American Journal of Engineering Research (AJER)
e-ISSN : 2320-0847 p-ISSN : 2320-0936
Volume-03, Issue-04, pp-197-206
www.ajer.org

Research Paper Open Access

Performance of Saw-Dust in Low Cost Sandcrete Blocks

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Synopsis: - This paper presents the salient features of an experimental study on sandcrete blocks prepared by partially replacing sand with saw dust. Influence on compressive strength, water absorption capacity and density characteristics are studied by varying replacement percentage of sand with sawdust.
Saw dust, the Industrial waste obtained from sawdust refuse dump form Timber shade & saw-mills, if used for partially replacing sand can reduce the density of block to a considerable extent.

In framed structure the principle function of wall is that of cladding. Hence light weight blocks will reduce the dead load of masonry on beam, giving light section of beam and blocks thereby saving in construction material resources.

Keeping this in view an experimental study has been carried out to test the performance of saw dust in cement sand create blocks. Effect of type of curing on compressive strength, density etc. have been carried out on various proportions of cement and ordinary sand partially replaced with varying % of saw dust by weight. Blocks of 100* 100* 100 mm are considered for test report.

The result of the various tests are sufficiently encouraging and author suggest to manufacture sandcrete block prepared in proportion of 1:6 cement: (85% sand +15% saw dust)since compressive strength for this ratio is found to be 4.5 N/MM^2 under gunny bag curing condition and provides optimum & desired result.

Keyword: - *Saw dust, sandcrete blocks, compressive strength, water cement ratio, Density.*

I. INTRODUCTION

India is experiencing an unprecedented growth of its urban center due to its developing economy and industrialization. The characteristic feature of urbanization has been heavy concentration of urban population in large cities demanding economical and efficient housing layout with vertical expansion in short period.
The rapid progress and research over recent past, leads the engineers to accept framed structures as against conventional load bearing structures
In frame structure walls are simply to serve as a screen for privacy of various rooms. They support their self weights only. Hence in such structures for masonry component low density low strength material can be used to reduce dead load.
The higher density conventional concrete blocks gives heavy self weight of masonry, thereby increasing the cost of frame structure. Mud bricks consumes fertile soil as also wood for burning bricks exhausting CO2 thereby creating environmental pollution issues.
Saw dust is industrial waste material which is obtained from sawdust refuse dump from timber shade & saw mills, in various shapes and sizes as shown in fig. 1. This main by product of saw mills, unless reprocessed in to particle board, are burned in a saw dust burner and are use to make heat for other milling operation, saw dust may collect in pipes and add harmful leachates in to local water systems, creating an environmental hazard. In India proper utilization of saw mill waste has not been given due attention. This saw dust there by constitutes an environmental nuisance as they form refuse heaps in the premises of saw mills and shades. Similarly sand is naturally occurring granular material composed of finely divided rock and minerals particles obtained from Perennial River. Huge consumption of sand in concrete structures also facing a acute shortage of sand. According to the environmentalist removal of sand from river may create environmental problems in future to come.

Fig. 1 : Sawdust particle Size and shape

Density of saw dust varies from 650 kg/m^3 to 1650 kg/m^3. if this is used partially in manufacturing the morter blocks as a replacement to sand can reduce the density to considerable extent. [1]

Compressive strength of blocks is a measure of their resistance to load application when placed in the crushing machine. I.S./ B.S recommends 3.45 N/mm^2 mean strength of 2.59 N/mm^2 lowest individual strength.[2] No. of research have been carried out on sawdust and agricultural waste to provide solution of getting low cost masonry blocks.

S.T. Tyagher,(2011) used saw dust ash to partially replace cement in the production of sandcrete hollow blocks.[3]

According to Adebakin I. H. (2012) The percentage replacement of sand should not be 10 % to achieve better results in production of sand create blocks. [4]

L.O.Ettu,(2013) investigated the variation of strength of OPC – RHA- SDA cement composites with mix proportion and found that for all percentage replacement of OPC with RHA-SDA at 28 and 50 days of curing at a given water cement ratio, the compressive strength increased with leanness of mix up to some level of leanness after which the strength reduced.[5]

Keeping all the above issues in mind object of the study was to

i. Investigate the performance of saw dust as partial replacement of sand in manufacturing cement sandcrete blocks in order to reduce overall construction cost and to minimize the environmental issues created due to excessive use of sand
ii. To suggest a rational proportion of cement: sand: sawdust: w/c ratios based on experimental observation which will effectively produce light weight low cost sand create blocks.

Various test carried out are cube compressive strength for various proportions, density relationship, water absorption etc.

However, fire resistance, weather, resistance, thermal and sound insulation though important are beyond the scope of this study and needs separate investigation.

