PARTIAL REPLACEMENT OF FINE AGGREGATE BY USING TIMBER WASTE IN CONCRETE

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Abstract: This Timber waste is the by-product of wood. It is considered as waste material but now a days this waste material is utilized in the construction of the building as timber waste concrete. It is utilized to make light-weight concrete and possess long duration heat transfer. In this research timber waste concrete was made at three different mix proportions of cement to timber of 1:1, 1:2 and 1:3 by volume. At these proportions mechanical and thermal properties like density, workability, strength, elastic modulus and heat transfer were investigated after, 7 , 14 and 28 days of curing. It was found that with the increase in the amount of timber waste, the workability and strength decreased however, concrete with higher amount of timber waste performed very well. It was also found that the heat transfer of timber waste concrete decreased. Considering the overall physical and mechanical properties, timber waste concrete can be used in building construction.

Index Terms **- Timber waste, River Sand, M-Sand, Portland cement**

I. INTRODUCTION

Concrete is the most common used material in the construction over hundred years ago. The mix of normal concrete is cement, fine aggregate, coarse aggregate and water. The rapid development of composite structure nowadays requires a better quality material and concrete performance. Concrete is the most economical material used but because of the high density of the concrete, the dead load of the building also increases. Reducing the density of concrete has several advantages and this will lead to the efficient construction because the cost of handling, transportation and constructability will be reduced. Concrete is the conventional and one of the most durable building materials for most civil engineering works in the world. It provides superior fire resistance. Structures made of concrete can have a long service life. The construction industry consumes more natural resources than any other industry. With increasing public awareness of the needs and demands of sustainable development and environmental conservation, no other industry is called on as much as the country's construction and building industry to evolve their practices to satisfy the needs of our current generation, without curtailing the resources of future generations to meet theirs.

For example, concrete accounts for the most important building material, with billions of tons produced each year worldwide, and without which the nation's infrastructure is inconceivable. Considerable progress and breakthroughs have been achieved in recent years in concrete technology, which has largely gone unnoticed by the public at large. One alternative to make concrete lighter is introducing lightweight concrete in the construction industry.

Lightweight concrete has been used recently because of it the capability to reduce the dead load and the earthquake force. The density of LWC is approximately 80% of normal weight concrete. The density of structural LWC typically ranges between 1440 and 1840 kg/m3. Whereas these values vary between 2240 and 2400 kg/m3 for normal weight concrete. Research has been devoted towards finding the methods of making it lighter in weight together with better insulating properties and cheaper in cost.

1.1 SCOPE OF STUDY

- Use of timber waste by replacing sand in normal concrete for real time projects there by reducing the overall cost of construction.
- Reduce the weight of concrete to some extent.
- Reduction in use of river sand helps protecting the ground water table.
- Effectively utilising waste material to produce a clean environment.

II. LITERACTURE REVIEW

The main purpose of literature review is to give an idea about the research work conducted in the world. This forms the basis on which one can carry out the work and techniques that can be used for conducting experiments. The following literature elaborates the research studies made on the timber waste replacement of fine aggregate in concrete

2.1 THE USE OF TIMBER WASTE ASH AS FINE AGGREGATE REPLACEMENT IN CONCRETE

M. Abdullahi (Civil Engineering Department, Federal University of Technology, Niger State, Nigeria,).Concrete is a construction material composed of Portland cement and water combined with sand, gravel, crushed stone, or other inert material such as expanded slag or vermiculite. The major constituent of concrete is aggregate, which may be natural (gravel or crushed rock with sand) or artificial (blast furnace slag, broken brick and steel shot).

2.2 EFFECT OF PROPERTIES OF CONCRETE BY USING TIMBER WASTE ASH AS PARTIAL REPLACEMENT OF CEMENT

Rosyid Kholilur Rohman & Setiyo Daru Cahyono studied about Concrete has unlimited opportunities for innovative applications, design and construction techniques. Its great versatility and relative economy in filling wide range of needs has made it is very competitive building material.

