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AN EXPERIMENTAL INVESTIGATION OF RICE HUSK CEMENT BOARD PARTITION REINFORCED WITH SISAL FIBER

S.Javid Ahamed[1],B.Jayachandaran[2], O.R.Karthik[3], T.Lokesh[4],

N.Vinoth Kumar[5],

[1,2,3,4] B.E., Student, Department of Civil Engineering, SRM Valliammai Engineering College,

SRM Nagar, Kattangulathur-603 203, Tamil Nadu, India.

[5] Assistant Professor, Department of Civil Engineering, SRM Valliammai Engineering College,

SRM Nagar, Kattangulathur-603 203, Tamil Nadu, India.

Abstract: The experimental investigation is to know the behavior of rice husk cement partition board reinforced with Sisal Fiber which is effective in both cost and stability. Nowadays the major problems faced by the world is global warming. The use of such boards could be seen as partially solving the problem of global warming and the problem of pollution associated with the disposal of rice husks in developing countries. Instead of that need alternative material for without affecting the environment. In our investigation an attempt made to partial replacement of cement by rice husk and sisal fiber used to improve the strength of board.

Results indicate that water absorption and thickness swelling decreased with an increase in fiber content and that there is an optimum rice husk / cement ratio and fiber content that gives maximum flexural strength and that such boards could be used in low cost housing construction.

This study has deals with the ultimate strength of rice husk cement partition board reinforced with sisal fiber and influence of fiber content in board at various proportions of sisal fiber has been find out by conducting Compressive strength, Flexural strength, Water absorption tests, Drilling characteristics and Drop-down characteristics.

Keywords: Rice husk, Sisal fiber, Cement, Calcium chloride

1. INTRODUCTION

The increase in population, the growing desire to cutting the forest and increase in the number of major problems faced by the World is Global Warming. The causes of Global Warming are high Emission of CO2, CO and Hydrofluorocarbon, it is mostly controlled by afforestation but every year several square kilometers of forest are destroyed due to increase in need of Timber and other uses in construction work. Instead of that alternative material without affecting the Environment. So, we Recycle waste Organic Demand for wood products. Composites are a material to form Panels which is effective in both cost and stability.

Fibers are added to cement based matrices as primary or secondary reinforcement. In thin products where conventional reinforcement bars cannot be used, fibers can be added as primary reinforcement. In these applications the fibers increases both the strength and toughness of the composite.

To find substitutes for solid wood as the factors such as resource quality, rising timber prices in growing world. Panels made from agricultural materials are economic and long last in life. And also, the panels are replacing for wooden panels.

1.1 OBJECTIVES

- To determine sisal fibers could be used to reinforce rice husk cement paste composites and also find the optimum mix proportions of the ingredients.
- To utilize the rice husk effectively for making cement board.
- To find the results for various sets of tests to be check the nature of cement board.
- To compare and analyses the properties of unreinforced cement board with rice husk cement board reinforced by sisal fiber.

1.2 SCOPE

- To encourage the use of agricultural materials for various purpose in construction.
- Natural fibers are considered as possible replacement for synthetic fiber in fiber/polymer composite.
- Natural fibers have significant advantages over synthetic fibers, in terms of the positive environmental impact, low cost, low density and their biodegradability.
- To gain the technical knowledge about various composition of agriculture materials.
- Panel will reduce the pollution and promotes reuse.

2. EXPERIMENTAL PROGRAM

2.1 PANEL FOR PARTITION BOARD

Cement board Panel is generally a member which is made from the cement, agricultural material and fiber which used for several purposes in our construction field. Panels are playing a role as various members in the buildings i.e. Doors, windows, ventilators, partition panels, fall shieling.

Cement board panels usage drastically developed in our construction field due to demand of various construction materials. Panels are used as both horizontal and vertical member based upon our need.

2.2 PANEL FROM AGRICULTURAL MATERIAL AND FIBER

The materials used for making panel is very cheap and easily available that encourage us to make panel from agricultural materials. This will lead to show a new way to alternative source of using the agricultural materials. In our project the materials are selected based on their properties.

2.3 MATERIALS AND CHEMICALS USED

- Rice husk
- Sisal fiber
- Cement
- Calcium chloride

2.3.1 MATERIALS PROPERTY

RICE HUSK

- Class A insulating material
- Silica makes less attractive to Termites
- It consists of Silica and Lignin
- It is highly Porous and light Weight

Fig 1 Rice husk

SISAL FIBER

- It is anti-static
- Does not absorb moisture or water easily
- As good brittle strength

- Exhibits good sound and impact absorption properties

Fig 2. Sisal fiber

2.4 MIX RATIO

The agricultural materials are having various types of physical and chemical property so that various types of ratio are needed to mix the materials in various propagation. It is essential to find the right mix used for panel making.

