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Utilization of Saw Dust in Cement Mortar & Cement Concrete

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ABSTRACT

The use of sand (river sand) plays a major role in all type of construction, especially in cement concrete & cement mortar. The ultimate aim of the saw dust concrete is to recycle the waste material from saw mill & utilizing in concrete ingredients in the state of partial replacement.

Sequentially, the shortage of river sand is partially rectified by the replacement of sawdust for the sand. So, the river sand abundantly gets destructed due to the huge consumption. To enhance the progress of river sand, we prefer a scope on saw dust concrete.

In this project, we introduce two reproductive form of sawdust, and we named as Dry Sawdust (DSD) and Sawdust Ash (SDA). Dry sawdust was used partially replacement for fine aggregate and Sawdust Ash was used for partially replacement for cement.

Dry Sawdust & Sawdust Ash were mixed with concrete separately, in this study, totally 16 mortar cubes & 48 concrete cubes are casted. And these are subjected to test, such as Slump test & Compressive test, then it is compared with normal mix of concrete & mortar.

The application of saw dust mix for residential building structural member such as column, beam, slab and foundation and plastering are also elicited. The study brings out the fact that it also more economical than the typical cement concrete.

1. INTRODUCTION

1.1. GENERAL

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, 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 large number of the settlement security of those building 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 . With the increasing high building construction, the construction weight becomes important and this problem can be solved using lightweight concrete. On the other hand lightweight concrete is its low density, allowing construction on ground with only moderate bearing capacity, the need for less reinforcement.

Structural lightweight aggregate concrete is an important and versatile material in modern construction. It has many and varied applications: multistory building frames and floors, curtain walls, shell roofs, folded plates, bridges, pre stressed or precast elements of all types, and others. In many cases the architectural expression form combined with functional design can be achieved more readily in structural lightweight concrete than in any other medium.

Sawdust has been used in concrete, but not widely. Although seriously limited by its low compressive strength. It has serious limitations that must be understood before it is put to use. Within these limitations, the advantages that sawdust concrete are offers considerable reduction in weight of the structure, thereby reducing the dead loads transmitted to the foundation, high economy when compared to and normal weight concrete.

1.2.SAWDUST

Sawdust is the waste material from the timber saw mills. Where the timbers are sawed for the specific purpose and the waste powder which extract from them is called saw dust.

The sawdust is acquired in abundance in tropical countries. This sawdust is used as fuel limitedly. The main method of disposal is by open burning method.

In some countries, the usage of sawdust for the construction has been in process for several years ago. This is the light weight material which can be carried

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easily. The physical and chemical properties of the sawdust will not be same and it will be varies from one tree to another tree.

In this project, the sawdust is carried out from sawmill in two forms

1. Powder form
2. Chips form

The powder form sawdust is used for replacement of fine aggregate with some treatment; this is named as Dry Sawdust. The chips form or skin form of sawdust is used to replacement for cement after a burning process this form of sawdust is named as Sawdust Ash.

1.1.1.SAWDUST MORTAR

By using the Dry sawdust we may prepare the mortar which is made by mixing the sawdust with sand and cement at certain ratio. According to the ratio of adding Dry Sawdust, the strength of the mortar will be varied.

1.1.2.SAWDUST CONCRETE

The concrete which is made by addition of sawdust is called sawdust concrete. In this type of concrete the Dry Sawdust is replaced partially for the aggregate and Sawdust Ash was replaced partially for the cement.

INTERNATIONAL JOURNAL OF SCIENTIFIC & ENGINEERING RESEARCH, VOLUME 6, ISSUE 4&423-2015
ISSN 2229-5518

CHAPTER - 2

LITERATURE REVIEW

2. LITERATURE REVIEW

- THE PROPERTIES OF CEMENT-SAWDUST MORTARS, PLAIN AND WITH VARIOUS ADMIXTURES by S. H. GRAF and R. H. JOHNSON
  Bulletin Sen , No. 3 September, 1930

Engineering Experiment Station Oregon State Agricultural College, Corvallis.

Published by authority of the State Board of Higher Education

This investigation covers the practicability of using sawdust in Portland cement mortar and includes the effect of incorporating sand and certain other materials into the mixtures. From a consideration of the uses for which this material may be employed, the more important properties are the compressive and tensile strengths and the thermal conductivity. Tests were made on these points and also on the resistance of the material toward certain corrosive agents.

- SAWDUST ASH (SDA) AS PARTIAL REPLACEMENT OF CEMENT by C.MARTHONG,
  Lecturer, Civil Engineering Department, Shillong Polytechnic, Meghalaya, India, 793008.

