EXPERIMENTAL STUDY AND COMPARISON BETWEEN THE FINE AGGREGATE REPLACED WITHIRON WASTE AND JULIFLORAWOOD WASTE IN CONCRETE MIXTURE

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Abstract: *Concrete's value as a building material is growing by the day. Sand, as a main fine aggregate, offers greater component adherence and strength in concrete. Civil engineers have been challenged to transform industrial wastes into useable building and construction materials because to a high demand for building materials, particularly in the previous decade, owing to a rising population that produces a chronic scarcity of building materials. Our research aims to show that Juliflora wood waste-cement-gravel mix and iron waste-cement-gravel mix have the same benefits as the conventional cement-sand-gravel mix. When testing the compressive strength of concrete, it was discovered that concrete containing Juliflora wood debris compacted more efficiently than conventional concrete. Dry porous wood powder might absorb enough water to serve as an efficient internal curing agent, absorbing excess water in the mix while also providing the water necessary for cement hydration. The use of Juliflora wood waste and iron waste as partial replac ements for sand for 12 percent and 2% of the time,parallely , w ould help to reduce the amount of Juliflora wood waste an- iron waste created in society while also lowering pollution.*

Key Words: Concrete, Juliflora Wood Waste, Iron Waste, Compressive Strength, Tensile Strength

1. Introduction

1.1 General

In recent years, several research throughout the world have begun to look at the use of low-cost, low-energy substitute construction materials. Increasing cement and fine aggregate costs, on the other hand, not only increase a building's budget, but also represent a serious threat to the country's economic growth. [12] Among the numerous choices for conventional material substitutions are iron waste and prosopis juliflora wood powder. [9] There is a lot of iron dust in industrial areas. Automobile workshops and Leths and Prosopis juliflora may be found in abundance all throughout the world, including South America, Africa, Asia, and other continents. In impoverished nations where typical construction materials are limited or excessively costly, the use of these features as a form of concrete upgrade is particularly tempting. [12]

1.2 Concrete

Concrete is a homogeneous combination of Binder (Cement), Fine Aggregate, and Coarse Aggregate that has an appropriate water-cement ratio. It is one of the most important building materials. Concrete has a high compressive strength but is weak in tension; to increase the tensile characteristics of concrete, reinforcements are developed and applied.

1.3 Cement

The cement used was grade 43 Portland cement. The most prevalent type of cement is Portland cement, which is also the most frequent component in concrete. Cement is made by combining calcium, silica, aluminium, iron, and other components in a well regulated chemical reaction.

1.4 Iron Dust

Iron powder is made up of other iron particles and has a variety of applications. Particle sizes range from 20 to 200 nanometers. The characteristics of iron vary based on the technique of manufacture and the history of a given iron powder. Because the powder form is comparable to the fine aggregate used in concrete, it may be utilized as a substitute for fine aggregate to provide the concrete and structural components more strength.

Fig 1.1 Iron Dust

1.5 Juliflora Wood Powder

Juliflora wood powder is made from the waste wood dust of the prosopis juliflora tree. This tree can readily adapt to the drylands since it is suited to our current climate. They're similarly comparable to fine aggregates in concrete, thus they can be employed in place of fine aggregates to give the concrete more strength

FIG 1.2 Juliflora Wood Waste

2. METHODOLOGY:

3. OBSERVATIONS AND RESULTS:

3.1 TESTS FOR CEMENT

3.1.1 Standard consistency

The consistency of standard cement paste is described as the consistency that allows a 50 mm long vicat plunger with a 10 mm diameter to penetrate to a position 5 mm to 7 mm from the vicat mould's bottom.