III. MATERIAL COLLECTION

3.1 GENERAL

This project aims to study the effects of application of timber waste as a sustainable material on concrete's strength properties.

3.2 MATERIALS USED

1. Ordinary Portland Cement

Cement is a binder, a material that sets and hardens and can bind other materials together. Cement is a product including lime as the primary curing ingredient, but it is far from the first material used for cementation. Cement starts to set when mixed with water which causes a series of hydration chemical reactions.

2. Coarse Aggregates

The fractions from 20 mm to 4.75 mm are used as coarse aggregate. The Coarse Aggregates from crushed Basalt rock, conforming to IS: 383 is being used .Also, the properties show minimal presence of Sulphates (SO3) which causes formation of secondary in concrete leading to its expansion and rupture; thus the coarse aggregates are deemed to be innocuous and are suitable for production of concrete.

3. Fine Aggregates

Those fractions from 4.75 mm to 150 micron are termed as fine aggregate. The river sand and crushed sand is being used in combination as fine aggregate conforming to the requirements of IS: 383-1987.

4. Water

This is the least expensive but most important ingredient of concrete. The quantity and quality of water required to be looked in to very carefully. It should be free from organic matter and the pH value should be between 6 to 7

5. Timber waste.

The timber waste is a light weight material compare to the fine aggregate which makes the structure more light in weight, less costly and environment friendly. The timber waste is replaced in varying proportion in place of sand (0%, 5%, 10%, 15%, and 20%).

IV. RESULT AND DISCUSSION

To study and compare the behavior of concrete using timber waste as the replacement of fine aggregate, various experimental investigations as mentioned above were carried out on concrete samples for their strength and workability properties. To compare the test results, control concrete and timber waste replaced concrete were tested for all its replacements

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The concrete samples were casted with mix proportion of M30 grade concrete. The tests were carried out after 7, 14 and 28 days of water curing. Summary of the test result were discussed and recorded in tables. The percentage variation in properties of concrete using timber waste as partial replacement of fine aggregate, with respect to that of normal concrete is also tabulated for comparative study.

4. TEST ON CONCRETE

4.1 TESTS ON FRESH CONCRETE

SLUMP CONE TEST

A Slump test is a method used to determine the consistency of concrete. The consistency, or stiffness, indicates how much water has been used in the mix. The stiffness of the concrete mix should be matched to the requirements for the finished product quality.

- Slump is measurement of concrete's workability, or fluidity.
- It's an indirect measurement of concrete consistency or stiffness.
- Workability of the concrete in slump cone test is 110mm.

Table 1. SLUMP VALUE

Workability	Slump value	use
Low	25 – 75	Foundation
Medium	50 – 120	RCC
High	100 – 220	Pumping
Very High	Collapse	Very raise pumping /delay concreting

4.2 TEST ON HARDENED CONCRETE

4.2.1 COMPRESSIVE STRENGTH TEST

This test is considered as one of the most important properties of concrete and it is often used as an index of the overall quality of concrete. For this, the cubes were tested for its compressive strength at the age of 7th, 14th & 28th days. From the test results, it was observed that the strength of concrete which contains timber waste slightly higher than the conventional concrete up to 20 % replacement of timber Waste for river sand . Below listed tables and graphs shows the relationship between the no. of days and its mean compressive strength.

Figure 1. COMPRESSION STRENGTH TESTING

4.2.2 FLEXURE TEST

The prism specimens were tested for its flexural strength at the age of 7, 14 & 28th days. The test result shown in table revealed that flexural strength of timber waste replaced concrete and standard concrete. Chart shows the relation between no. of days and its mean flexural strength of prism.