International Journal of Engineering Research and Applications (ijera) vol. 2, issue4, July-august 2012, pp.1980-1985

Important oxide content was 65.45% by weight of SDA and has a pH value of 11.12, which shows that it's alkaline in nature. This shows that SDA has a significant physical and chemical property that encourages its uses as a pozzolanas.

- INVESTIGATIONS ON SAWDUST AND PALM KERNEL SHELLS AS AGGREGATE REPLACEMENT by F.A. OLUTOGE
  Department of Civil Engineering, University of Ibadan, Ibadan, Nigeria

A possibility exists for the partial replacement of sand and granite with sawdust and palm kernel shell in the production of lightweight concrete slabs. Organic materials are subjected to deterioration over time hence sawdust and palm kernel shell concrete applications should be regularly maintained and replaced when necessary.

- DEVELOPMENT OF SAWDUST CONCRETE FOR BLOCK MAKING by Dr. R. SRI RAVINDRARAJAH
  Centre for Infrastructure Research, University of Technology, Sydney, Australia

Sawdust is an ideal filler material to produce lightweight concrete blocks. Optimum mix proportions may depend on sawdust type

INTERNATIONAL JOURNAL OF SCIENTIFIC & ENGINEERING RESEARCH, VOLUME 6, ISSUE 4&423-2015
ISSN 2229-5518

CHAPTER - 3

CHEMICAL COMPOSITION OF SAWDUST

3. CHEMICAL COMPOSITION OF SAWDUST

3.1.CHEMICAL COMPOSITION OF SAWDUST ASH (SDA)

Table: 3.1

Elements	SDA % by weight	OPC % by weight
Specific gravity	2.51	3.14 (33 OPC) 3.15 (43 OPC) 3.20 (53 OPC)
Moisture contents (% by weight)	2.16	0.344
Loss on ignition (g/cm3)	3.67	1.05
pH	11.12	12
SiO2	50.20	20.70
AL2O3	1.02	5.75
Fe2O3	14.23	2.50
CaO	5.45	64.00
MgO	0.09	1.00
MnO	5.60	0.05
Na2O	0.07	0.20
K2O	9.57	0.60
P2O5	0.56	0.15
SO3	0.58	2.75

Table: 3.2

3.2. CHEMICAL COMPOSITION OF DRY SAWDUST (DSD)

Elements	SDA % by weight	OPC % by weight
Specific gravity	5.10	3.14 (33 OPC) 3.15 (43 OPC) 3.20 (53 OPC)
Loss on ignition (g/cm3)	96.22	8.20
pH	9.9	12
SiO2	1.17	20.70
Al2O3	2.38	5.75
Fe2O3	0.23	2.50
CaO	0.0	64.00
MgO	0.0	1.00
Na2O	0.0	0.20
K2O	0	0.60
Cl	0	0.006
SO3	0	2.75

INTERNATIONAL JOURNAL OF SCIENTIFIC & ENGINEERING RESEARCH, VOLUME 6, ISSUE 4&4 23-2015
ISSN 2229-5518

CHAPTER – 4

BENEFITS OF SAWDUST CONCRETE

4. BENEFITS OF SAWDUST CONCRETE

4.1. BENEFITS OF SAWDUST CONCRETE

Sawdust concrete has several unique characteristics which make it competitive among other building materials:

1. Sawdust concrete is made of green, ecologically pure stuff.
2. Sawdust Concrete controls interior humidity level.
3. Sawdust Concrete is frost proof.
4. Sawdust Concrete has favorable thermal and sound-proofing properties.
5. Sawdust Concrete is not subject to mold and fungi.
6. Sawdust Concrete is light weight.
7. It is an economical alternative to conventional building concrete method and material.
8. Due to material's inert nature, it does not react with any ingredients of concrete and steel.
9. It can save labor and natural resources.
10. At the end of its initial service life, concrete can be crushed and reused as aggregate for new concrete continuing the cycle of environmental benefits.

Larger volume of concrete can be handled by lighter equipment with less wear and tear on the equipment.

INTERNATIONAL JOURNAL OF SCIENTIFIC & ENGINEERING RESEARCH, VOLUME 6, ISSUE 4&423-2015
ISSN 2229-5518

CHAPTER-5

MATERIALS AND METHODOLOGY

5. MATERIALS AND METHODOLOGY

5.1. PRELIMINARY TEST

5.1.1 TEST ON SAWDUST ASH

5.1.1.1. FINENESS OF CEMENT WITH SDA

AIM

To determine the fineness of cement with partially replacement of Sawdust Ash.

