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RESEARCH ARTICLE OPEN ACCESS

Effect of Sawdust as Fine Aggregate In Concrete Mixture

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Abstract:

The study entitled "Replacement of the fine aggregate with saw dust - An evaluation of strength characteristics of concrete" is done by following the methodology given below M 20 Conventional control mix is prepared with mix proportions as 1:1.5:3.In the next stage, 5% of fine aggregate is replaced with saw dust and cubes, cylinders were casted. Similarly the fine aggregate is replaced with saw dust with percentages up to 15% at an interval of 5%.All these casted cubes and cylinders were cured for 7 and 28 days and are tested to find out the compressive strength and spilt tensile strength for these respective days.

Keywords — **Saw dust, Fine aggregate.**

INTRODUCTION

Concrete is known to be the most widespread structural material due to its quality to shape up in various geometrical configurations. In some conditions, one might assume that normal weight concrete is inconvenient due to its density (2200-2400kg/m3). Replacing partially or entirely the normal weight aggregate concrete with lower weight aggregates produces lightweight aggregate concrete Large increasing amount in the population of the world requires larger establishment of the settlement. Thus new techniques and materials should be developed to construct new buildings. Besides a large number of the settlement security of those buildings against natural disaster is the durability of the construction and also thermal conductivity. Lightweight concrete (LWC) is a very versatile material for construction, which offers a range of technical, economic and environment-enhancing and preserving advantages and is destined to become a dominant material for construction in the new millennium.

LIGHTWEIGHT CONCRETE

One of the disadvantages of conventional concrete is the high self-weight of concrete. Density of the normal concrete is in the order of 2200 to 2600 kg/m3. This heavy self-weight will make it to some extent an uneconomical structural material. Attempts have been made in the past to reduce the self-weight of concrete to increase the efficiency of concrete as a structural material. The light-weight concrete as we call is a concrete whose density varies from 300 to 1850 kg/m3.There are many advantages of having low density. It helps in reduction of dead load, increases the progress of the building, and lowers haulage and handling costs. The weight of a building on the foundation is an important factor in design, particularly in the case of weak soil and tall structures. In framed structures, the beams and columns have to carry loads of floors and walls. If floors and walls are made up of light-weight concrete, it will result in considerable economy. Another most important characteristic of lightweight concrete is the relatively low thermal conductivity, a property which improves with decreasing density. In extreme climatic conditions and also in case of buildings where air-conditioning is to be installed, the use of light-weight concrete with low thermal

conductivity will be of considerable advantage from the point of view of thermal comforts and lower power consumption. The adoption of light-weight concrete gives an outlet for industrial wastes such as clinker, fly ash, slag etc. which otherwise create a problem for disposal. Basically there is only one method for making concrete light i.e., by the inclusion of air in concrete. This is achieved in actual practice by three different ways.

(a) By replacing the usual mineral aggregate by cellular porous or light-weight aggregate.
(b) By introducing gas or air bubbles in mortar. This is known as aerated concrete.
(c) By omitting sand fraction from the aggregate. This is called 'no-fines' concrete.

The Table shows the whole ranges of light-weight concrete under three main groups. Light-weight concrete has become more popular in recent years owing to the tremendous advantages it offers over the conventional concrete. Modern technology and a better understanding of the concrete has also helped much in the promotion and use of light- weight concrete. A particular type of light-weight concrete called structural light-weightconcrete is the one which is comparatively lighter than conventional concrete but at the sameTime strong enough to be used for structural purposes. It, therefore, combines the advantagesof normal normal weight concrete and discards the disadvantages of normal weight concrete.Perhaps this type of concrete will have great future in the years to-come. Out of the three maingroups of light-weight concrete, the light-weight aggregate concrete and aerated concrete are more often used than the 'no-fines' concrete. Light-weight concrete can also be classifiedon the purpose for which it is used, such as structural light weight concrete, non-load bearingconcrete and insulating concrete. The aerated concrete which was mainly used for insulating purposes is now being used for structural purposes sometimes in conjunction with steel reinforcement. The aerated concrete is more widely manufactured and used in the Scandinavian countries; whereas in U.K., France, Germany and U.S.A. owing to theproduction of large scale artificial industrial light-weight aggregate, light-weight aggregatesconcrete is widely used. In some countries the natural dense graded aggregate are either inshort supply or they are available at a considerable distance from the industrial cities. In suchcases the use of locally produced light-weight aggregates in the city area offers moreeconomical solutions. These factors have led to the development and widespread use ofconsiderable varieties of industrial light-weight aggregates of varying quality by trade names such as Leca (expanded clay), Aglite (expanded shale), Lytag (sintered pulverised fuel ash),Haydite (expanded shale).

