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Experimental Study on Partial Replacement of Sand by Teak Wood Dust in Concrete

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Abstract: ***An experimental and analytical study was conducted to study the partial replacement of sand using Teak Wood Dust in concrete. The substitution of sand by wood waste can relieve the scarcity of raw materials and lighten concrete masonry block weight. Several trial mixes is being prepared with varying amount of Teak wooden powder. For making M30 grade of concrete replacing sand with teak wood dust in proportions of 0%, 5%, 10%, 15%, 20%, 25% and 30% . The results obtained by varying the percentage of Teak Wood Dust being analyzed and compared with standard concreteand find out the optimum mix .Then its Workability, strength, durability, impact and water absorption test are studied and compared with control mix. The most important properties of concrete are the compressive strength and Tensile strength. Also, increasing the teak wooden dust incorporation caused decreases in unit weights and strength values of mortars with a parallel increase in water absorption values at all ages.***

1. Introduction

Concrete is the most widely used construction material all over the world .With innovations in science and technology in construction industry, the scope of concrete as a structural material has widened. The overall relevance of concrete in virtually all civil engineering practice and building construction works cannot be overemphasized. Concrete is a combination of cement, fine and coarse aggregates and water, which are mixed in a particular proportion to get a particular strength. The cement and water react together chemically to form a paste, which binds the aggregate particles together. The mixture sets into a rock-like solid mass, which has considerable compressive strength but little resistance in tension and flexure. The utilization of concrete is increasing at a higher rate due to development in infrastructure and construction activities all around the world.

The development in the construction industry all over the world is progressing. Many structures are being built, both residential and non-residential. As a result of the increase in the cost of construction materials, especially cement, crushed stone (coarse aggregate), fine sand (fine aggregate); there is the need to investigate the use of alternate building materials which are locally available. Since most building construction works consist of concrete work; therefore, reduction in cost of concrete production will reduce the cost of building construction.

Sawdust is not a familiar material in the construction/ building industry. This is either because it is not available in very large quantities as sand or gravel, or because their use for such has not been encouraged. For some time now, there have been calls for the use of local materials in the construction industries especially in developing countries to check costs of construction. Sawdust is an industrial waste in the timber industry constitutes a nuisance to both the health and environment when not properly managed. Wood sawdust wastes are accumulated from the countries all over the world and cause certain serious environmental problems and health hazards. It is one of the major underutilized by products from sawmilling operations. Generation of wood wastes in sawmill is an unavoidable hence a great efforts are made in the utilization of such waste. Fig 1 shows the teak wood dust

In this project the main aim is to study the partial replacement of the Teak wood dust with the different percentage in fine aggregate concrete and to check the properties of teak wood dust concrete (TWD) by comparing it with the normal concrete. The replacement of fine aggregate (sand) with certain wooden powder in concrete makes the structure more light in weight. The strength, workability, durability and impact test were considered in this dissertation. The most important properties of concrete is the strength in compression. Also, increasing the wooden dust in corporation caused decreases in unit weights and compressive strength values of mortars with a parallel increase in water absorption values at all ages. The wooden powder dust replaced by fine aggregates (sand) gives the properties and the benefits in the actual production of concrete.

Fig 1.Teak wood dust

2. Methodology

- Collection of literature review in the areas of teak wood dust replaced concrete.
- Testing of cement, fine aggregate, teak wood dust and coarse aggregate so as to find their properties
- Determination of the desired mix proportion of concrete (M30 grade) using IS 10262:2009

- Casting and testing of specimens to determine mechanical properties by replacing fine aggregate with TWD from 0-30% (21 nos)
- Finding out optimum teak wood dust combination from test result
- Studying the split tensile strength and flexural strength of TWD replaced concrete

3. Materials and Methods

Conventional concrete is made up of three basic components such as portland cement, aggregates and water. Teak wood dust concrete has ingredients such as cement, sand fine aggregate, coarse aggregate, water and fine aggregate was replaced with suitable amount of TWD. The quality and quantity of each component has their own role in the properties of concrete both in fresh and hardened stage. Different materials used in present study were cement, coarse aggregates, fine aggregates, water and Teak wood dust and water were shown in Fig 2.

Figure 2: Materials for casting

a) Cement

Cement is an extremely ground material having adhesive and cohesive properties which provides a binding medium for the discrete ingredients. Cement is very often the most important because it is usually the delicate link in the chain. It constitutes only about 20 percent of the total volume of concrete mix; it is the active portion of binding medium and is the only scientifically controlled ingredient of concrete. In order to ensure the quality and physical properties of cement various tests such as fineness, normal consistency, specific gravity, initial and final setting time (Fig 3) were carried out and the results were found to be agreed with IS specifications. Table1 shows the physical properties of cement.