II. MATERIALS & METHOD

The materials used to manufacture light weight cement sandcrete mortar block consist of

i. Cement (OPC)
ii. Local sand (fineness modules 3.69)

iii. Sawdust (mix of teak, nim, babool and mango and other species trees etc.) obtained from saw mills of Pusad (India) town (fineness modules 3.63.)

100x100x100 mm solid blocks were produced under laboratory condition. The mix ratio used was 1:4 to 1:8 with different replacement percentage of sand with saw dust. For each replacement percentage 30 blocks sample were casted. The replacement percentage and water cement ratio to make workable mix at each level used is shown in table 1.

Mixing: - The required quantities of material were weighted out as per proportions and mixing was done as per IS specification. Drum type mixer was used for mixing the material.

Moulding: - Casting was affected as per IS specification and compacted with the help of electrically operated vibrating machine. Size of block used was 100mm* 100mm. various mix proportions providing (cement: fine aggregate (sand + sawdust) tested were:

1:4 (0%, 5%, 10%, 15% & 20% sawdust replacement)
1:6 (0%, 5%, 10%, 15% & 20% sawdust replacement)
1:8 (0%, 5%, 10%, 15% & 20% sawdust replacement)

Curing: Specimens were divided into two sets for curing under sprinkling method and wet gunny bag method and was affected up to 6 days, 13 days & 27 days, for testing the blocks for 7 days, 14 days & 28 days. De molding was affected after 24 hours Specimen containing higher replacement % of sawdust, the mould bases were left a little longer period.

Testing: - Blocks were tested for compressive strength separately and density of block at7 days, 14 days and 28 days. Effect of type of curing on compressive strength, effect of sawdust on water observation % has also been tested.

Materials used for preparing sandcrete blocks were tested as per IS specification and following are the observations.

a. Fineness modulus of saw dust was found to be 3.69.
b. Fineness modulus of sand was found to be 3.63.
c. Moisture content of sawdust was found to be 9.3% which is within the permissible limit.
d. Silt content in local sand was found to be only 3%.

Curing and its types plays vital role on the effect of compressive strength. The main objective of curing is to keep concrete / mortar saturated or nearly saturated so as to support the hydration of cement, eliminating problem likes plastic shrinkage cracking.[6] The cement sandcrete blocks with varying percentage replacement of sand with sawdust under, Sprinkler curing and Gunny bag curing are tested for compressive strength at 7,14 and 28 days.

III. RESULT AND DISCUSSION

The variation of compressive strength with curing age for different cement sand ratio with partially replacement of sand with saw dust under above curing conditions are presented in Table 1. The result of compressive strength of cement sandcrete blocks and its trend with reference to proportion, age of curing and type of curing are represented in fig. 2 to7.

Table 1: Compressive strength on various proportions of cement :Sand: Saw dust.

Sr.	Proportions				Compressive strength N/mm^2			Type of curing
	Cement	Sand % + sawdust %		w/c Ratio	7 days	14 days	28 days	
	1:4							
1	1	4 (100%)	0%	0.5	7.68	8.00	8.00	S.C.
					9.34	9.00	1.30	G.C.
2	1	4 (95%)	5%	0.6	7.10	7.00	8.00	S.C.
					9.01	9.00	9.00	G.C.
3	1	4 (90%)	10%	0.6	7.00	7.00	7.00	S.C.
					8.30	9.00	9.30	G.C.
4	1	4 (85%)	15%	0.7	5.80	5.00	5.00	S.C.
					6.30	7.00	7.00	G.C.
5	1	4(80%)	20%	0.87	4.50	5.00	5.00	S.C.
					6.00	6.00	6.00	G.C.
	1:6							
6	1	6 (100%)	0%	0.5	5.00	5.00	6.50	S.C.
					5.00	6.00	6.50	G.C.

7	1	6(95%)	5%	0.6	5.00	5.00	5.00	S.C.
					5.00	5.00	6.00	G.C.
8	1	6 (90%)	10%	0.7	4.00	4.00	5.00	S.C.
					5.00	5.00	5.00	G.C.
9	1	6 (85%)	15%	0.7	2.00	2.00	3.00	S.C
					3.00	4.00	4.00	G.C.
10	1	6 (80%)	20. %	0.8	1.00	2.00	1.00	S.C.
					2.00	2.00	2.00	G.C.
	1:8							
11	1	8 (100%)	0%	0.6	2.00	2.00	2.00	S.C.
					2.00	2.00	2.00	G.C.
12	1	8 (95%)	5%	0.7	1.00	1.00	1.00	S.C.
					1.00	1.50	2.00	G.C.
13	1	8 (90%)	10%	0.8	1.00	1.00	1.00	S.C.
					1.00	1.50	1.00	G.C.

❖ S.C. – Sprinkler curing, G.C. – Wet Gunny bag curing.