Fig 1.1 Light weight concrete

SAW DUST:

Sometimes saw dust is used as a light-weight aggregate in flooring and in the manufacture of precast products. A few difficulties have been experienced for its wide-spread use. Saw dust affect adversely the setting and hardening of Portland cement owing to the content of tannins and soluble carbohydrates. With saw dust manufactured from soft wood, the addition of lime to the mix in an amount equal to about 1/3 to 1/2 the volume of cement will counteract this. But the above method i.e., addition of lime is not found effective when the saw dust is made from some of the hard woods. Others methods such as boiling in water and ferrous sulphate solutions also have been tried to remove the effect of tannins, but the cost of the process limits its application. To offset the delay in setting and hardening, addition of calcium chloride to the extent of about 5 per cent by weight of cement has been found to be successful. The shrinkage and moisture movement of saw dust is also high. The practical mix is of the ratio of 1 : 2 to 1 : 3 i.e., cement to saw dust by volume. Saw dust concrete has been used in the manufacture of precast concrete products, joint less flooring ad roofing tiles. It is also used in concrete block for holding the nail well. Wood aggregate also has been tried for making concrete. The wood wool concrete is made by mixing wood shavings with Portland cement or gypsum for the manufacture of precast blocks. This has been used as wall panels for acoustic purposes.

MATERIALS:

The following materials are used for the present work.

1. Cement
2. Fine aggregate
3. Coarse Aggregate
4. Water
5. Sawdust

Saw Dust:

Saw dust

The small particles of wood or other material that fall from an object being sawed.Sawdust or wood dust is a by-product of cutting, grinding, drilling, sanding, or otherwise pulverizing wood with a saw or other tool it is composed of fine particles of wood. It is also the by-product of certain animals, birds and insects which live in wood, such as the woodpecker and carpenter ant.There are some properties of saw dust.

TESTING ON MATERIALS

Tests on Cement

The following tests are done on the cement.

a. Fineness test
b. Specific gravity test
c. Normal consistency
d. Initial setting time and final setting time

Test on Fine Aggregate

The following tests are conducted to know the properties of Fine Aggregate:

a. Grading of Sand
b. Specific Gravity & Water Absorption Test
c. Bulking of sand
d. Moisture content of sand

Tests on Coarse Aggregate

The following tests are conducted to know the properties of Coarse Aggregate:

a. Specific Gravity & Water Absorption Test
b. Aggregate Crushing value Test
c. Aggregate Impact value Test

Tests on saw dust

The following tests are conducted to know the properties of Coarse Aggregate.

a. sieve analysis of the saw dust
b. specific gravity of saw dust
c. Bulking of saw dust

METHODOLOGY

The study entitled "Replacement of the fine aggregate with saw dust - An evaluation of strength characteristics of concrete" is done by following the methodology given below.

1. M 20 Conventional control mix is prepared with mix proportions as 1:1.5:3.
2. In the next stage, 5% of fine aggregate is replaced with saw dust and cubes, cylinders were casted.
3. Similarly the fine aggregate is replaced with saw dust with percentages up to 15% at an interval of 5%.

4. All these casted cubes and cylinders were cured for 7 and 28 days and are tested to find out the compressive strength and spilt tensile strength for these respective days.