Figure 3: Initial setting time test set up

Table 1: Physical properties of cement

Properties	Result	IS Specification
Fineness	3%	<10
Normal consistency	31%	-
Specific gravity	3.14	-
Initial setting time	55 min	>30 min
Final setting time	360 min	<600 min

b) River sand

Clean and dry River sand locally available was used. Sand passing through IS 4.75mm sieve was used for casting all the specimens. Various tests on river sand was performed to obtain its physical properties such as specific gravity, bulk density, void ratio, porosity, uniformity coefficient and fineness modulus etc. The fine aggregate used to conform to Zone III grading curve as per IS 383:1970. The properties of fine aggregate were given in Table 2.

Table 2: Properties of fine aggregate

Properties	Result	IS Specifications
Specific gravity	2.52	2.5-2.9
Bulk density	1.655 g/cm3	1.52-1.62g/cm3
Void ratio	0.526	-
Porosity	34.4%	-
Fineness modulus	2.024	2-4
Uniformity coefficient	3.125	<4

c) Coarse aggregate

Crushed stone with particle size less than 20 mm were used in the present investigation. Various tests on coarse aggregate was performed based on IS 383:1970 and IS 2386:1963 to obtain its physical properties such as specific gravity, bulk density, void ratio, porosity, uniformity coefficient and fineness modulus etc.The properties of coarse aggregate were given in Table 3

Table 3: Properties of coarse aggregate

Properties	Result	IS Specifications
Specific gravity	2.631	2.60-2.72
Bulk density	1.549 g/cm^3	1.520-1.68 g/cm^3
Void ratio	0.69	-
Porosity	40.6%	-
Fineness modulus	7.239	6.5-8
Uniformity coefficient	1.667	<4

d) Teak wood dust

Teak wood dust is also known as wood dust. It is the by-product of cutting, drilling wood with a saw or any other tool. It is composed of fine particles of wood. Certain animals, birds and insects which live in wood, such as the carpenter ant are also responsible for producing the saw dust. Wooden powder dusts are produced as a small alternate chips or small fragments of wood during sawing of logs of timber into different sizes. Various tests on Teak wood dust was performed to obtain its physical properties such as specific gravity, bulk density, void ratio, porosity, uniformity coefficient and fineness modulus etc. The properties of Teak wood dust were given in Table 4.

e) Water

Water is an important ingredient of concrete as it actually participates in the chemical reaction with cement. When water reacts with cementitious materials forms a cement paste by the process of hydration. It helps to form the strength giving cement gel. The quantity and quality of water must be looked very carefully. Strength and durability of concrete is controlled to a large extent by its w/c ratio. Casting and curing of specimens were done with the potable water that is available in the laboratory.

Table 4: Properties of Teak wood dust

Properties	Value
Specific gravity	0.933
Bulk density	0.241g/cm^3
Void ratio	2.866
Porosity	74.1
Fineness modulus	2.11
Uniformity coefficient	4

4. Fresh Concrete Properties

a) Slump test

Slump test is most commonly used test to get a rough idea of workability. Consistency and workability are relative terms. The consistency of concrete is defined as the wetness of concrete. Wet concrete is more workable than dry concrete, but sometimes concrete of same consistency may vary in workability. By slump test actually we are measuring the consistency and indirectly the workability of concrete. Fig 4 shows typical slump test set up.

Figure 4: Slump test set up

5. Hardened Concrete Properties

a) Compressive strength of concrete

Out of many test on concrete, this is the utmost important which gives an idea about all the characteristics of concrete. By this single test one can judge that whether Concreting has been done properly or not.

Compressive strength of concrete depends on many factors such as water-cement ratio, cement strength, quality of concrete material, and quality control during production of concrete etc.

Compressive strength of a material or structure measure the largest compression force it can with stand before fails or loses in shape.

Here cube specimens are prepared using M30 mix. Teak wood dust was used as the fine aggregate. Three cubes of 150mm size were used for each mix (Fig 5). Concrete were mixed by hand. The cement and fine aggregate were mixed on water tight non-absorbent platform until the mixture is thoroughly blended and of uniform color. Coarse aggregate was added and mixed with cement and fine aggregate until the coarse aggregate was uniformly distributed throughout the batch.