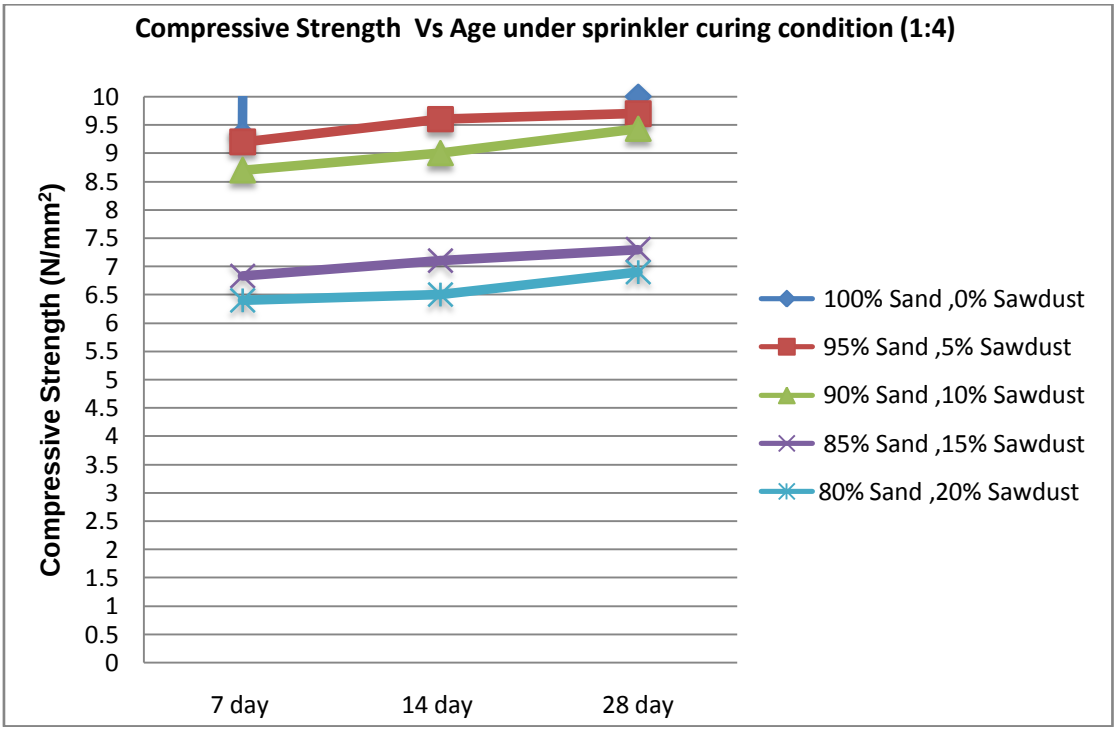


Fig. 2: Compressive Strength Vs Age under sprinkler curing condition (1:4)

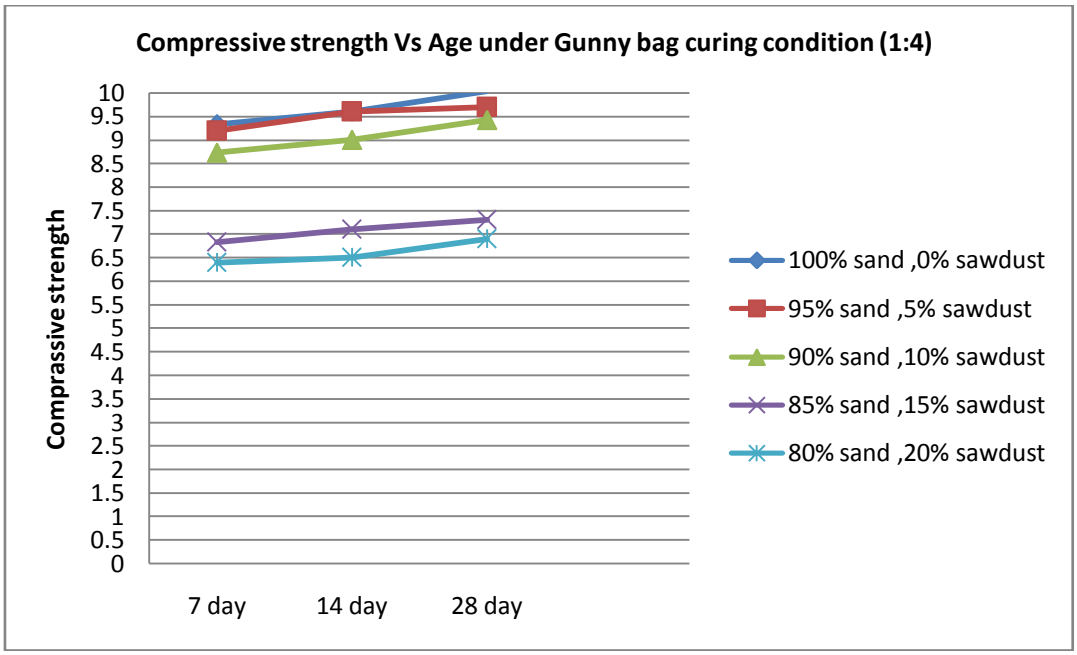


Fig. 3: Compressive strength Vs Age under Gunny bag curing condition (1:4)

