Partial Replacement Of Sand With Sawdust In Concrete

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Abstract - *In our project we use saw dust as a waste material for partial replacement of sand in concrete for modifying its properties. In the concrete mixes sand was replaced at 5%, 10%, 15%, 20% and 25% by weight and effects of replacement on concrete is observed. Use of saw dust in concrete permits disposal of waste (saw dust) and make concrete light in weight. Concrete, cubes measuring 150 x 150 x 150 mm, beams of sizes 550 x 100 x 100 mm and cylinder 15 cm in diameter and 30 cm in height were cast and their compressive, flexural strength and split tensile strength is evaluated respectively after 7, 14 and 28 days. Metakaolin is use as an admixture which possess cementious properties which provides good bonding between saw dust and ingredient of concrete.*

Keywords: **Saw dust, Metakaolin, Compressive strength, Split tensile strength, Flexural strength.**

1. INTRODUCTION

Concrete is used in worldwide in all major and minor civil engineering projects. The ingredients which are used for making concrete provides durability and strength to concrete. These ingredients are sand, cement, aggregates, water in definite water cement ratio for better performance of concrete. Use of waste material (saw dust) in place of sand up to a certain proportion with all other ingredients modifies the properties of concrete. However, by reducing content of sand and using waste material makes concrete light in weight.

Generally concrete is a composite mixture of binding material, filler material (coarse & fine aggregate) & water; which combines the whole mass. The aim of concrete mix design is to achieve maximum durability and compressive strength as possible as without any compromise with the quality. Engineers and scientists are further trying to increase its limits with the help of innovative chemical admixtures and various supplementary binding & filler materials along with modified manufacturing techniques. Now a day's lots of technology is used in the field of concrete technology that modifies concrete properties.
Saw dust is waste which when burnt, produce lot of carbon emissions which pollutes the environment. If this waste is used in concrete, then there will be less emissions of carbon dioxide in environment; as we are using the saw dust material in concrete. The replacement of fine aggregates with saw dust can be beneficial for the building components. Thus, the properties such as workability, compression test, elongation index etc. of concrete changes.

2. OBJECTIVES

1) To prepare light weight saw dust concrete of nearly equal advantages like conventional concrete.

2) To prepare economical concrete.

3) Good disposal of waste (Saw dust).

3. SCOPE

It has many advantages over traditional concrete, such as,

- Internal curing due to the absorbed water in the saw dust.
- Better heat dissipation and heat insulation property.
- Efficient in case of acoustics.
- Lack of availability of fine aggregates can be compensated.

4. MATERIALS & TESTS

4.1. Sawdust

Sawdust is obtained from wood. The saw dust consist of chippings from various hardwoods. It was sundried and kept in waterproof bags .The sawdust is sieved through 1.18mm.

Fig-1: Sawdust

Table-1: Chemical characteristics of saw dust

Sr.No.	Constituents	Percentage (By weight)
1.	SiO2	87
2.	Al2O3	2.5
3.	Fe2O3	2.0
4.	MgO	0.24

5.	CaO	3.75
6.	Loss of Ignition(LOI)	4.76

i. Specific gravity of sawdust

The test was conducted by density bottle. The calculated Specific gravity of sawdust is 0.91.

ii. Water absorption of sawdust

The calculated Percentage of water absorption is 47%.

iii. Moisture content test on sawdust

The calculated moisture content of sawdust is 10%.

4.2. Cement

i. Standard consistency

The obtained value for standard consistency is 31%.

ii. Initial and final setting time

As per IS 1489 part 1 the minimum initial setting time is 30 min and maximum final setting time is 600 min. The obtained initial and final setting time is 110 min and 310 min respectively.

iii. Secific gravity of cement

Le Chatlier's flask and Gravity bottle is used for finding the specific gravity of cement.

As per IS 2720-part 3 specific gravity of Ordinary Portland cement is near to 3.15.

4.3. Water

Tap water was used for this study. The water was clean from visible impurities.