3.1.2 Initial setting time

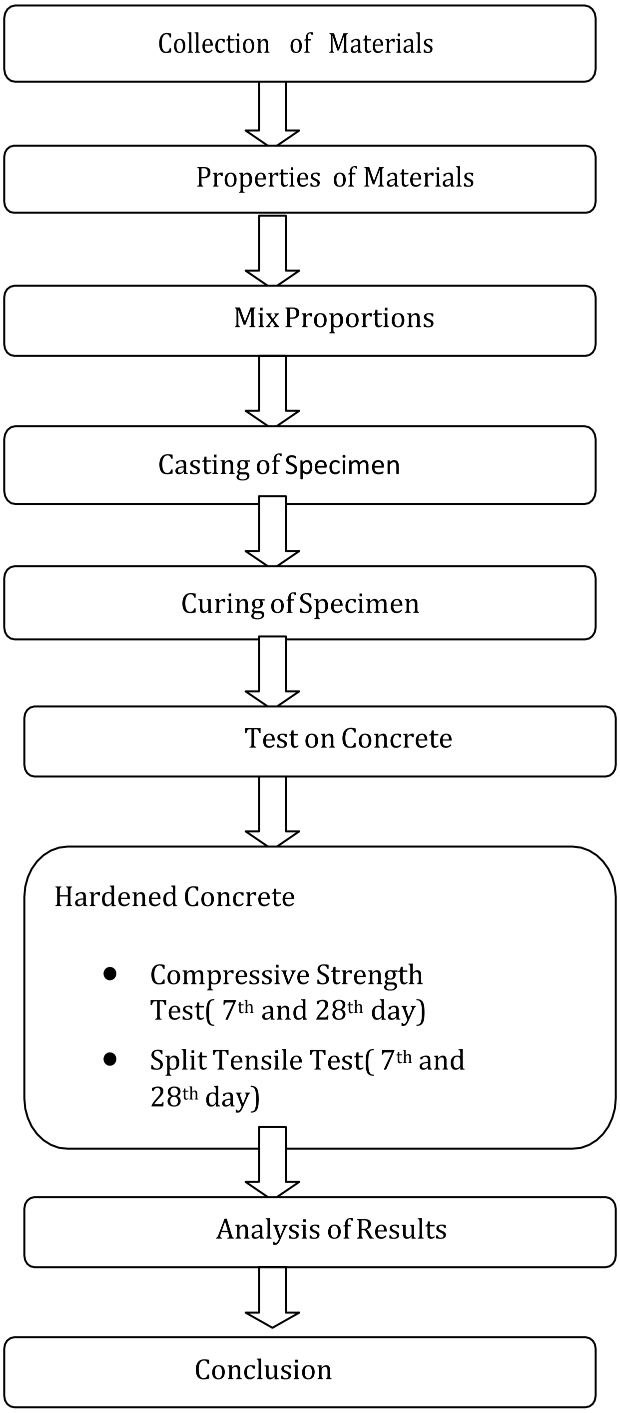
Setting refers to the transition of cement paste from a fluid to a hard condition. Hardening is the process of a set cement paste increasing strength.

3.1.3 Final setting time

A needle with a concentric ring is utilised for the final setting time. When the needle leaves an impression on the paste's surface but does not penetrate the 0.5 mm required for the ring to mark the surface, the final setting time has arrived. The longer it takes for the cement to hydrate, the higher the water content of the paste. The process for initial and final setting time is similar, with the exception of the time length and needle.

Table 3.1 Standard consistency

S.no	Percentage of weight Of water	Initial Reading (mm)	Final reading (mm)
1	25	41	41
2	27	41	40
3	28	41	38
4	30	41	33



Standard consistency = 30%

3.1.4 Fineness of cement

The fineness of the cement has a significant impact on the pace of hydration, and hence the rate of strength growth and heat development. Finer cement has a larger surface area for hydration, resulting in a faster and stronger strength development

Table 3.2 Initial setting time

S.No	Duration (min)	Initial Reading (mm)	Final Reading (mm)
1	10	0	0
2	20	0	0
3	30	0	0
4	40	0	2
5	50	2	4
6	60	4	7

Initial setting time of cement=60 min

Final setting time of cement=9.30 hrs

Table 3.3 Fineness of cement

Trial no.	Wt. of sample	Wt. of residue	% of fineness
1	100	0.2	0.2
2	100	0.2	0.2
3	100	0.3	0.3

% of fineness = (Weight of residue/ Weight of sample) x 100

= (0.2/100) x 100

= 0.233

3.2 TEST FOR FINE AGGREGATE

3.2.1 Sieve Analysis

The particle size distribution of coarse aggregates can be determined via sieve analysis. This is accomplished by screening the aggregates according to IS codes. We utilize different sieves that are standardized by IS codes and then run the aggregates through them, collecting different sized particles that are left over the different sieves.