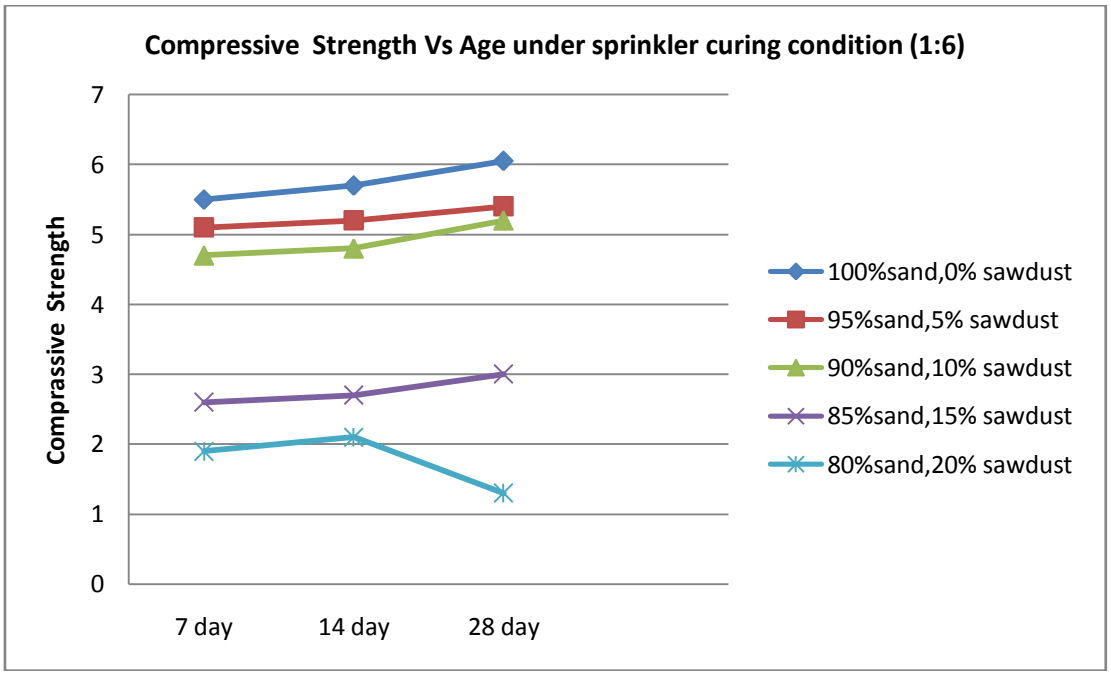


Fig. 4: Compressive Strength Vs Age under sprinkler curing condition (1:6)