The overall work in a glance is provided below:

In achieving the objective of the work, the following procedural steps are followed.

1. Batching
2. Mixing
3. Casting of cubes and cylinders
4. Compaction
5. Curing
6. Testing

TESTING OF CONCRETE-COMPRESSIVE STRENGTH

Compressive test is the most common test conducted on hardened concrete, partly because it is easy to perform, and partly because most of the desirable characteristic properties of concrete and qualitatively related to its compressive strength.

Fig 4.7 Testing of concrete compressive strength

The compressive strength is carried out on a specimen cubical or cylindrical in shape. Prism is also sometimes used, but it is not common in our country. Sometimes the compressive strength of concrete is determined by using parts of a beam tested in flexure. The end parts of beam are left intact after failure in flexure and because the beam is usually of square cross section, this part of beam could be used to find out the compressive strength.

The cube specimen is of 15×15×15cm. If the largest nominal size of the aggregate does not exceed 20 mm, 10 cm size cubes may also be used as alternative. Cylindrical test specimens have a length of twice that of diameter. They are 15 cm in diameter and 30 cm long. Smaller test specimens may be used but a ratio of the diameter of the specimen to maximum size of aggregate, not less than 3 to 1 in is maintained.
The results are presented in detail, in the next chapter.

RESULTS AND DISCUSSION

Based on the experimental investigations, the resultsof cubes are presented below:

Table 5.1 0% saw dust replaced in concrete cubes compressive strength:

No. of days	cube numbers	weight of cube	load in KN	compressive strength in N/mm2	Avg.compressive strength in N/mm2
7	1	8.18	490	21.78	22.22
	2	8.12	500	22.22	
	3	8.14	510	22.67	
28	1	8.12	680	30.22	29.33
	2	8.16	660	29.33	
	3	8.14	640	28.44	

The average compressive strength for 7 days=22.22 N/mm2.
The average compressive strength for 28 days=29.33 N/mm2.

Table 5.2 5% of saw dust replaced in concrete cubes compressive strength:

No. of days	cube numbers	weight of cube	load in KN	compressive strength in N/mm2	Avg.compressive strength in N/mm2
7	1	7.98	490	21.78	21.8
	2	8.08	480	21.33	
	3	8.06	500	22.22	
28	1	8.06	630	28.00	27.70
	2	8.015	620	27.56	
	3	8	620	27.56	

The average compressive strength for 7 days =21.8N/mm2.
The average compressive strength for 28 days=27.70 N/mm2.

Table 5.3 10% saw dust replaced in concrete cubes compressive strength:

No. of days	cube numbers	weight of cube	load in KN	compressive strength in N/mm2	Avg.compressive strength in N/mm2
7	1	7.98	462	20.53	20.9
	2	8	443	19.69	
	3	8.06	505	22.44	
28	1	7.97	580	25.78	26.37
	2	7.99	591	26.27	
	3	8.05	609	27.07	

The average compressive strength for 7 days =20.9 N/mm2.
The average compressive strength for 28 days=26.37 N/mm2.

Table 5.4 15% saw dust replaced in concrete cubes compressive strength:

No. of days	cube numbers	weight of cube	load in KN	compressive strength in N/mm2	Avg.compressive strength in N/mm2
7	1	7.96	435	19.33	19.1
	2	8.02	423	18.80	
	3	7.65	430	19.11	
28	1	7.86	530	23.56	24.15
	2	8.05	560	24.89	
	3	8	540	24.00	

The average compressive strength for 7 days =19.1 N/mm2.
The average compressive strength for 28 days=24.15 N/mm2.

Table 5.5 20% saw dust replaced in concrete cubes compressive strength:

No. of days	cube numbers	weight of cube	load in KN	compressive strength in N/mm2	Avg.compressive strength in N/mm2
7	1	7.5	400	17.78	18.0
	2	7.55	410	18.22	
	3	7.65	403	17.91	
28	1	7.54	500	22.22	22.67
	2	7.56	510	22.67	
	3	7.45	520	23.11	

The average compressive strength for 7 days =18.0 N/mm2.