Table 1. Mix Ratio

Samples	Ratio of Mortar	Vol. of Cement (cu.m)	Weight Of cement (kg)	Vol. of Rice Husk (cu.m)	Weight of rice husk (kg)	W/C Ratio	Water content (ml)	Sisal Fiber (g)
CB	1:0 (without sisal & rice husk)	0.001715	2.5	NIL	NIL	0.4	1000	NIL
RCB	1:0.25 (with rice husk & 0 % sisal)	0.001372	1.97	0.000343	0.205	0.4	788	NIL
FRCB 1	1:0.25 (with rice husk & 0.6% sisal)	0.001372	1.97	0.000343	0.205	0.4	788	12
FRCB 2	1:0.25 (with rice husk & 0.8% sisal)	0.001372	1.97	0.000343	0.205	0.4	788	16

2.5 MOULD MAKING

- Mould is made from wood
- Base plate thickness is of 20mm
- Side plate thickness is of 20mm
- Top plate size is of 300mm x 300mm
- Bottom plate size is 320mm x 320mm

Fig 3. Mould for partition board

2.6 HYRADULIC LOAD PRESS

The materials are mixed together in the right proportions. Then the materials are filled inside the mould are given load to remove the voids and compact the materials to attain its strength. The UTM is used for hydraulic press due to its high loading capacity and availability of machine.

- Materials filled in the Mould about a Height of 20 mm.
- Top of the Mould is Closed with the Top Plate.
- Mould is Placed and Positioned on the UTM.
- UTM is operated and the load is gradually applied on the Mould.
- The Height of the Material is reduced from 20 mm to 18 mm.
- Finally, the cement board is formed.

3. RESULTS AND DISCUSSION

3.1 TEST

The panel are made after hydraulic press are to checked various properties by several tests. The panel are undergoing several sets of tests as per IS code. It clearly explains about the tests are to done by step wise procedure.so that the properties of plates are to determine by test.

The various types of tests are conducted on cement board,

- Determination of compressive strength perpendicular to surface
- Determination of water absorption
- Determination of drilling characteristics
- Determination of drop-down characteristics
- Determination of flexural strength

3.1.1 DETERMINATION OF COMPRESSIVE STRENGTH PERPENDICULAR TO SURFACE

The test specimen shall be 300 X 300 X 18 mm, the specimen shall be prepared in the correct size. The test shalt be carried out at room temperature on a suitable testing machine. The specimen shall be placed perpendicularly on the platform of the machine in flat position. The load shall be applied vertically on the specimen through a bearing plate placed on the specimen and covering the whole surface. The compressive strength of the samples was evaluated at the sample age of 7days, 14days and 28 days.

Table 2. compressive strength

Mix designation		Ultimate load (KN)			Compressive strength			Mean value		
		7 days	14 days	28 days	7days	14 days	28 days	7 days	14 days	28 days
		KN	KN	KN	N/mm^2	N/mm^2	N/mm^2	N/mm^2	N/mm^2	N/mm^2
CB	Sample 1	14.25	16.62	19	2.63	3.07	3.51	2.66	3.025	3.49
	Sample 2	14.53	16.1	18.75	2.69	2.98	3.47			
RCB	Sample 1	18	21.5	23.16	3.33	3.98	4.28	3.318	3.97	4.315
	Sample 2	17.86	21.39	23.52	3.307	3.96	4.35			
FRCB 1	Sample 1	24.33	28.43	32.45	4.50	5.26	6	4.46	5.32	6.075
	Sample 2	23.88	29.1	33.24	4.42	5.38	6.15			
FRCB 2	Sample 1	32.61	38.04	43.48	6.03	7.04	8.05	5.97	7.015	7.995
	Sample 2	31.95	37.78	42.89	5.91	6.99	7.94			

Fig 4. compressive strength perpendicular to surface in UTM

3.1.2 DETERMINATION OF WATER ABSORPTION

Each test specimen shall be 300 X 300 X 18 mm and shall be prepared. Conditioning, the specimen shall be weighed to an accuracy of not less than ±0.2 percent and the width, length and thickness shall be measured to an accuracy of not less than ±0.3 percent. The specimen shall then be submerged horizontally under 25 mm fresh clean water maintained at a temperature of 27 ± 2°C.After a 2-hour submersion, the specimen shall be suspended to drain for 10 minutes, at the end of which time the excess surface water shall be removed and the specimen immediately weighed. The specimen shall then be submerged for an additional period of 22 hours and the above weighing procedure repeated.