APPARATUS REQUIRED

- ✓ 90 micron sieve
- ✓ weighing balance

PROCEDURE

- ✓ 100g of sample is taken and sieved through a 90 micron sieve in a sieve shaker for about 15 min.
- ✓ The weight of residue on sieve is taken.
- ✓ From these data the fineness of cement with Sawdust Ash is determined.

5.1.1.2. DENSITY TEST FOR SAWDUST ASH

AIM

To determine the density of the Sawdust Ash by using Density test.

APPARATUS REQUIRED

- ✓ A unit (or) Mould of size 10cm X 10cm X 10cm
- ✓ Weight balance.

PROCEDURE

- ✓ Take the mould with known dimension and it is cleaned well
- ✓ Fill the Sawdust Ash thoroughly in the mould.
- ✓ The weight of the Sawdust Ash in the mould is measured by weighing balance.
- ✓ The density of Sawdust Ash is calculated.

5.1.2. TEST ON DRY SAWDUST

5.1.2.1. SPECIFIC GRAVITY TEST FOR DRY SAWDUST

AIM

To determine the specific gravity of Dry Sawdust by using pycnometer.

APPARATUS REQUIRED

- ✓ Pycnometer
- ✓ Weight balances

PROCEDURE

- ✓ The empty weight of the apparatus is taken (W1)
- ✓ The one- third of apparatus is filled by Dry Sawdust and its weight is measured (W2)
- ✓ The apparatus is then filled with water and the weight of the apparatus, Dry Sawdust and the water together is measured (W3)
- ✓ The apparatus is then emptied and filled entirely with water and its weight is measured (W4)
- ✓ Form the above measurements the specific specific gravity of sand is determined.

5.1.2.2. SIEVE ANALYSIS FOR DRY SAWDUST

AIM

To classify the Dry Sawdust according to the grading limits.

APPARATUS REQUIRED

- ✓ IS Sieves of various sizes

PROCEDURE

- ✓ About 1kg of Dry Sawdust sample is taken in the set of IS sieve from 4.75mm trough 150 micron and sieved in a sieve for 15 min.
- ✓ The weight of Dry Sawdust retained on each sieve is noted.
- ✓ The cumulative percentage passing in determined.
- ✓ This is compared with the following table and the sand is zoned accordingly.

5.1.2.3. DENSITY TEST FOR DRY SAWDUST

AIM

To determine the density of the Dry Sawdust by using Density test.

APPARATUS REQUIRED

- ✓ **A unit (or) Mould of size 10cm X 10cm X 10cm**
- ✓ **Weight balance.**

PROCEDURE

- ✓ **Take the mould with known dimension and it is cleaned well**
- ✓ **Fill the Dry Sawdust thoroughly in the mould.**
- ✓ **The weight of the Dry Sawdust in the mould is measured by weighing balance.**

INTERNATIONAL JOURNAL OF SCIENTIFIC & ENGINEERING RESEARCH, VOLUME 6, ISSUE 4, 4 23-2015
ISSN 2229-5518

- ✓ **The density of Dry Sawdust is calculated.**

5.2. FINAL TEST

5.2.1. TESTS ON SAWDUST MORTAR

5.2.1.1. COMPRESSIVE STRENGTH TEST FOR SAWDUST MORTAR

AIM

To determine the compressive strength of sawdust mortar cubes.

APPARATUS REQUIRED

- ✓ **Moulds size of 7cm X 7cm X 7cm**
- ✓ **Weight balance**
- ✓ **Trowel**
- ✓ **Tray (or) a unit for volume batch.**
- ✓ **UTM (Universal Testing Machine)**

PROCEDURE

- ✓ Volume of the moulds is calculated and Sawdust - cement mortar is prepared in the mix ratio 1:4 and 1:5 ratio.
- ✓ Sawdust mortar is place inside the moulds in three layers by giving 25 times tamping and it is given perfect finish.
- ✓ The cube is placed in a UTM after 7th day of curing and the load is applied until the failure of the cubes.
- ✓ Then the compressive strength of the cube of the cube is calculated and the average is taken.

5.2.1.2. DENSITY TEST FOR SAWDUST MORTAR

AIM

To determine the density of the Sawdust Mortar.

APPARATUS REQUIRED

- ✓ **Mould of size 7cm X 7cm X 7cm**
- ✓ **Weight balance.**

PROCEDURE

- ✓ Prepare the concrete cubes of size 7cm X 7cm X 7cm
- ✓ After the 7th day of curing, weight of cube is measured by using weight balance.
- ✓ The density of Sawdust mortar cube with different **ratio is calculated.**

5.2.2. TESTS ON SAWDUST CONCRETE

5.2.2.1. SLUMP TEST ON FRESH CONCRETE

AIM

To study of the workability of concrete of given mixture by determining the slump value of concrete mixture for various percentage of water content.