The average compressive strength for 28 days=22.67 N/mm2.

The results of cylinders are presented below:

Table 5.6 0% saw dust replaced in concretecylinderssplit tensile strength:

No. of days	cylinders numbers	weight of cylinders	load in KN	split tensilestrength in N/mm2	Avg. split tensilestrength in N/mm2
7	1	12.826	120	1.70	1.48
	2	12.787	103	1.46	
	3	12.84	90	1.27	
28	1	12.72	140	1.98	2.08
	2	12.84	150	2.12	
	3	12.8	152	2.15	

The average split tensile strength for 7 days =1.48 N/mm2.

The average split tensile strength for 28 days=2.08 N/mm2.

Table 5.7 5% saw dust replaced in concretecylinderssplit tensile strength:

No. of days	cylinders numbers	weight of cylinders	load in KN	split tensilestrength in N/mm2	Avg. split tensile strength in N/mm2
7	1	12.4	80	1.13	1.23
	2	12.36	90	1.27	
	3	12.36	90	1.27	

28	1	12.6	130	1.84	1.82
	2	12.65	130	1.84	
	3	12.67	125	1.77	

The average split tensile strength for 7 days =1.23 N/mm2.

The average split tensile strength for 28 days=1.82 N/mm2.

Table 5.8 10% saw dust replaced in concretecylinderssplit tensile strength:

No. of days	cylinders numbers	weight of cylinders	load in KN	split tensile strength in N/mm2	Avg. split tensile strength in N/mm2
7	1	12.32	75	1.06	1.00
	2	12.44	72	1.02	
	3	12.3	65	0.92	
28	1	12.35	120	1.70	1.69
	2	12.5	114	1.61	
	3	12.48	125	1.77	

The average split tensile strength for 7 days =1.00 N/mm2.

The average split tensile strength for 28 days=1.69 N/mm2

Table 5.9 15% saw dust replaced in concretecylinderssplit tensile strength:

No. of days	cylinders numbers	weight of cylinders	load in KN	split tensilestrength in N/mm2	Avg. split tensile strength in N/mm2
7	1	11.83	78	1.10	1.00
	2	11.92	74	1.05	
	3	12.1	61	0.86	
28	1	12.3	110	1.56	1.49
	2	11.56	110	1.56	
	3	11.88	95	1.34	

The average split tensile strength for 7 days =1.00 N/mm2.

The average split tensile strength for 28 days=1.49 N/mm2.

Table 5.10 20% saw dust replaced in concretecylinderssplit tensile strength:

No. of days	cylinders numbers	weight of cylinders	load in KN	split tensilestrength in N/mm2	Avg. split tensilestrength in N/mm2
7	1	11.8	75	1.06	0.99
	2	11.5	72	1.02	
	3	11	62	0.88	
28	1	11.4	100	1.41	1.41
	2	11	102	1.44	
	3	11.12	98	1.39	

The average split tensile strength for 7 days =0.99N/mm2.

The average split tensile strength for 28 days=1.41N/mm2.

CONCLUSION

Saw Dust is a waste material which is coming from cutting of wood sawing of wood. This is available in sizeable quantities. The present study concludes that saw Dust is a potential mineral for preparation of light weight concrete. The environmental issues associated with disposal of this waste can be appropriately addressed by using it as a light weight aggregate concrete.

The following conclusions are drawn based on the outcomes of the experimental investigation using saw dust at various proportions in target concrete.

Based on the results of the experimental investigations, following conclusions could be as follows:

The strength and durability characteristics of concrete mixtures have been computed in the present work by replacing 5%, 10%, 15% and 20% sand with the saw dust. On the basis of present study, following conclusions are drawn.

The cost of concrete is less than conventional concrete.The concrete becomes environment friendly, due to use of waste industrial material.

Concrete produced using sawdust as partial replacement of fine aggregate has influence on the properties of the concrete.

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