Table 3. water absorption

Samples		Dry weight (Kg)	Wet weight (Kg)	Water Absorption (%)	Mean Value
CB	Sample 1	3.23	3.42	6.16	6.17
	Sample 2	3.24	3.44	6.17	
RCB	Sample 1	2.69	2.89	7.43	7.43
	Sample 2	2.69	2.89	7.43	
FRCB 1	Sample 1	2.67	2.86	7.16	7.15
	Sample 2	2.66	2.85	7.14	
FRCB 2	Sample 1	2.77	2.85	2.88	2.87
	Sample 2	2.78	2.86	2.87	

The water absorption by specimen which helps to find the exposure to humidity in the outer area.

Fig 5. specimen kept for water absorption

3.1.3 DETERMINATION OF DRILLING CHARACTERISTICS

The test specimen shall be 300 X 300 X 18 mm, the specimen shall be prepared in the correct size. Mark the spot to drill the hole with a pencil or marker. Punch a small hole on the spot using a hammer or nail. This will make a slight indentation in the panel to place the drill bit. Fit the drill bit into the hole. Start drilling at a low speed. Slowly increase the drill speed. Reduce the speed of the drill hole is made and slowly pull the bit out. Switch the drill off when the bit is completely out of the hole.

Table 4. Drilling characteristics

Samples	Evaluation of failure
CB (0%Rice husk + 0% of Sisal Fiber)	Cracks
RCB (Rice husk + 0% of Sisal Fiber)	No cracks
FRCB 1 (Rice husk + 0.6% of Sisal Fiber)	No cracks
FRCB 2 (Rice husk + 0.8% of Sisal Fiber)	No cracks

Fig 6. RCB & FRCB showed efficient drilling characteristics

3.1.4 DETERMINATION OF DROP-DOWN CHARACTERISTICS

Each test specimen shall be 300 X 300 X 18 mm and shall be prepared. The specimens are dropped from a particular distance. One board from each category was selected for this test. Each board was dropped from 12 feet height.

Table 5. Drop down characteristics

Samples	Evaluation of failure
CB (0%Rice husk + 0% of Sisal Fiber)	Cracks & Detachment
RCB (Rice husk + 0% of Sisal Fiber)	Small cracks
FRCB 1 (Rice husk + 0.6% of Sisal Fiber)	No cracks, slight bending
FRCB 2 (Rice husk + 0.8% of Sisal Fiber)	No cracks, no bending

Fig 7. CB cracks & detachment

Fig 8. FRCB 1 & FRCB 2 no cracks & slight bending

3.1.5 DETERMINATION OF FLEXURAL STRENGTH TEST

The test specimen shall be 300 X 300 X 18 mm, the specimen shall be prepared in the correct size. The test shalt be carried out at room temperature on a suitable testing machine. The specimen shall be placed parallel on the platform of the machine in flat position. The load shall be applied vertically on the specimen. The flexural strength of the samples was evaluated at the sample age of 28 days

Table 6. Flexural strength

Samples		Ultimate load (KN)	Flexural strength (N/mm^2)	Mean value (N/mm^2)
CB	Sample 1	1.05	3.24	3.32
	Sample 2	1.10	3.39	
RCB	Sample 1	1.23	3.79	3.75
	Sample 2	1.20	3.70	
FRCB 1	Sample 1	2.02	5.45	5.52
	Sample 2	2.08	5.59	
FRCB 2	Sample 1	3.76	4.77	4.68
	Sample 2	3.70	4.59	

Fig 9. Shows the failure state of the specimen when subject to flexural

4. CONCLUSION

1. The compressive strength firstly increased with increase in fiber content up to 0.8 % and then decreased upon further increment of fiber content.
2. The flexural strength is increased with increase in fiber content about 66.26% when compared with cement panel.
3. The percentage of water absorbed by the boards decreased from 6.17% to 2.8% respectively.
4. Cement panel board has poor drilling characteristics. On other hand, fiber cement boards with 0%, 0.6% and 0.8% fiber content showed effective drilling characteristics.
5. CB cement panel board and RCB 0% sisal fiber content displayed small cracks and detachments occur. On the other hand, fiber cement panel with 0.6% and 0.8% fiber content showed no crack on the drop-down characteristics.

The conclude as, different types of sisal fiber content 0%, 0.6% and 0.8% cement board compared with the normal cement board. The 0.8 % sisal fiber cement board will be obtaining the maximum Compressive strength, Water absorption, Drilling characteristics and Drop-down characteristics. and the 0.6 % sisal fiber cement board will be obtaining the maximum Flexural strength.

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