4.4. Fine aggregates

i. Specific gravity of fine aggregate

The calculated specific gravity of fine aggregate is 2.5.

ii. Grain size distribution of fine aggregate

The selected fine aggregate belongs to grading zone II.

iii. Silt content test on fine aggregates

The permissible value in silt content is to be around 6%.The calculated value for silt content is 3.03%.

iv. Moisture content of fine aggregates

The calculated value for moisture content is 1.93%.

4.5. Coarse aggregate

i. Specific gravity of coarse aggregate

Specific gravity of coarse aggregate 2.71 as per IS codes. And the calculated specific gravity is 2.67.

ii. Flakiness index

The flakiness index of given particles Range is 24%.

iii. Elongation index

The elongation index of given particles Range is 30%.

iv. Water absorption test

Calculated percentage of water absorption is 2.41 %.

4.6. Admixture

i. Metakaolin

Metakaolin is a chemical phase that forms due to thermal treatment of kaolinite. Kaolinite has chemical composition of AL_2O_3: $2SiO_2.H_2O$. It is white in colour and act as a pozzolanic material.

Table-2: Chemical composition of Metakaolin

Composition	Concentration (%)
Silica(SiO_2)	53
Alumina(Al_2O_3)	45
Iron Oxide (Fe_2O_3)	1.1
Titania(TiO_2)	0.65
Lime(CaO)	0.09
Magnesia(MgO)	0.03
Soda(Na_2O)	0.10
Potash(K_2O)	0.03

5. EXPERIMENTAL WORK

i. Concrete mix design

M25 grade with nominal concrete mix having proportion of (cement: fine aggregate: coarse aggregate) 1:1.62:2.83 by weight is prepared. The calculated water cement ratio used is 0.48. It was proposed to investigate the properties of concrete and were casted with partial replacement of sand with 5%, 10%, 15%, 20% and 25% of sawdust.

ii. Casting details

Total number of 30 cubes of size 150 mm X 150 mm X 150 mm were casted for compressive strength test. For split tensile strength test 5 cylindrical specimens of diameter 150 mm and height of 300 mm was casted. For flexural strength test 5 beam specimens of width, depth and length of the beam were 100 mm, 100 mm and 500 mm respectively.

iii. Testing

- **Compressive strength test**

The compressive strength test is the most important test conducted to determine the load carrying capacity of the concrete. The test was conducted in compression testing machine of 2000 KN capacity after curing period of 28 days under normal room temperature.

- **Split tensile strength test**

This is an indirect test to determine the tensile strength of cylindrical specimens. Splitting tensile strength tests were carried out at the age of 28 days for the concrete cylinder specimens of size 150 mm diameter and 300 mm length, using compression testing machine of 2000 KN capacity. The load was applied gradually till the specimen splits and readings were noted.

- **Flexural strength test**

Flexural strength test is done on universal testing machine (UTM) which have the capacity of 1000 KN. The test were done at the age of 28 days for the casted beams. The central one point load was applied for the test.

6. RESULT AND DISCUSSION

Table-3: Compressive strength for cubes

Mix	Compressive strength(N/mm2)
Normal Mix	26.44
5%	21.105
10%	12.445
15%	10.07
20%	7.25
25%	5.12

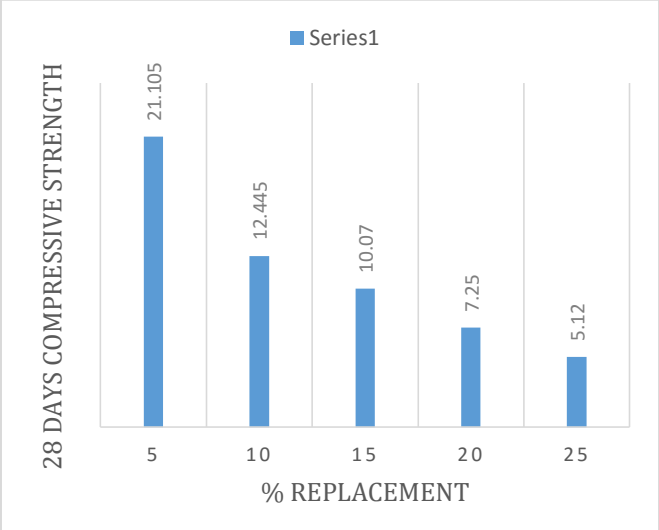

Fig-2: Compressive strength comparison for cubes

- With increase in percentage replacement of sawdust by weight with sand; compressive strength gradually decreasing.
- However satisfactory results are obtained at 5% replacement.