APPARATUS REQUIRED

- ✓ Slump cone
- ✓ Weighing balance with weight
- ✓ Measuring scale
- ✓ Measuring jar
- ✓ Trowel and
- ✓ Tamping rod

PROCEDURE

- ✓ The slump cone is placed on a water tight leveled platform and fresh concrete is placed in three layers.
- ✓ Each layer is tamped with 25 blows with rounded end tamping rod of steel of 16mm diameter 60mm long.
- ✓ After filling the slump cone, the cone is gently and vertically raised, the concrete is allowed to settle under its own weight,
- ✓ The vertical distance from the original level to the new level after subsidence is measured. This is called slump and is measured in mm
- ✓ The above procedure is repeated for various other water cement ratio.

While conducting slump test, cone often comes in the following types of cones:

❖ TRUE SLUMP

In this cone the mixture subsides uniformly and cohesively. This type of slump in normally obtained in rich mixture and where the proportion of fine aggregate is higher.

❖ SHEAR SLUMP

Here half of the cone shears off along the inclined plane while the other half is true slump. This normally happens in mixes such as 1:6 or 1:8 and the slump is measured from the level of the cone to the center of the shear plane. The shear slump is obtained in the first instance. The test should be repeated at least once.

❖ COLLAPSE SLUMP

In this type of slump the concrete first collapses and spreads over a larger area. This phenomenon normally occurs in wet mixture.

INTERNATIONAL JOURNAL OF SCIENTIFIC & ENGINEERING RESEARCH, VOLUME 6, ISSUE 4&423-2015
ISSN 2229-5518

5.2.2.2. COMPRESSIVE STRENGTH FOR SAWDUST CONCRETE

AIM

To determine the compressive strength of concrete cubes

APPARATUS REQUIRED

- ✓ Moulds size of 10 cm X 10 cm X 10 cm
- ✓ Weight balance
- ✓ Trowel
- ✓ Tray (or) a unit for volume batch.
- ✓ UTM (Universal Testing Machine)

PROCEDURE

- ✓ Volume of the moulds is calculated and concrete is prepared in the mix ratio 1:1.5:3 (M20 Grade)
- ✓ Concrete is place inside the moulds in three layers by giving 25 times tamping and it is given perfect finish.
- ✓ The cube is placed in a UTM after 7th, 21st and 28th days of curing and the load is applied until the failure of the cubes.
- ✓ Then the compressive strength of the cube of the cube is calculated and the average is taken.

5.2.2.3. DENSITY TEST FOR SAWDUST CONCRETE

AIM

To determine the density of the concrete.

APPARATUS REQUIRED

- ✓ Mould of size 10cm X 10cm X 10cm
- ✓ Weight balance.

PROCEDURE

- ✓ Prepare the concrete cubes of size 10cm X 10cm X10cm
- ✓ After the 28th day of curing, weight of cube is measured by using weight balance.

The density of concrete cube with different ratio is calculated.

INTERNATIONAL JOURNAL OF SCIENTIFIC & ENGINEERING RESEARCH, VOLUME 6, ISSUE 4&423-2015
ISSN 2229-5518

CHAPTER – 6

OBSERVATION AND RESULTS

6. OBSERVATION AND RESULTS

6.1. RESULTS OF PRELIMINARY TEST

6.1.1 TEST ON SAWDUST ASH

6.1.1.1. FINENESS OF CEMENT WITH SDA

Table: 6.1.1 (a)

S.no.	Size of Sieve in (microns μ)	Weight of Cement + SDA taken in (gms)	Weight of the Residue in (gms)	Weight of Cement + SDA passing through Sieve in (gms)	Fineness of cement + SDA in (%)
1	90	100	4	96	95.67
2	90	100	5	95	
3	90	100	4	96	

$$Fineness\ of\ cement\ in\ \% = \frac{\text{Weight of the (Cement + SDA) passing the sieve}}{\text{Total weight of cement}}\ x\ 100$$

The fineness of cement is found to be 95.67 %

6.1.1.2. DENSITY TEST FOR SAWDUST ASH

Table: 6.1.1 (b)

Trails	Mass of SDA in (kg)	Volume of Mould in (m3)	Density of SDA in (kg/m3)	Mean Density of SDA in (kg/m3)
Trail 1	0.312	0.001	312	318.67
Trail 2	0.315	0.001	315	
Trail 3	0.320	0.001	320	

$$Density\ of\ Sawdust\ Ash = \frac{\text{Mass of Sawdust Ash}}{\text{Volume of Mould}}$$

