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A new design recycle agricultural waste materials for profitable use rice straw and maize husk in wall

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Abstract

This research presents the wall light to develop products from agricultural waste. We are using rice straw and shell corn as raw material. Adhesives and synthetic urea Fort Thomas aldehyde 13% act as adhesives. Manufacture of light wallboard made by heat compression at temperatures 120 ° C with pressure of 150 kg/m² for recording the 9th Na density of 400 kg/m³ and 600 kg/m³ dry. To study the thermal properties, ASTM C 177 standard test of physical and mechanical properties JIS A 5908: 2003(8type), respectively. The results show that wall light from agricultural waste. Using straw and shell corn Organized a great wall of light is determined by the materials tested showed that the fibre material derived from corn shell. Density of 600 kg/m³ feature good product. The water absorption of less value to 61.00 (1hoursoak) 104.93 (Soak 24hours) tension fire. (Internal Bond) to 0.16 MPa density (Density) 622.09 kg/m³ and moisture (Moisture Content) 10.54% 13% by volume of synthetic adhesives, dry weight. In this paper show result optimize of the properties of standard JIS A 5908-2003 and Mokfrom0.876to2547.

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Keywords: recycle agricultural; waste materials; rice straw; maize husk

1. Introduction

Thailand is a major agricultural country of the world which more than 50 percent of the farmers. By-product is agricultural waste such as straw, rice husk, black ash, palm fiber and the amount of agricultural waste in each year has been increased. Therefore, it has environmental consequences due to failure to eliminate three of the residues from agricultural production. [1] Currently used agricultural residues from renewable sources have been used for industrial applications and the production of light wall panels because it can help reduce the impact to the environment. The benefits of this research is to produce wallboard manufacturing to develop new products in light industry, construction materials which has no pollution to the environment and earn income for farmers in local communities that grow economic plants using materials from rice straw and corn husk as a major component.

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2. The theory of light wallboard

2.1. Properties of light wallboard [2]

- 2.1.1 Able to protect the heat from the sun through the ceiling and walls into the building.
- 2.1.2 Retain and prevent loss of cold air.
- 2.1.3 Absorb the noise from outside the building and reduce the volume down from 35-60 decibels.
- 2.1.4 Protect rainwater from the roof shall not leak through the ceiling.
- 2.1.5 Do not absorb water and moisture.
- 2.1.6 It is not a food or housing of insects and animals.
- 2.1.7 Good for health, Non-irritating to the respiratory system and no cause of skin cancer.

2.2. The definition of thermal insulation [3]

Thermal insulation means material capable of blocking the transmission of heat from one side to the other side easily. Transfer heat from one side to the other side of any materials or heat transfer (heat transfer) between objects can be achieved only when the temperature of both objects are different. Heat is a process. This happens because the metal atoms in the case of thermal conductivity as a result of the movement of free electrons (Similar to electrical conductivity) in liquids and solids having a low thermal conductivity. The thermal conductivity of the gas occurs through the oscillation between the molecules. It was found that the rate of heat transfer by thermal conductivity is directly proportional to the difference in temperature across the surface of the object. (The high temperature and low temperature) and surface heat flow (perpendicular to the direction of flow of heat) is proportional to the thickness of the object, the heat of the flat as shown in Fig. 2.1 and can be calculated by using equation 2.1.

$$Q = \frac{K \cdot A [T_1 - T_2]}{X} \quad (2.1)$$

- where
- Q is the heat flow per 1 minute is measured in watt (W).
 - K is the thermal conductivity is measured in watts / m.K. (W / m.K).
 - A is the cross-sectional area of the heat flow is measured in square meter.
 - T₁-T₂ is the high and low temperature on the surface of each side respectively, measured in Degree Kelvin.
 - X is the thickness of the board measured in meter.