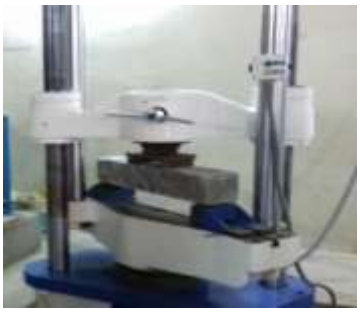

Figure 2. FLEXURAL STRENGTH TESTING

4.2.3 SPLIT TENSILE TEST

The cylindrical specimens were tested for its split tensile strength at the age of 7, 14 & 28th days. The test result shown in table revealed that split tensile strength of timber waste replaced concrete and standard concrete. Chart shows the relation between no. of days and its mean split tensile strength of cylinders.

Figure 3. SPLIT TENSILE TESTING

4.3 TEST RESULTS

4.3.1. 7TH DAY TEST RESULTS

Table 2. 7TH DAY TEST RESULTS

SL. NO	Percentage of Timer Waste replacement	Compressive Strength (N/mm^2)	Flexural Strength (N/mm^2)	Tensile Strength (N/mm^2)
1.	0	24.27	3.545	3.24
2.	10	24.62	3.695	3.50
3.	15	24.95	3.805	3.78
4.	20	25.97	3.890	3.94
5.	25	24.67	3.830	3.66

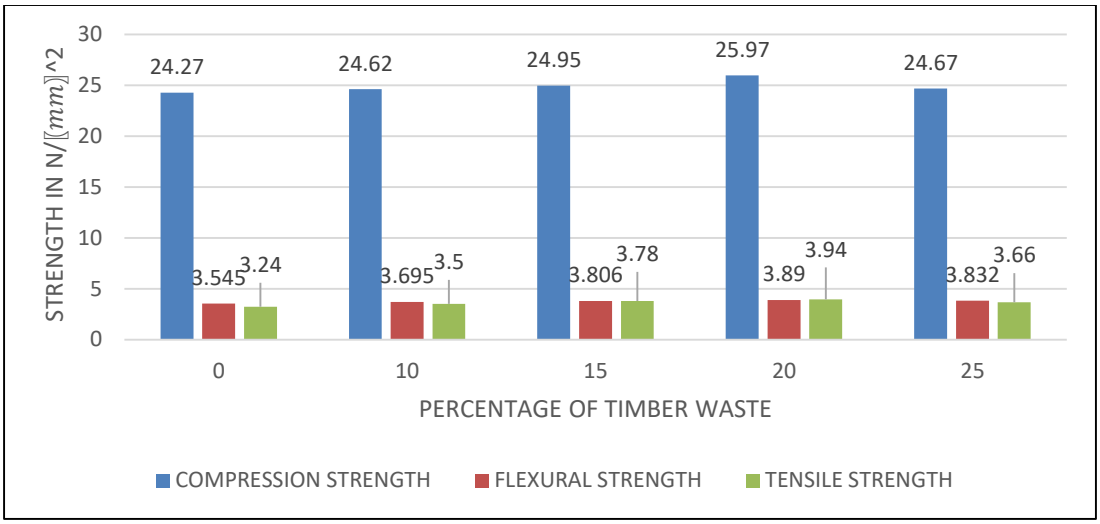

Fig 4. TEST RESULTS AFTER 7^{th} DAY

4.3.2 14TH DAY TEST RESULTS

Table 3. 14TH DAY TEST RESULTS

SL. NO	Percentage of Timber Waste replacement	Compressive Strength (N/mm^2)	Flexural Strength (N/mm^2)	Tensile Strength (N/mm^2)
1.	0	34.27	4.290	3.91
2.	10	34.76	4.395	4.13
3.	15	35.02	4.505	4.32
4.	20	35.86	4.725	4.58
5.	25	34.86	4.550	4.21