The density of Sawdust Ash is found to be 318.67 kg / m3

6.1.2. TEST ON DRY SAWDUST

6.1.2.1. SPECIFIC GRAVITY TEST FOR DRY SAWDUST

Table: 6.1.2 (a)

S.no	Empty weight of the Apparatus. (W1) (gms)	Weight of Apparatus + Dry Sawdust. (W2) (gms)	Weight of Apparatus + Dry Sawdust + Water. (W3) (gms)	Weight of Apparatus + Water (W4) (gms)	Weight of Dry Sawdust (W2-W1) (gms)	Weight of Equal volume. (W2-W1) – (W3-W4) (gms)	Specific Gravity (G)
1	675	731	1412	1367	56	11	5.09
2	675	743	1435	1380	68	13	5.23
3	675	735	1418	1370	60	12	5.00

Average 5.10

$$Specific\ Gravity = \frac{(W2 - W1)}{(W2 - W1) - (W3 - W4)}$$

The specific gravity of Sawdust Ash is found to be 5.10

6.1.2.2. SIEVE ANALYSIS FOR DRY SAWDUST

Table: 6.1.2 (b)

S.no	I.S. Sieve Size	Weight of Dry Sawdust Retained (gms)	Cumulative Weight Retained (gms)	Cumulative % Weight Retained	Cumulative % Weight Passing
1	4.75mm	-	0	0	100
2	2.36mm	4	4	1.33	98.67
3	1.18mm	36	40	13.33	86.67
4	600 μ	52	92	30.67	69.33
5	300μ	124	216	72	28
6	150μ	44	260	86.67	13.33
7	PAN	40	300	100	0.0

INTERNATIONAL JOURNAL OF SCIENTIFIC & ENGINEERING RESEARCH, VOLUME 6, ISSUE 4, 4 23-2015
ISSN 2229-5518

6.1.2.3. DENSITY TEST FOR DRY SAWDUST

Table: 6.1.2 (c)

Trails	Mass of DSD in (kg)	Volume of Mould in (m3)	Density of DSD in (kg/m3)	Mean Density of DSD in (kg/m3)
Trail 1	0.054	0.0034	157.43	167.18
Trail 2	0.060	0.0034	174.93	
Trail 3	0.057	0.0034	166.18	

$$Density\ of\ Sawdust\ Ash = \frac{\text{Mass of Sawdust Ash}}{\text{Volume of Mould}}$$

The density of Sawdust Ash is found to be 167.18 kg/ m3

6.2. FINAL TEST

6.2.1. TESTS ON SAWDUST MORTAR

6.2.1.1. COMPRESSIVE STRENGTH FOR SAWDUST MORTAR

Table: 6.2.1 (a)

Mortar ratio – 1:4 **Curing Period – 7 days**

Specimen mark	Sawdust ratio (%)	Water / Cement ratio	Compressive stress (N/mm2)
A	0	0.5	9.2
B	10	0.5	8
C	30	0.6	7.62
D	50	0.7	6.53

Mortar ratio – 1:5 **Curing Period – 7 days**

Specimen mark	Sawdust ratio (%)	Water / Cement ratio	Compressive stress (N/mm2)
E	0	0.5	8.5
F	10	0.5	7.8
G	30	0.6	6.52
H	50	0.7	4.23

6.2.1.2. DENSITY TEST FOR SAWDUST MORTAR

Table: 6.2.1 (b)

Mortar ratio – 1:4 **Curing Period – 7 days**

Specimen mark	Sawdust ratio (%)	Density (Kg / m3)
A	0	1850.12
B	10	1721.15
C	30	1676.38
D	50	1545.18

Mortar ratio – 1:5 **Curing Period – 7 days**

Specimen mark	Sawdust ratio (%)	Density (Kg / m3)
E	0	1870.26
F	10	1770.45
G	30	1597.66
H	50	1431.35

$$Density\ of\ Sawdust\ Ash = \frac{\text{Mass of Sawdust Mortar}}{\text{Volume of Mould}}$$

6.2.2. TESTS ON SAWDUST CONCRETE

6.2.2.1. SLUMP TEST ON FRESH CONCRETE

6.2.2.1.1. SLUMP TEST FOR DRY SAWDUST CONCRETE

Table: 6.2.2 (a)