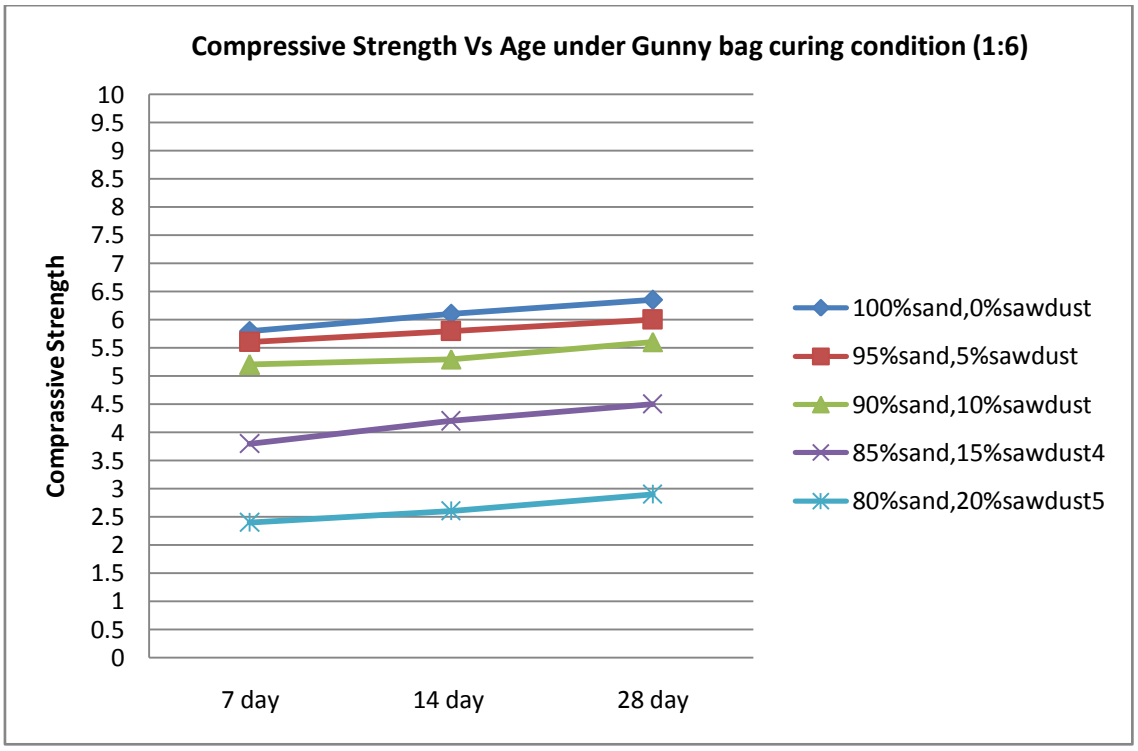


Fig. 5: Compressive Strength Vs Age under Gunny bag curing condition (1:6)

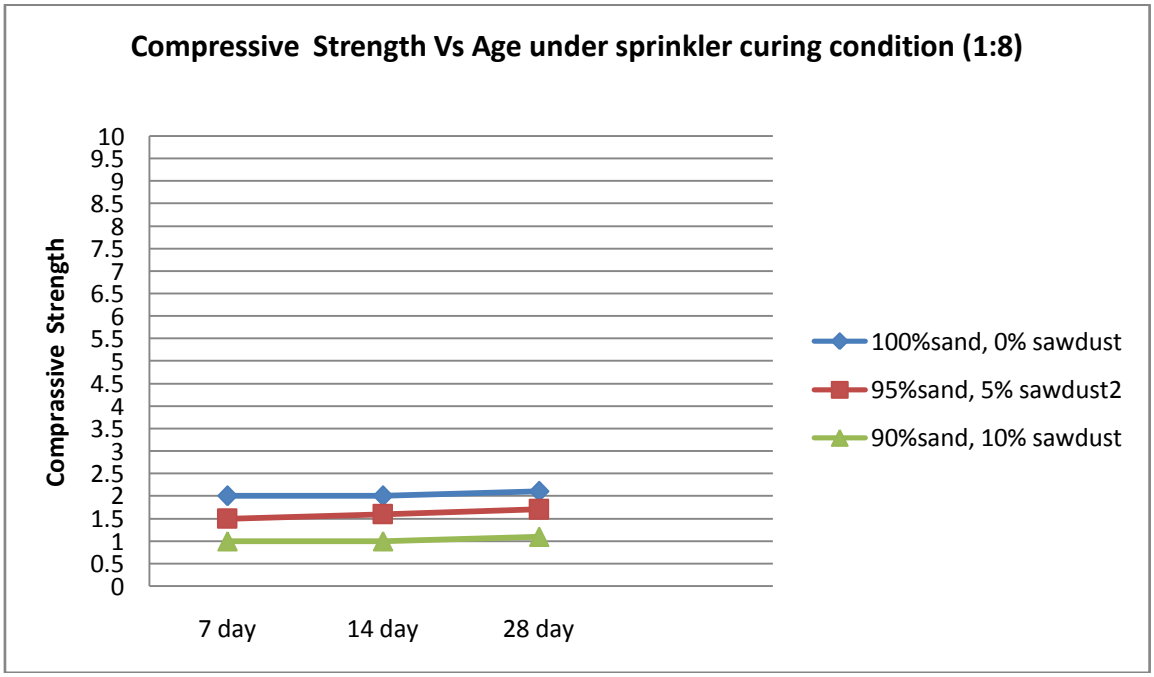


Fig. 6: Compressive Strength Vs Age under sprinkler curing condition (1:8)