3.2.2 Specific gravity of fine aggregate

This method covers the determination of specific gravity of fine aggregate. Specifis gravity is the characteristics generally used for calculation of the volume occupied by aggregate in the mixes.

3.3 TESTS FOR COARSE AGGREGATE

3.3.1 Sieve Analysis

The particle size distribution of coarse aggregates can be determined via sieve analysis. This is accomplished by screening the aggregates according to IS codes. We utilize different sieves that are standardized by IS codes and then run the aggregates through them, collecting different sized particles that are left over the different sieves.

3.3.2 Specific gravity and water absorption of coarse aggregate

The determination of fine aggregate specific gravity is covered by this approach. The parameters often used for calculating the volume occupied by aggregate in mixes are specified gravity.

Ratio 1:1.71:2.9

Cube size = 150 x 150x 150 mm

3.375×10^3

= $3.375 \times 10^3 \times 1.2$

= $4.05 \times 10^3 \times 2400$

Weight of cement = 9.72 kg

Cement = 1/(5.61x9.72)

= 9.30 hrs = 1.732 kg

Replacement :

Fine aggregate with replacement of 2% of iron waste and 12% of juliflora wood waste

Iron waste (2%)

Table 5.1 Mix Proportions

Cement	F. A(kg/m³)	C.A (kg/m³)	Water cementratio (kg/m³)
394	677	1148.19	197.16
1	1.71	2.91	0.5

Fig. 3.1 Dry mix

Fig. 3.2 Wet Proportion

Fig 3.3 Casting and Molding

FIG 3.4 Curing

4. PROPERTIES OF HARDENED CONCRETE

iron waste = 0.02x3.02 = 0.0604 kg

fine aggregate = 0.98x3.02 = 2.9596 kg

Juliflora wood waste (12%)

wood waste = 0.12x3.02 = 0.3624 kg

fine aggregate = 0.88x3.02 = 2.65kg

COMPRESSIVE STRENGTH TEST

The capacity of a concrete to crush is measured by its compressive strength. A compressive strength test is the most typical test on hardened concrete. It's because the test is simple to carry out. Furthermore, many desired properties of concrete are qualitatively connected to its strength, emphasizing the relevance of concrete's compressive strength in structural design. The compressive strength of the test specimen provides an excellent and obvious indicator of how the strength is impacted by the self-curing chemicals.

The compressive strength of concrete can be calculatedusing the following equation

F_c = [P x 100]/A

Where:

F_c = compressive strength of concrete (MPa)

P = maximum load applied to the specimen (kN)A

= cross area of the specimen (mm^2)

TENSILE STRENGTH TEST

Tensile strength is defined as the ability of a material to resist a force that tends to pull it apart

Apparatus:

Machine: Universal Compressive testing machine

Mould Size: 150mm x 150mm x150mm

TABLE 4.1 COMPRESSIVE STENGTH AT 7 DAYS

S.No	% of C.A replaced with juliflora wood waste	% of C.A replaced with iron waste	Ultimate load (kg)x10³	Ultimate stress (N/mm²)	Average (N/mm²)
1	(Conventional Cube)	(Coventionalcube)	56 53 60	26.42 26.05 26.50	26.32
2	12%	-	64 57 61	26.97 26.72 26.84	26.85
3	**-**	**2%**	**67** **61** **58**	**30.65** **30.52** **30.48**	**30.55**