M20 grade – 1:1.5:3 **Sand Replaced 0% by DSD**

S. no	Water / Cement ratio (%)	Slump value
1	0.4	No Slump
2	0.5	True Slump
3	0.6	Shear Slump
4	0.7	Collapse

M20 grade – 1:1.5:3 **Sand Replaced 10% by DSD**

S. no	Water / Cement ratio (%)	Slump value
1	0.5	No Slump
2	0.6	True Slump
3	0.7	Shear Slump
4	0.8	Collapse

INTERNATIONAL JOURNAL OF SCIENTIFIC & ENGINEERING RESEARCH, VOLUME 6, ISSUE 4&423-2015
ISSN 2229-5518

M20 grade – 1:1.5:3 Sand Replaced 30% by DSD

S. no	Water / Cement ratio (%)	Slump value
1	0.6	No Slump
2	0.7	True Slump
3	0.8	Shear Slump
4	0.9	Collapse

M20 grade – 1:1.5:3 Sand Replaced 50% by DSD

S. no	Water / Cement ratio (%)	Slump value
1	0.7	No Slump
2	0.8	True Slump
3	0.9	Shear Slump
4	1.0	Collapse

6.2.2.1.2. SLUMP TEST FOR SAWDUST ASH CONCRETE

Table: 6.2.2 (b)

M20 grade – 1:1.5:3 Sand Replaced 0% by SDA

S. no	Water / Cement ratio (%)	Slump value
1	0.45	No Slump
2	0.50	True Slump
3	0.55	Shear Slump
4	0.60	Collapse

M20 grade – 1:1.5:3 Sand Replaced 5% by SDA

S. no	Water / Cement ratio (%)	Slump value
1	0.50	No Slump
2	0.55	True Slump
3	0.60	Shear Slump
4	0.65	Collapse

M20 grade – 1:1.5:3 Sand Replaced 10% by SDA

S. no	Water / Cement ratio (%)	Slump value
1	0.55	No Slump
2	0.60	True Slump
3	0.65	Shear Slump
4	0.70	Collapse

M20 grade – 1:1.5:3 Sand Replaced 15% by SDA

S. no	Water / Cement ratio (%)	Slump value
1	0.55	No Slump
2	0.60	True Slump
3	0.65	Shear Slump
4	0.70	Collapse

6.2.2.2. COMPRESSIVE STRENGTH TEST

6.2.2.2.1. COMPRESSIVE STRENGTH FOR DRY SAWDUST CONCRETE

Table: 6.2.2 (c)

M20 grade – 1:1.5:3 Curing Period – 7 days

Specimen mark	Sawdust ratio (%)	Compressive Stress (N/mm2)
I1	0	18.763
J1	10	14.122
K1	30	13.786
L1	50	3.222

M20 grade – 1:1.5:3 Curing Period – 21 days

Specimen mark	Sawdust ratio (%)	Compressive Stress (N/mm2)
I2	0	20.136
J2	10	17.229
K2	30	15.513
L2	50	9.650

INTERNATIONAL JOURNAL OF SCIENTIFIC & ENGINEERING RESEARCH, VOLUME 6, ISSUE 4, 4 23-2015
ISSN 2229-5518

M20 grade – 1:1.5:3 **Curing Period – 28 days**

Specimen mark	Sawdust ratio (%)	Compressive Stress (N/mm2)
I3	0	24.15
J3	10	19.322
K3	30	18.092
L3	50	11.469

6.2.2.2.2. COMPRESSIVE STRENGTH FOR SAWDUST ASH CONCRETE

Table: 6.2.2 (d)

M20 grade – 1:1.5:3 **Curing Period – 7 days**

Specimen mark	Sawdust ratio (%)	Compressive Stress (N/mm2)
M1	0	19.24
N1	5	18.67
O1	10	15.92
P1	15	14.18

M20 grade – 1:1.5:3 **Curing Period – 21 days**

Specimen mark	Sawdust ratio (%)	Compressive Stress (N/mm2)
M2	0	22.39
N2	5	20.85
O2	10	18.54
P2	15	17.29

M20 grade – 1:1.5:3 **Curing Period – 28 days**

Specimen mark	Sawdust ratio (%)	Compressive Stress (N/mm2)
M3	0	24.32
N3	5	22.34
O3	10	19.65
P3	15	18.94

6.2.2.3. DENSITY TEST

6.2.2.3.1. DENSITY TEST FOR DRY SAWDUST CONCRETE

Table: 6.2.2 (e)

M20 grade – 1:1.5:3 **Curing Period – 28 days**

Specimen mark	Sawdust ratio (%)	Density (Kg / m3)
I1	0	2556
J1	10	2340
K1	30	2166
L1	50	1974

6.2.2.3.2. DENSITY TEST FOR SAWDUST ASH CONCRETE

Table: 6.2.2 (f)