Table 1. Physical properties, the heat of the material and insulation of buildings [4]

Material density	Density (kg/m ³)	Thermal conductivity (W/m.K)
Gypsum board	801	0.16
Low-density plywood board.	593	0.08
Medium-density plywood board.	801	0.14
High-density plywood board	1001	0.17
Plywood board using for supporting	641	0.31
Plywood board	545	0.14
Medium-density overlay board.	352	0.06
Normal density overlay board.	288	0.05
High-density hard board under normal temperature	881	0.12
High-density hard board under standard temperature	1009	0.14
Medium-density hard board	801	0.09

Table 2. Types of Particle board density [5]

Types of particle board	Density (Kg / delete key.)		
	FAO 1976	CS 236-66	TIS 876-2532
Low density or Insulation board	250-400	<590	-
Medium density	400-800	590-800	500-800
High density or Hard board	810-1200	>800	-

3. Materials preparation for trial [6]



Fig. 1. Physical characteristics of corn husk



Fig. 2. Physical characteristics of screened corn



Fig. 3. Physical characteristics of rice straw



Fig. 4. The physical characteristics of the screened straw

3.1. Factors contributing to the research

- 3.1.1 Coarse and fine grinder.
- 3.1.2 Hydraulic pressing machine.
- 3.1.3 Digital weight machine.
- 3.1.4 Moisture measurement machine.
- 3.1.5 Split and screen size machine.
- 3.1.6 Tensile test machine.
- 3.1.7 Anchor screws Test machine.
- 3.1.8 Tensile test perpendicular machine to the surface.
- 3.1.9 Thermal Conductivity Tester.
- 3.1.10 Water absorption equipment tester and swelling when immersed in water.

4. Results

A study of the properties of a light wall, two types of agricultural residues and researcher shaped the light wallboard. Use of adhesives; types of synthetic adhesives, urea, formaldehyde resin of industrial grade, 13% by weight of dry ingredients, mixing ratio, which consists of two rates fiber from the husk of corn and fibers from rice straw. The samples were tested to calculate thermal conductivity by using ASTM C 177.

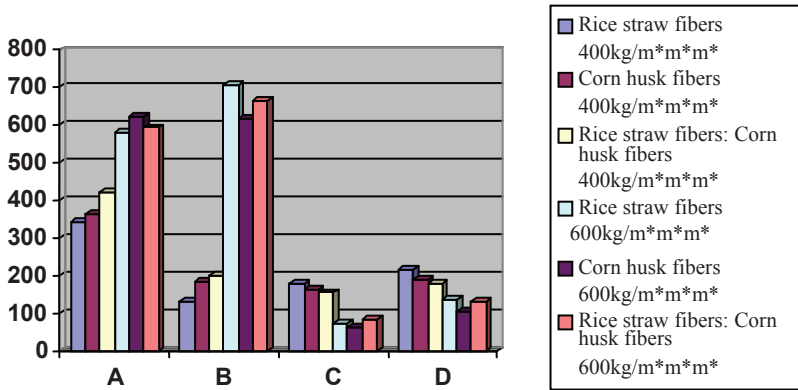


Fig. 5. Show physical and mechanical properties

Table 3. The physical and mechanical properties

Symbolic	Meaning
A	Density test results
B	Elastic modulus resistance test result
C	The absorption of water for 1 hour test result
D	The absorption of water for 24 hours test result

It was found that density, resistance modulus of elasticity, the absorption of water for 1 hour and 24 minutes of rough and fine fibers can mix together perfectly and also has less porous the distribution of the waterproofing coating to reach the compression board. This is to help increasing board thickness result in capturing a piece of contact between the binders fibers are closely packed in the heat compression.

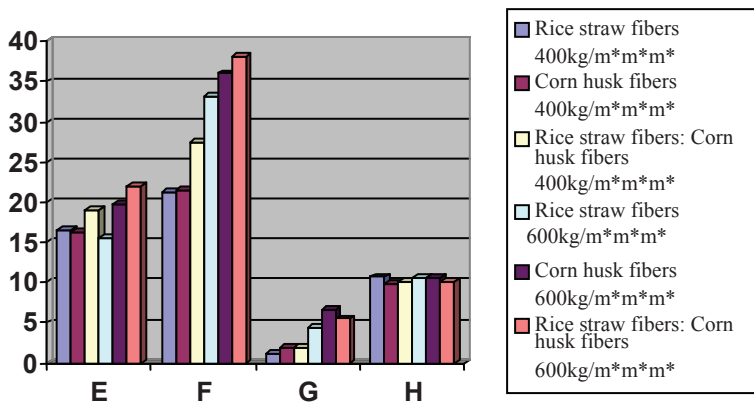


Fig. 6. Show physical and mechanical properties

Table 4. The physical and mechanical properties

Symbolic	Meaning
E	The expansion of the thickness for 1 hour test result
F	The expansion of the thickness for 24 hours test result
G	Russell cracking resistance modulus test result
H	Test result of moisture content

