150mm

S.NO	DAYS	SPECIMEN DETAILES	ULTIMATE LOAD (KN)	COMPRESSION STRENGTH (N/mm^2)
1	7 Days	5%	327Kn	14.5
2	7 Days	10%	318Kn	14.13
3	7 Days	15%	288kN	12.8

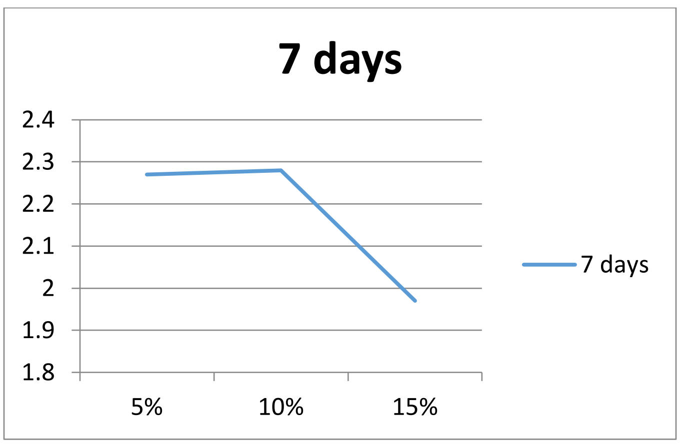


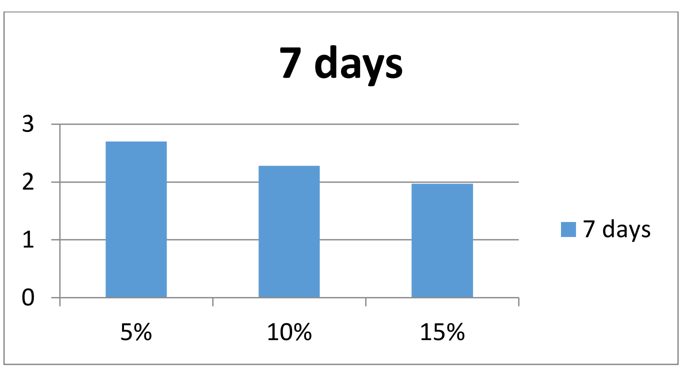


10.FLEXURAL STRENGTH TEST

Dimension of Specimen in mm – 700 x 150 x 150mm

S. NO	DAYS	SPECIMEN DETAILES	ULTIMATE LOAD (KN)	COMPRESSION STRENGTH (N/mm²)
1	14 Days	5%	13kN	2.7
2	14 Days	10%	11kN	2.28
3	14 Days	15%	9.5kN	1.97





11.CONCLUSION

Based on the experimental investigation on concrete with cement is partially replaced by prosopis juliflora as 5%, 10%, 15% on 7,14 & 28 days the following conclusions were made: respectively to increase the strength of concrete. Compressive strength of concrete increases with the amount of prosopis juliflora by 10 % on various days of curing respectively. After that strength gradually slips while increasing the percentage of prosopis juliflora. The replacement of cement with prosopis juliflora upto 15% is desirable, as it is cost effective. As a result of these, this research work concludes that more than 15% of prosopis juliflora is not a suitable material for cement replacement in concrete.

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