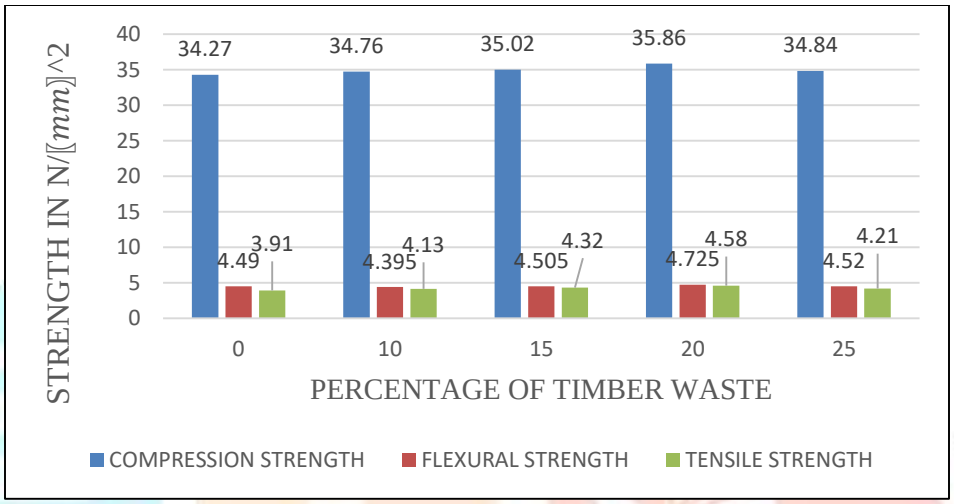

Fig 5. TEST RESULTS AFTER 14TH DAY

4.3.3 28TH DAY TEST RESULTS

Table 4. 28TH DAY TEST RESULTS

SL. NO	Percentage of Timber Waste replacement	Compressive Strength (N/mm^2)	Flexural Strength (N/mm^2)	Tensile Strength (N/mm^2)
1.	1.	0	38.43	4.51
2.	2.	10	39.02	4.63
3.	3.	15	39.89	4.77
4.	4.	20	40.31	4.98
5.	5.	25	39.02	4.80

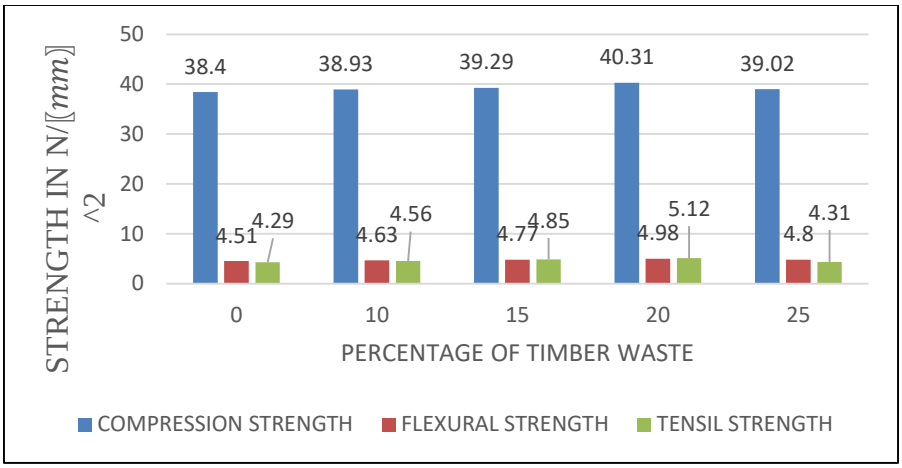

Fig 6. TEST RESULTS AFTER 28TH DAYS

V. CONCLUSION

Based on the limited study carried out on the strength behaviour of saw dust the following conclusions are drawn:

- At the initial ages, with the increase in the percentage replacement of timber waste, the strength as well as compressive strength increases.
- Moreover with the use of timber waste, the weight of concrete reduces, thus making the concrete lighter which can be used as a light weight construction material in many civil engineering purposes.
- The test results indicate that it is possible to manufacture concrete containing timber waste with characteristics similar to those of natural sand aggregate concrete provided that the percentage of timber waste as fine aggregate is limited to 20% respectively.

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