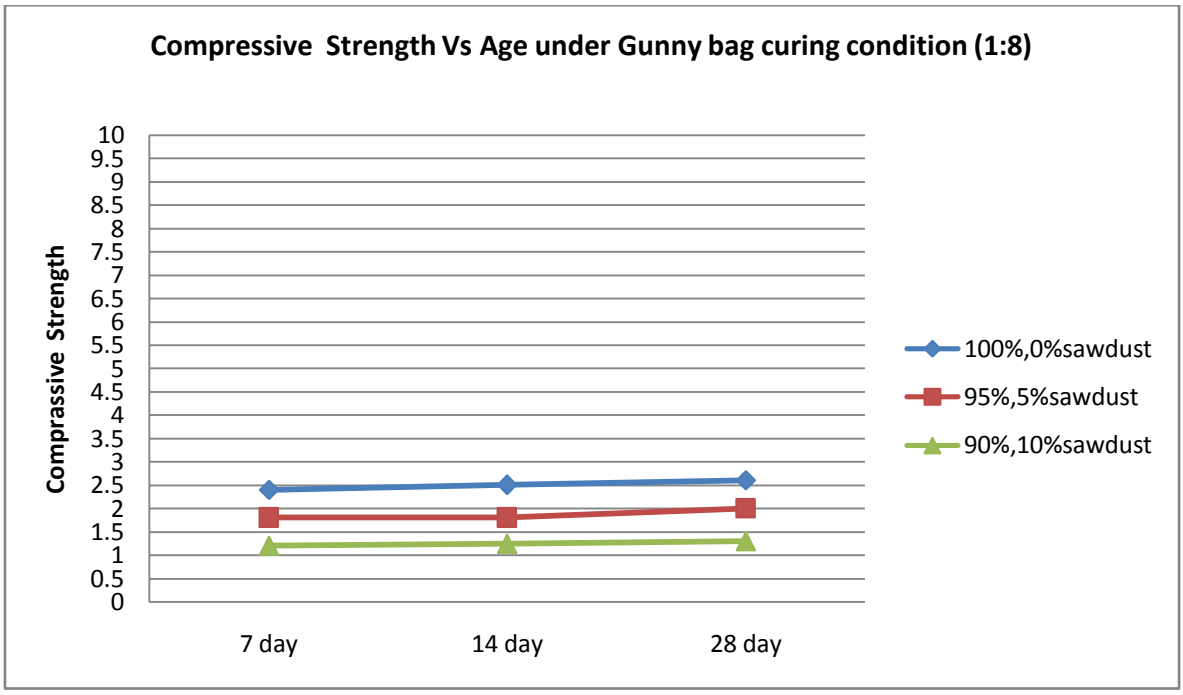


Fig. 7: Compressive Strength Vs Age under Gunny bag curing condition (1:8)

IV. DENSITY

Density depends upon the sand and sawdust ratio. It is observed that density decreases with increase in percentage saw dust in sandcreate blocks. The variation of density for varying percentage of saw dust replacement is presented in Table 2 and partial replacement of sand, with sawdust has a significant effect on the density of mortor. For zero percentage replacement density remain constant for different percentage of cement, sand, however for more % of sawdust replacement density reduces significantly. The trend is shown in Fig. 8

Table: 2 Density – Sawdust content relationship.

Sr.no.	Proportions			Density kg/m^3		
	Cement	Sand	%sawdust	7 days	14days	28days
	1:4					
1	1	100%	0%	2400	2400	2400
2	1	95%	5%	2300	2200	2100
3	1	90%	10%	2200	2100	2000
4	1	85%	15%	2100	2000	1950
5	1	80%	20%	2000	1900	1800
	1:6					
6	1	100%	0%	2400	2400	2400
7	1	95%	5%	2400	2300	2200
8	1	90%	10%	2200	2150	2100
9	1	85%	15%	2200	2100	2000
10	1	80%	20%	2000	1900	1800
	1:8					
11	1	100%	0%	2400	2400	2400
12	1	95%	5%	2400	2350	2300
13	1	90%	10%	2300	2200	2100
14	1	85%	15%	2200	2100	2000