Figure 5: Casting of cubes

Water was added and mixed it until the concrete appears to be homogeneous and of the desired consistency. For each mix, three cubes were tested at the age of 28th day of curing in a compression testing machine of 600 kN capacity.

b) Split Tensile Strength

Fig 6 shows the test set up .Splitting tensile strength on concrete cylinder is a method to determine the tensile strength of concrete. The test was carried out by placing a cylindrical specimen horizontally between the loading surfaces of a compression testing machine and the load was applied until failure of cylinder, along the vertical diameter occurs. In this test, the compressive load was applied along the opposite generators of a concrete cylinder placed with its axis horizontal between the plates of the compression testing machine capacity 600kN.The loading condition produces high compressive stress immediately below the two generators to which the load is applied.

When the load is applied along the generatrix, an element on the vertical diameter of the cylinder is subjected to a horizontal stress known as splitting tensile stress and is,

$$f_{ct}=\frac{2P}{\pi DL} \quad (5.1)$$

where,
f_{ct} = Split tensile strength(N/mm^2)
P = Tensile load at failure (N)
D = Diameter (mm)
L = Length of the specimen (mm)

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Figure 6: Split tensile test

c) Flexural strength

Flexural strength is also known as modulus of rupture is a property, defined as the stress in, material just before it yields in flexure test .The modulus of rupture of concrete characterizes the bending strength of unreinforced beam. The transverse bending test is most frequently employed, in which a specimen has either a circular or a rectangular cross section is bend until fracture using a two point load test technique. The flexural strength represents the highest stress experienced within the material at its moment of failure. Fig 7 shows the test setup .Modulus of rupture is measured in terms of stress and is given by,

$$f_{cr}= \frac{Pl}{bd2} \quad (5.2)$$

Where,

f_{cr}= modulus of rupture(N/mm^2)

P = failure load (N)

l = clear span (mm)

b = breadth of beam (mm)

d = depth of beam (mm)

Figure 7: Shows the test setup of modulus of rupture

6. Results and Discussion

a) Slump test

Slump values of different l mix are shown in table 5.

Table 5: Slump values of different mix

Mix designation	Slump value (mm)	Decrease in workability (%)	Slump designation
CC	60	-	True slump
TWD1	58	3.33	True slump
TWD2	54	10	True slump
TWD3	52	13.33	True slump
TWD4	50	16.66	True slump
TWD5	46	23.33	True slump
TWD6	42	30	True slump

From Table 5it is clear that the addition of teak wood dust decreases the workability. Among all the seven mixes the slump value for TWD6 is obtained as minimum.TWD6 mix shows about 30% decrease in workability than CC.

b) Compressive strength of concrete

Table 6 shows compressive strength of specimens

Table 6: Compressive strength of specimens

Mix designation	Average compressive strength (N/mm^2)	% increase
CC	32.04	-
TWD1	33.91	5.83
TWD2	35.05	9.39
TWD3	32.90	2.68
TWD4	24.41	-23.81
TWD5	21.40	-33.20
TWD6	17.70	-44.75

The results obtained from compression test, it is clear that 10% replacement of fine aggregate with teak wood dust showed maximum compressive strength. The compressive strength of TWD2 increased by 9.39% than CC.

c) Split Tensile Strength

Table 7 shows the split tensile strength of cylinders

Table 7: Split tensile strength of cylinders

Mix designation	Split tensile strength (N/mm^2)	Percentage increase
CC	2.188	_
TWD2	3.04	38.93

The results obtained from split tensile test, it is clear that the split tensile strength of TWD2 increased by 38.93% than CC.

d) Flexural strength

Flexural strength of concrete shown in table 8.

Table 8: Modulus of rupture

Mix designation	Modulus of rupture (N/mm^2)	Percentage increase
CC	2.188	_
TWD2	8	19.94

7. Conclusions

- From the slump and compaction factor test, the addition of teak wood dust reduced the workability than conventional concrete
- The compressive strength of the TWD2 was increased by 9.39% over CC
- The split tensile strength of TWD2 was increased by 38.93% compared to CC
- The flexural strength of TWD2 was increased about 19.94% than CC

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References

[1] **Shashank Tiwari et al** (2018). "Experimental study on partial replacement of sand by teak wood in concrete" *International Research Journal of Engineering and Technology*.
[2] **Mehnaza Akter** (2017). "Experimental Study on Effect of Wood Ash on Strength of Concrete" *International Research Journal of Engineering and Technology*.
[3] **M. Albert Joy et al**(2016). "Partial replacement of fine aggregate with sawdust for concrete" *International Journal for Technological Research in Engineering*.
[4] **A. A. Raheen et al** (2017). "Saw dust ash as partial replacement for cement in concrete'' *International Journal for Technological Research in Engineering*.
[5] **I.H. Adebakin et al (**2012).Uses of sawdust as admixture in production of low cost and light-weight hollow sandcrete blocks "*American Journal Of Scientific And Industrial Research*.