TABLE 4.2 COMPRESSIVE STENGTH AT 28 DAYS

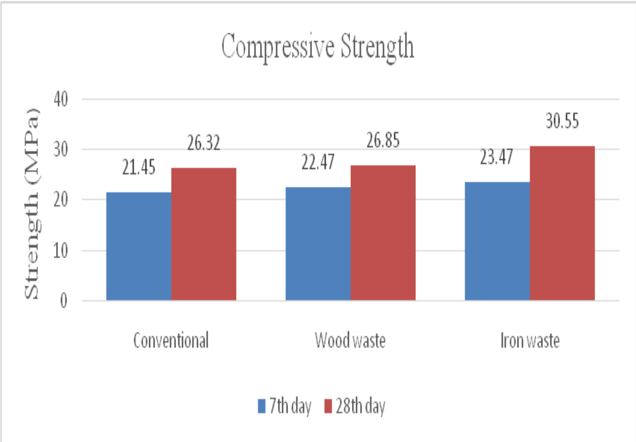
S.No	% of C.A replaced with iron waste	% of C.A replaced with Juliflora wood waste	Ultimate load (kg)x10³	Ultimate stress (N/mm²)	Avg. (N/mm²)
1	Conventional Cube	Coventionalcube	47 51 48	21.48 21.52 21.36	21.45
2	**2%**	**-**	**56** **54** **51**	**23.59** **23.48** **23.33**	**23.47**
3	-	12%	47 50 53	22.64 22.59 22.71	22.65

TABLE 4.3 TENSILE STENGTH AT 7 DAYS

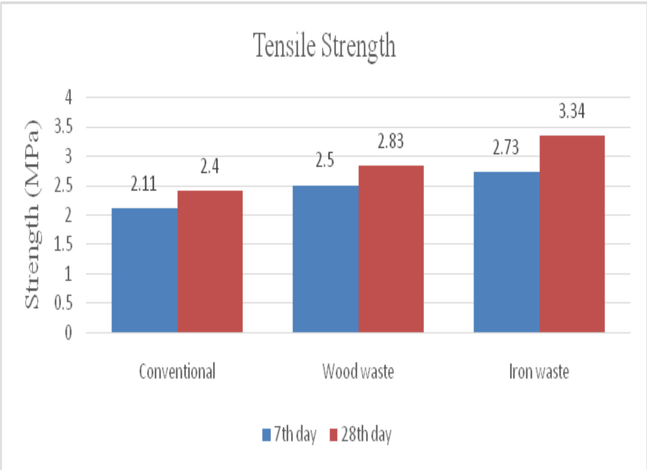
S.No	% of C.A replaced with juliflora wood waste	% of C.A replaced with iron waste	Ultimate load (kg)x10³	Ultimate stress (N/mm²)	Average (N/mm²)
1	(Conventional Cube)	(Coventionalcube)	147 153 157	2.09 2.11 2.14	2.11
2	12%	-	180 169 173	2.56 2.31 2.64	2.50
3	-	2%	384 390 373	2.72 2.85 2.61	2.73

TABLE 4.4 TENSILE STENGTH AT 28 DAYS

S.No	% of C.A replaced with juliflora wood waste	% of C.A replaced with iron waste	Ultimate load (kg)x10³	Ultimate stress (N/mm²)	Average (N/mm²)
1	(Conventional Cube)	(Coventional cube)	178 169 165	2.53 2.40 2.39	2.40
2	12%	-	206 192 201	2.92 2.73 2.85	2.83
3	-	2%	235 201 240	3.33 3.28 3.41	3.34



BAR CHART 4.5 COMPRESSIVE STRENGTH OF CONCRETE



BAR CHART 4.6 TENSILE STRENGTH OF CONCRETE

5. CONCLUSION:

The characteristics of concrete whose fine aggregate is largely substituted with juliflora wood waste and iron waste are investigated experimentally using established techniques, such as compressive strength and split tensile. Increase in Juliflora wood waste and iron waste, reduces the strength properties of concrete. Thus replacing the fine aggregates increases the strength than conventional, where 2% of iron waste increases 5Mpa than the conventional concrete. So, it can be recommended for structures which require high strength. 5.5 and 5.6 are seen in the bar chart above. The fine aggregate in the concrete mixture can be replaced with Juliflora wood waste. This helps to reduce the weight of concrete per unit. This is helpful in applications that need non-load bearing light weight concrete, such as facade concrete panels, Krebs, and so forth. With an increase in the amount of wood waste in concrete, the density of juliflora wood waste concrete decreases. The use of juliflora as a concrete substitute reduces the pollutants generated by juliflora burning. It is not recommended to raise the proportion of replacement based on the findings obtained. Instead, we may reduce the proportion to reach a strength that is closer to that of conventional, while also being more cost-effective and environmentally friendly.

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