It was found that Russell cracking resistance modulus for humidity and thickness swelling at 1 hour and 24 hours showed that the amount of the adhesive sheet resistance modulus of rupture and elastic modulus. From the graph, which is likely to stick together and the fibers are long slender and short ratio of the fiber. The strength of the bending of the sheet resistance is high. Because the fibers thinner than a piece of the plate with a less gap. The distribution of stress (Stress) caused by the bending is consistent throughout the piece as well as the long fibers are also affected to the compressive result in contrast to the above board of fiber. This could not resist cracking a high modulus because there is less overlapping pieces of fiber.

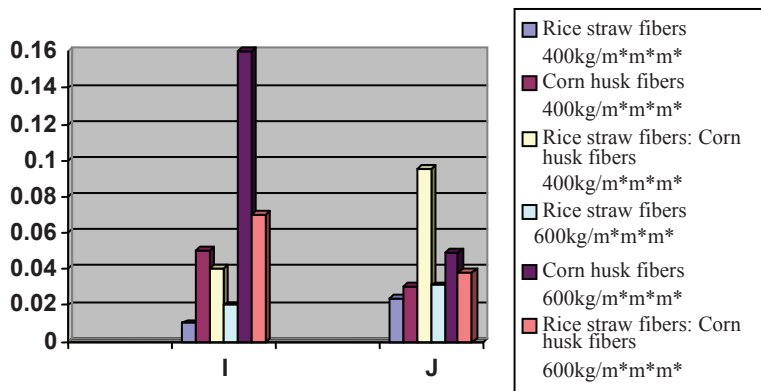


Fig. 7. Show physical and mechanical properties

Table 5. The physical and mechanical properties

Symbolic	Meaning
I	The internal bond test result
J	The study of thermal conductivity

The experiment found that density affected to the internal bond highly that is the adhesives contents and different in mass. The trend of bond is bond when the internal bond is higher. The fibers are thin and long pieces. The board with a less stress gap can be distributed across the entire board. The fibers are thin and long pieces also affected to the compressive. Pulling force parallel to the surface of the board, but a piece of fiber length effected to the internal bond strength (Internal bond) and the ability to reduce the dispersion of the fiber pieces effectively. The bond strength was adequate. There are also other factors such as the shape of the fiber. The proportion of small pieces of fibers is different, the moisture content of fiber and the integrity of the product.



Fig. 8. Shows a lightweight prefabricated wall

5. Conclusion

Physical properties test results showed that the moisture content, density, water absorption and swelling when immersed in water for 1 hour and 24 dropped, but depending on the type of fibers in use. The adhesive at 13% by dry weight, water absorption properties for 1 hour and 24 hours at 600 kg/m³ corn fiber hull has absorbed less water than other fiber materials for 1 hour, the swelling of rice straw fibers can swell least 600 kg/m³ and 400 kg/m³ 24 fibers from rice straw.

Test results showed that the mechanical properties indicated that resistance to cracking modulus and elasticity modulus. Strength perpendicular to the surface or within the anchor is higher. The amount of adhesive is at 13% by dry weight. The corn husk fiber properties are at 600 kg/m³.

The results showed that the thermal properties of adhesive board 13% have a high thermal conductivity material mixed with rice hulls, corn fiber 400 kg/m³, which shows that in experimental research. Fiber materials and ingredients are parts that have a higher heating value. From this research, we can conclude that the study of the possibilities. In the agricultural waste mixed in different ratios according to the features and proportions and can produce light, heat insulation wall panels used for buildings. Light wall can be used for the building like into a wall or ceiling etc.

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