M20 grade – 1:1.5:3 **Curing Period – 28 days**

Specimen mark	Sawdust ratio (%)	Density (Kg / m3)
M1	0	2556
N1	5	2523
O1	10	2490
P1	15	2445

INTERNATIONAL JOURNAL OF SCIENTIFIC & ENGINEERING RESEARCH, VOLUME 6, ISSUE 4, 4&423-2015
ISSN 2229-5518

Chapter – 7

GRAPHICAL REPRESENTATION OF RESULTS

7. GRAPHICAL REPRESENTATION OF RESULTS

7.1. TESTS ON SAWDUST MORTAR

7.1.1. COMPRESSIVE STRENGTH OF MORTAR CUBES

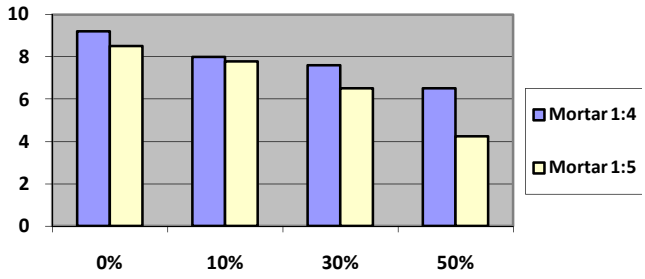

Fig. (a): % of Sawdust Vs. Compressive Strength (N/mm2) `

7.1.2. DENSITY FOR MORTAR CUBES

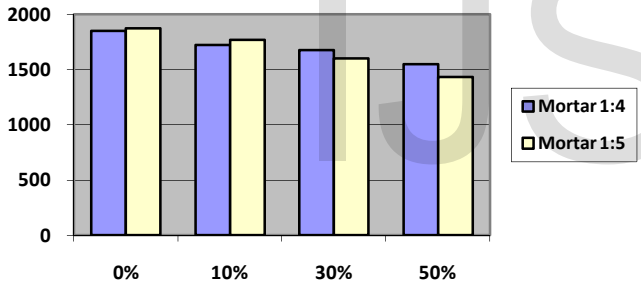

Fig. (b): % of Sawdust Vs. Density (Kg/m3)

7.2. TESTS ON SAWDUST CONCRETE

7.2.1. SLUMP TEST ON FRESH CONCRETE

7.2.1.1. SLUMP TEST FOR DRY SAWDUST CONCRETE

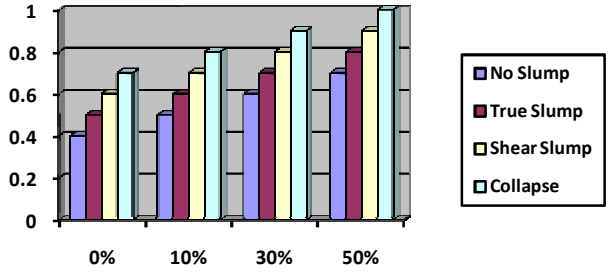

Fig. (c): % of Sawdust Vs. Water – Cement Ratio

7.2.1. 2. SLUMP TEST FOR SAWDUST ASH CONCRETE

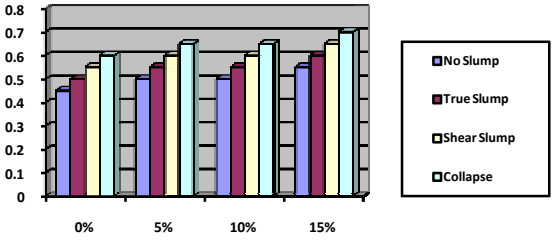

Fig. (d): % of Sawdust Vs. Water – Cement Ratio

7.2.2. COMPRESSIVE STRENGTH

7.2.2.1. COMPRESSIVE STRENGTH FOR DRY SAWDUST CONCRETE

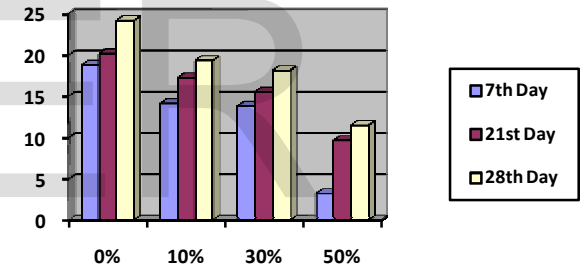

Fig. (e): % of Sawdust Vs. Compressive Strength (N/mm2)

