

Experimental Study of Concrete by Partial Replacement of Fine Aggregate with Sawdust

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ABSTRACT: In this project main objective is to study the partial replacement of the fine aggregate with Wooden Dust with the varying proportion in the concrete and to check the different properties of the concrete by comparing with the controlled concrete. The replacement of Fine aggregate (sand) with certain wooden dust in concrete that makes the structure more light in weight. For making M20 grade of concrete replacing sand with wood dust in proportions of 0%, 5%, 10%, and 25%. The Workability, strength and durability test are studied in this project. The most important properties of concrete is the compressive strength and Tensile strength. Also, increasing the wooden dust incorporation caused decreases in unit weights and strength values of mortars with a parallel increase in water absorption values at all ages.

I. INTRODUCTION

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. In this topic main aim is to study the partial replacement of the wooden powder dust with the different percentage in the concrete and to check the properties of the concrete by comparing with the normal concrete. The replacement of fine aggregate (sand) with certain wooden powder in concrete that makes the structure more light in weight. The strength, workability and durability test are analysed in this dissertation. The most important properties of concrete is the strength in compressive force. Also, increasing the wooden dust in incorporation 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.

II. MATERIAL USED

2.1 Materials:

Experimental study design was employed with the main research method which involved laboratory testing. This involved preparing samples of concrete mixes containing varying amounts of sawdust and then carrying out appropriate tests to determine the optimum sand replacement amount. Prior to this, physical natural source. properties of both sawdust and sand were determined by laboratory tests. The highlights of the methodology were as below:

2.1 Saw dust:

Sawdust 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. Sawdust's are produced as a small discontinuous chips or small fragments of wood during sawing of logs of timber into different sizes. The chips flow from the cutting edges of the saw blade to the floor during sawing operation.



Figure 2.1: Saw Dust

Table 2.1: chemical characteristics of sawdust

S.NO	constituents	%(by weight)
1	SiO ₂	87
2	Al ₂ O ₃	2.5
3	Fe ₂ O ₃	2.0
4	MgO	0.24
5	CaO	3.50
6	Loss on ignition	4.76

2.2 Portland cement:

The cement used is Ordinary Portland Cement confirming to Indian Standards IS 12269 – 1987 of grade 43. The tests conducted on cement are standard consistency, initial setting time, final setting time, and specific gravity. On mixing the water, cement hardens and hence all the ingredients are bounded together. Portland cement is the most commonly used cement with the composition of alumina, silica, lime, iron, and gypsum.

2.3 Aggregates:

Crushed granite of 20 mm maximum size has been used as coarse aggregate. The sieve analysis of combined aggregates confirms to the specifications of IS 383: 1970 for graded aggregates. The concrete mixtures consist of both coarse and fine aggregates which helps in increasing the strength of concrete. Now a days, sand,

gravel, crushed stone, recycled materials, including blast furnace slag, glass (mostly for decorative purposes), and ground-up concrete are used as aggregates.

2.4 Water:

Mixing water should not contain abominable organic substances or inorganic ingredients in excessive proportions. In this project clean potable water is used. The water in the concrete mix should be clean and free of impurities. The change in water content with respect of cement decides the properties of the cement like how easily the concrete flows, but also affects the final strength of the concrete. Excess water implies to easier flow of concrete, but decreases its strength.

2.5 Fine Aggregates:

Fine aggregate was purchased which satisfied the required properties of fine aggregate required for experimental work and the sand conforms to zone III as per the specifications of IS 383:1970. a) Specific gravity = 2.7

III. MIX DESIGN FOR M20 GRADE OF CONCRETE

3.1 Design Stipulations

Characteristic Compressive Strength required at the end of 28 days: 20N/mm²

Maximum size of Aggregate: 20mm (Angular)

Type of Exposure: severe

Degree of Quality Control: Good

3.2 Test Data for Materials

Specific Gravity of Cement: 3.15

Specific Gravity of Coarse Aggregate: 2.64

Specific Gravity of Fine Aggregate: 2.6

3.3 Target Mean Strength of Concrete

For a tolerance factor of 1.65, the obtained target mean strength for the given grade of concrete = 26.6 N/mm²

3.4 Selection of Water Cement Ratio

The free water cement ratio for the obtained target mean strength is 0.50. This is equal to the value prescribed for Moderate conditions in IS 456.

Table 3.1: The mix proportion

Water	cement	Fine aggregate	Coarse aggregate
0.5	1	1.5	3
186kg	372kg	733.2kg	1060.8kg

IV. EXPERIMENTAL PROGRAM

4.1 Compressive strength:

Strength of concrete structure are often based upon sample testing directly on site whenever concrete pouring is scheduled . simulating concrete testing being done on site samples are subjected to compressive strength tests using a compressive strength tests using a compressive strength machine. Specimens made underwent curing process for a certain number of days and were tested in standard intervals specified . the results indicated that wooden powder cement gravel mix showed high early compressive strength and seem to degrade till it stabilized shown in comparison, the standard mix began low and slowly increased in streng

Table 4.1: compressive strength

S.NO	Sawdust content %	Compressive strength	
		7 days	28 days
1	0	17.5	26.75
2	5	17.75	23.50
3	10	16.25	18.0
4	25	12.0	10.5