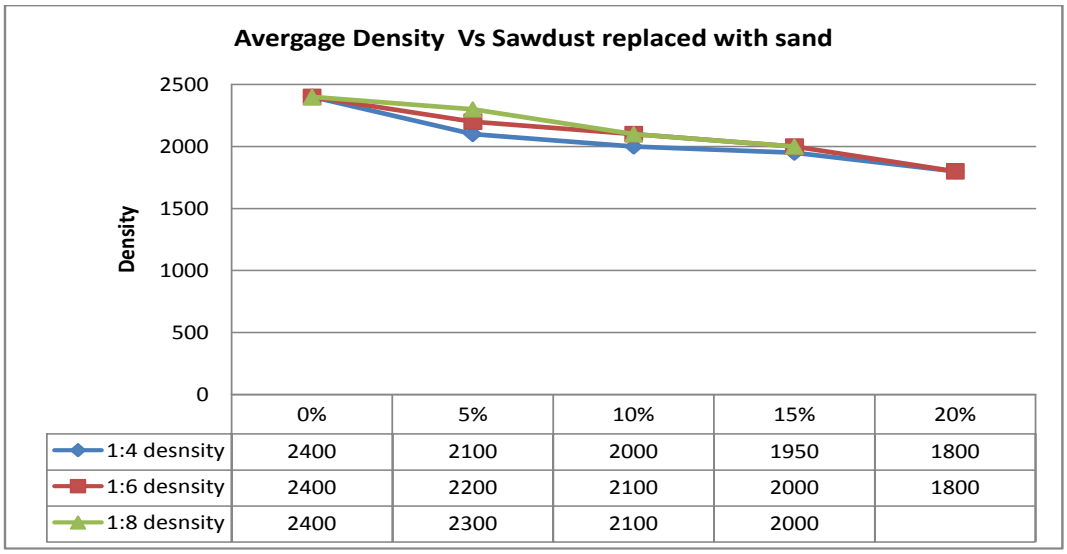


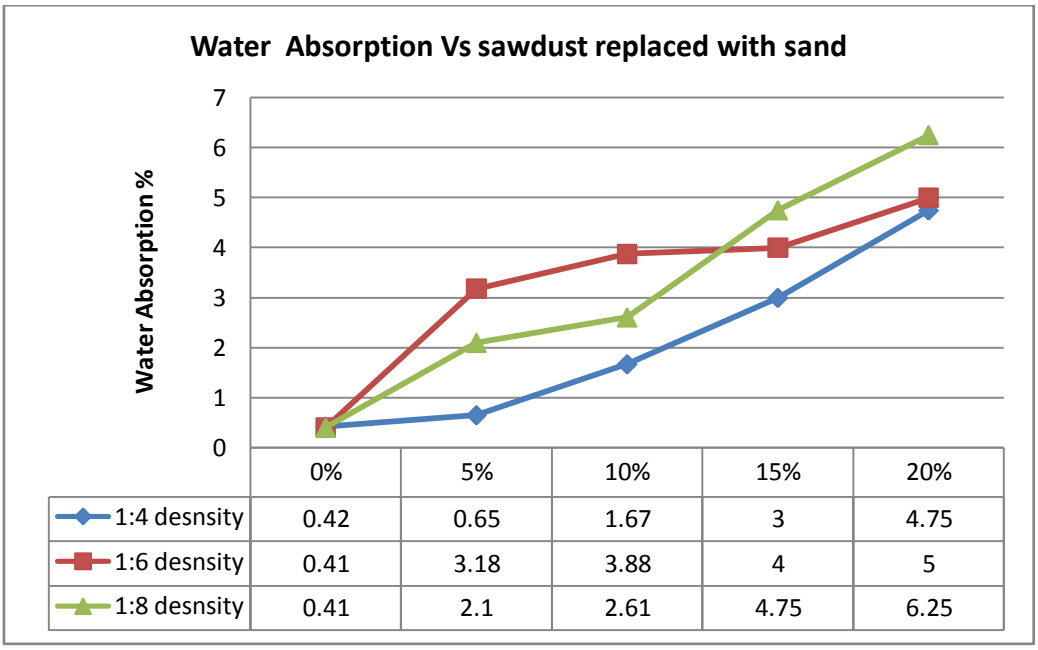
Fig. 8: Average Density Vs Sawdust replaced with sand

Water Absorption:-

Sawdust is more susceptible to moisture and hence water absorption test on each blocks was carried at 28 days and the result are presented in Table 3 and water absorption trend is represented in Fig. 9. For higher % of sawdust replacement, water absorption increases significantly. However up to 20% replacement water absorption is within reasonable limit.

Table 3: Water absorption of sawdust sandcrete block.

Sr.no.	Proportions			Water absorption(%)
	Cement	Sand	Saw dust	
	1:4			
1	1	100%	0%	0.42
2	1	95%	5%	0.65
3	1	90%	10%	1.67
4	1	85%	15%	3.00
5	1	80%	20%	4.75
	1:6			
6	1	100%	0%	0.41
7	1	95%	5%	3.18
8	1	90%	10%	3.88
9	1	85%	15%	4.00
10	1	80%	20%	5.00
	1:8			
11	1	100%	0%	0.41
12	1	95%	5%	2.10
13	1	90%	5%	2.61
14	1	85%	10%	4.75
15	**1**	80%	**15%**	**6.25**



	0%	5%	10%	15%	20%
1:4 desnsity	0.42	0.65	1.67	3	4.75
1:6 desnsity	0.41	3.18	3.88	4	5
1:8 desnsity	0.41	2.1	2.61	4.75	6.25

Fig. 9: Water Absorption Vs sawdust replaced with sand

V. ANALYSIS OF RESULT AND DISCUSSION

To introduce the use of sawdust in sandcrete blocks, the experimental analysis has been carried out. All experimental data and their results has been presented in the form of Tables and Graphs.

The Table 1 and typical nature of graph shown in Fig. 2 to 7 shows that as the percentage of sawdust increases, there is reduction in compressive strength significantly. As the study emphasizes on the partition wall of the framed structure, the reasonable low compressive strength blocks can also be used in the construction work. The behavior of block in compression as shown in fig. 2 to 7 reveals that compressive strength is more under gunny bag curing as compared to sprinkler curing. This may be due to the fact that, the gunny bag provides higher range of hydration to the block, that lead to desirable results. .