7.2.2.2. COMPRESSIVE STRENGTH FOR SAWDUST ASH CONCRETE

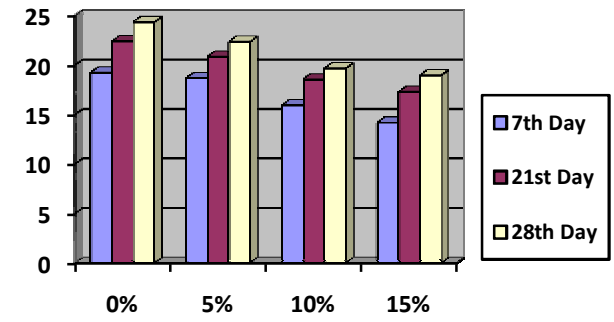

Fig. (f): % of Sawdust Vs. Compressive Strength (N/mm2)

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ISSN 2229-5518

7.2.3. DENSITY TEST

7.2.3.1. DENSITY TEST FOR DRY SAWDUST CONCRETE

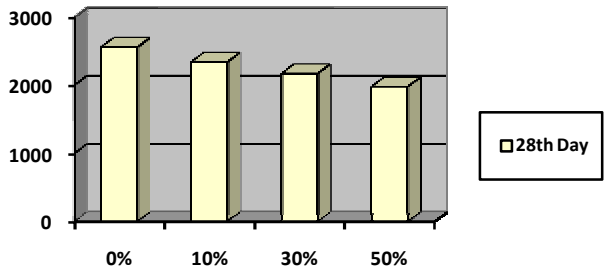

Fig. (g): % of Sawdust Vs. Density (Kg/m3)

7.2.3.2. DENSITY TEST FOR SAWDUST ASH CONCRETE

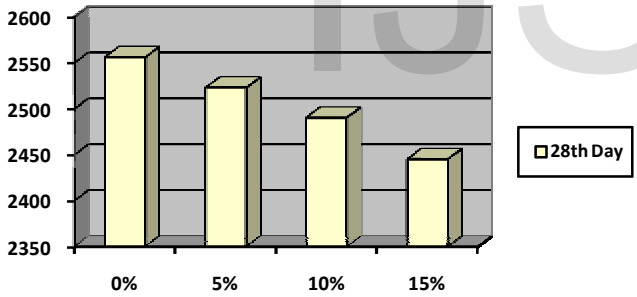

Fig. (g): % of Sawdust Vs. Density (Kg/m3)

INTERNATIONAL JOURNAL OF SCIENTIFIC & ENGINEERING RESEARCH, VOLUME 6, ISSUE 4, 4 23-2015
ISSN 2229-5518

CHAPTER – 8

8. CONCLUSION

1. As the percentage sawdust increase the density is found to be decrease.

2. From the results density of Dry Sawdust (DSD) is 90% less than normal river sand and density of Sawdust Ash (SDA) is 60% to80% less than Ordinary Portland Cement (OPC).

3. For 1:4 mortar, compressive strength of sawdust mortar cube after 7 days of curing was achieve 87%, 82% and 71% of strength for 10%, 30% and 50% replacement of sand (fine aggregate) respectively.

4. For 1:5 mortar, Compressive strength of sawdust mortar cube after 7 days of curing achieve 92%, 77% and 50% of strength for 10%, 30% and 50% respectively.

5. Density for 1:4 mortar cube, self-weight decrease 5%, 10% and 17% for 10%, 30% and 50% respectively and for 1:5 mortar the self-weight of cube decrease 6%, 15% and 24% for 10%, 30% and 50% respectively.

6. For M20 grade concrete, design mix ratio of 1:1.5:3, Compressive strength of Dry Sawdust concrete after 28 days of curing is achieve 80%, 75% and 47% of strength for 10%, 30% and 50% replacement of Dry Sawdust for fine aggregate respectively.

7. For same grade, Compressive strength achieve 91%, 80% and 78% for 5%, 10% and 15% replacement of Sawdust Ash respectively, after 28 days of curing.

8. Self-weight of the concrete also decreased by partially replacement of Dry Sawdust in 10%, 30% and 50% with cement concrete was reduce density 9%, 16% and 23% respectively and some changes in Sawdust Ash concrete was found from above results.

9. Comparing the density and Compressive strength of different ratio of concrete and mortar is well studied and may utilize in construction applications. Sawdust mortar is used as plastering and Sawdust Concrete may use in structural member like beam, column, etc.

10. And finally, from this project, wastage of sawdust is minimized and it can be recycled for construction work.

11. Further studies may be carried out for getting more information regarding to ultimate utilization of sawdust in different innovative approaches.

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CHAPTER – 9

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CHAPTER - 10

PHOTOGRAPHS

Fig . (1) COLLECTION OF MATERIALS

Fig . (2) SLUMP CONE TEST

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Fig . (3) COMPRESSIVE TEST