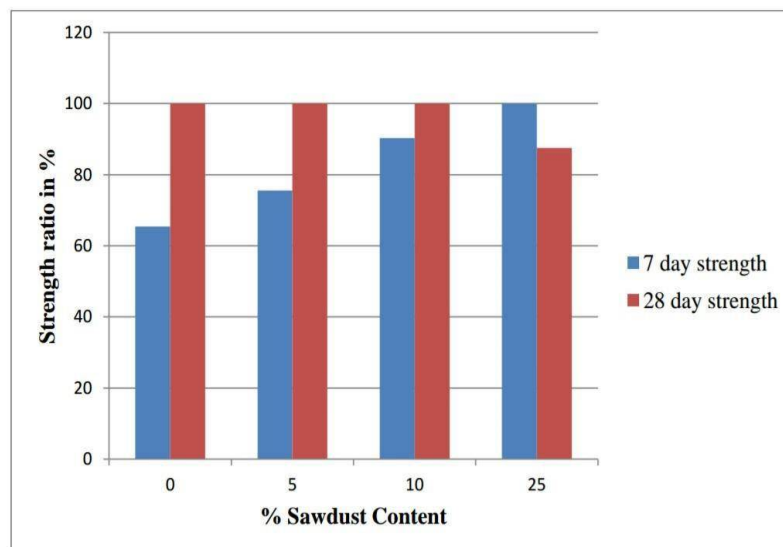


Figure 4.1: variation in strength development

4.2 Tensile strength:

. The cylinders were removed from curing tank and allowed the water on their surface wiped. They were then weighed and their weights recorded. One strip of wood was placed on the base plate of the compression test machine and the specimen laid over it ensuring that the wood was centrally placed. The second strip of wood was placed over the cylinder while ensuring that it was aligned to the one at the bottom. The upper plate of the testing machine was lowered till the top wood strip was held in position. The cylinder was then loaded gradually until failure. The failure load was noted.

Table 4.2: Tensile splitting strength

S.NO	Sawdust content%	Tensile strength for 28 days
1	0	2.46
2	5	2.41
3	10	2.26
4	25	1.91

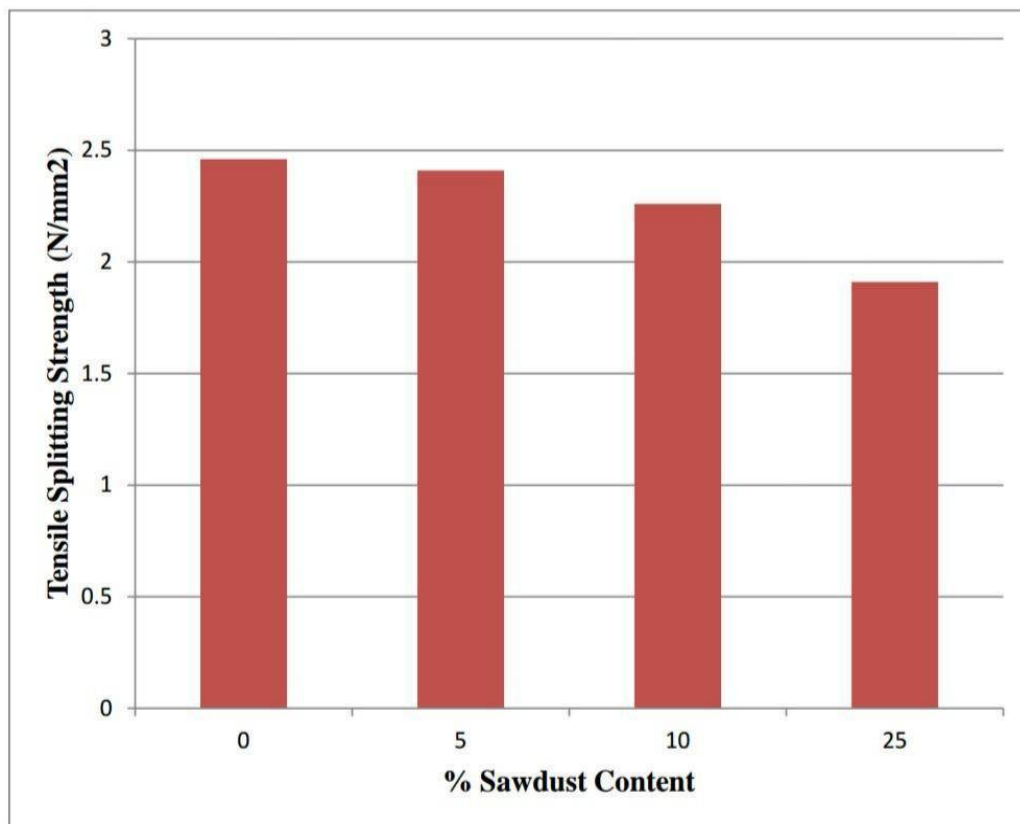


Figure 4.2: variation of tensile splitting strength with increase in sawdust

V CONCLUSION

From the results of the various tests carried out, the following conclusions could be drawn;

- Concrete becomes less workable as the proportion of sawdust increases at a constant water to cement ratio. This could be attributed to the high water demand resulting from the absorbent nature of sawdust.
- The compressive strength of sawdust concrete decreases with increase in amounts of sawdust. This was clearly exhibited by the 28 day strength. 10% partial replacement of sand with sawdust provided suitable strength above the minimum compressive strength for lightweight concrete which is 17N/mm².
- Compressive strength generally increases with curing period. However, for partial replacement beyond 10% this was not the case.
- Sawdust concrete exhibits early development of strength compared to normal concrete.
- The density of concrete decreases as the sawdust levels increased. However, the density requirement of 1480-1840kg/m³ for lightweight concrete was not met.
- The tensile splitting strength of concrete decreases with increase in sawdust amounts.
- Sawdust is a suitable material for use in concrete up to 10% partial replacement. However since at this level of replacement, the concrete is still denser than lightweight concrete, a number of modifications could be made to the sawdust so as to be able to increase its proportion in concrete while maintaining compressive strength above 17N/mm².

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