Table-4: Split tensile strength for cylinder

Mix	Splitting tensile strength(N/mm^2)
Nominal Mix	4.33
5%	3.53
10%	2.02
15%	1.13
20%	1.07
25%	0.91

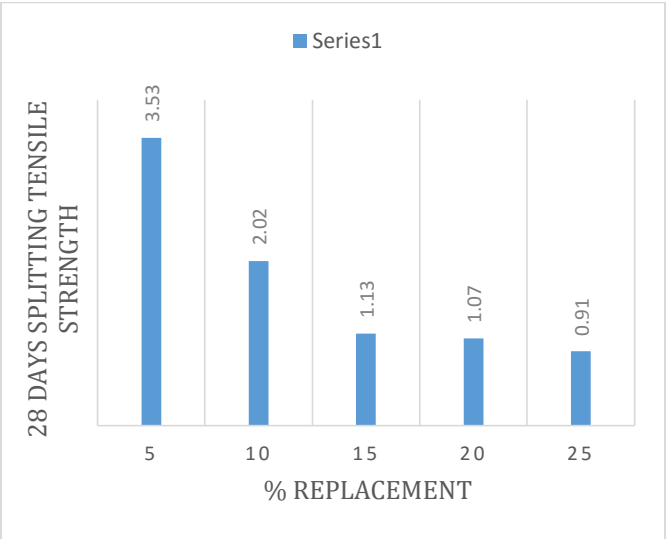

Fig-3: Splitting tensile strength comparison for cylinder

- With increase in percentage replacement of sawdust by weight with sand, splitting tensile strength goes on decreasing.
- Maximum strength is achieved at 5% replacement as compared to others.

Table-5: Flexural strength for beams

Mix	Flexural strength(N/mm²)
Nominal Mix	4.38
5%	2.43
10%	2.903
15%	2.363
20%	1.485
25%	1.237

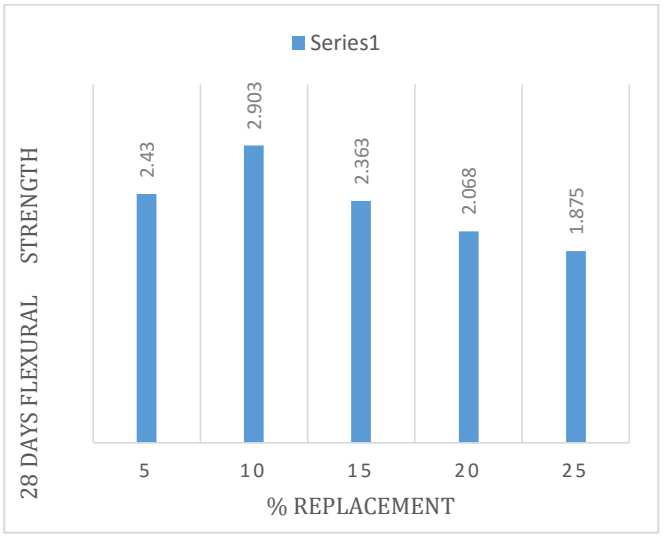

Fig-4: Flexural strength comparison for beams

- At 5 % replacement flexural strength is decreases, but at 10 % replacement sudden increase in strength is occurs.
- The flexural strength of sawdust concrete is gradually decreases after 10% replacement.
- Satisfactory results are obtained at 10 % replacement.

7. CONCLUSION

Based on the investigations on sawdust, the following conclusions were made:-

- For compressive strength test, 5 % replacement by weight shows satisfactory results. i.e. (21.105 N/mm²).
- For splitting tensile strength test, 5 % replacement by weight shows satisfactory results. i.e. (3.53 N/mm²).
- For flexural strength test, 10 % replacement by weight shows best results, i.e.(2.903 N/mm²)
- There is reduction in density of sawdust concrete with increase in percentage of sawdust in concrete.
- Use of sawdust as a waste in concrete decrease the pollution which is caused after burning of sawdust.

8. REFERENCES

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