The average value of the strength required for partition wall varies from 3 to 5 N/mm^2 [2]. It is worth noting here that the gunny bag curing to 1:6 (1 part of cement to 6 part (85% sand + 15% S.D.)) provides sufficient compressive strength (4.5.N/mm^2)to meet practically any requirement in the partition wall construction in framed structure multistoried building.

Density analysis shows that as % of sawdust increases, the density is greatly reduced. The results are shown in Table 2. As sawdust % increases in the sandcrete blocks density of the mortar decreases. The proportions of 1:6 cement and sand with 15% replacement of sawdust the observed valued of density is 2000 kg/m^3.

The absorption of water to some extent is appreciable and advisable, but excessive of it causes various defects in the block. Seepage of rain water, shrinkage of block after drying, thus cracking of blocks, opening of the joints are few points to be taken in to consideration. The addition of sawdust to the block rises the limit of its water absorption to significant extent. Test results are mentioned in Table 3. Experimental results show that water absorption % of various proportions of cement, sand for a various proportion of sawdust % ranges from 0.41% to 6.21%. The block without the sawdust has not shown any change in the absorption capacity with change in the proportion of cement, sand. It is noted that it is the % of sawdust causing the increase in water absorption capacity and not the proportion of cement: sand. For 1:6 cement and sand with 15% sawdust, water absorption capacity was found to be only 4%, which is within permissible limit.

As compared to conventional concrete blocks, 15 to 20% saving in terms of cost of material is possible if saw dust sandcrete blocks are used as masonry material in frame structure building .

VI. CONCLUSION

The objective of this study was to focus the attention on performance of sawdust in sandcrete blocks in the construction.

Detailed study was carried out and experimental work was done. Final conclusions of the study are as below.

1. Compressive strength of the block is the major factor to be taken into account for the construction purpose. It varies with the addition of the sawdust. As the present study emphasizes on the partition wall of the framed structure, so the reasonable strength of the block is sufficient. The 1:6 cement sand mix. with 15% sawdust

replacement gives strength of 4.5 N/mm^2 /cm^2 which is reasonable and economical to be used for the partition walls in frame structure.

2. Density of block reduces with increase in the % of sawdust. 1:6 cement sand with 15% sawdust replacement is found to be suitable from the point of view of strength as well as density, Since for this ratio density is 2000 kg/m$^{3.}$
3. Water absorption capacity increases with increase % of sawdust. Larger absorption of water causes the reduction in the strength. However for 1:6 proportions with 15% sawdust replacement, water absorption found to be within reasonable limit.
4. Two types of the curing method were adopted for the experimental work. (Sprinkler & gunny bag curing). The result of latter method of curing was appreciable. This was due to the fact that sawdust contained blocks required light but regular moisture content for hydration purpose.

It was unpresidently noted that complete submergence provided negligible strength. This was due to fact that sawdust caused more voids in the block thus rejecting the cement from it.

It is observed that the result of the tests are sufficiently encouraging to advocate a full scale production of sawdust sandcrete blocks with 1:6 cement sand with 15% sawdust replacement for use in masonry work having its own advantages in terms of thermal property too. The saving in terms of materials are appreciable.

Fire proof, thermal resistance properties, quality of saw dust and its effect on compressive strength, bending strength, statics hardness and shear strength require further study. Scope of the study can further be extended on hollow sandcrete block.

REFERENCES

[1] Parkar T. W. 1997, Sawdust cement and sawdust products, Journal of light weight concrete 1,2 p.p. 41,108 Dec. 1997.

[2] Neville A. M., 1983 “Proportion of concrete” 3rd edition, long man science & Technology, Horrow esses, U. K.

[3] S.T. Tyagher, et al (2011), “Suitability of Saw Dust ash-lime mixture for Production of Sandcrete Hollow Blocks”, Nigerian Journal of Technology Vol. 30, No. 1, March 2011.

[4] Adebakin I. H. et al (2012), “Uses of sawdust as admixture in production of low-cost and light-weight hollow sandcrete blocks American journal of scientific and industrial research. ISSN: 2153- 649X, 2012,volume 3, issue 6 page no. 458-463.[2]

[5] L.O.Ettu, et al (2013), Variation of OPC- Rice Husk Ash- Saw Dust Ash composites strength with mix proportion ISSN:2277-9655 Impact factor: 1.852 Ettu. 2(8): August,2013)

[6] Atis C.D., et al (2005), “Influence of dry and wet curing conditions on compressive strength of silica fume concrete”, Building and environment, 2005, Vol. 40 p.p. 1678-1683.