The Properties of the Insulation of Grass
คุณสมบัติฉนวนกันความร้อนของหญ้า

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Abstract

The main purpose of this paper is to study the properties of the insulation of grass. The ratio of mixture of grass and water timber were investigated with 60:40, 70:30 and 80:20 respectively. The sample were prepared on block size 15x15x3 cm^3. It was observed the physical and thermal properties. The results found that the density of insulation of grass were 0.020 - 0.021 g/cm^3 .The absorption of the sample were 5.769%, 6.060% and 3.125%. The tensile of all insulation sample around 7.614-8.628 Mpa. The thermal conductivity with ratio of grass and water timber 60:40, 70:30 and 80:20 were 0.0493, 0.0196 and 0.0351, respectively. The results confirm that the insulation of grass with ratio of grass and water timber of 70:30 is the most appropriate to develop the insulation.

Keywords: Insulation, Grass, Water timber, Thermal conductivity

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บทคัดย่อ

งานวิจัยนี้มีวัตถุประสงค์เพื่อศึกษาคุณสมบัติฉนวนกันความร้อนของหญ้าโดยมีส่วนผสมระหว่างหญ้าและน้ำยางพาราในอัตราส่วน 60:40 70:30 และ 80:20 ตามลำดับ กลุ่มตัวอย่างมีรูปร่างเป็นบล็อก ขนาด 15x15x3 cm^3 จากนั้นผู้วิจัยได้ศึกษาคุณสมบัติทางกายภายและความร้อน พบว่า ความหนาแน่นของฉนวนกันความร้อนของหญ้าคือ 0.020-0.021 กลุ่มตัวอย่างมีการดูดซึมร้อยละ 5.769 6.060 และ 3.125 แรงตึงของตัวอย่างฉนวนกันความร้อนอยู่ที่ประมาณ 7.614-8.628 Mpa การนำความร้อนของส่วนผสมระหว่างหญ้าและน้ำยางพาราในอัตราส่วน 60:40, 70:30 และ 80:20 คือ 0.0493 0.0196 และ 0.0351 ตามลำดับ ผลการศึกษายืนยันว่า ส่วนผสมระหว่างหญ้าและน้ำยางพาราในอัตราส่วน 70:30 มีคุณสมบัติในการกันความร้อนที่เหมาะสมที่สุดสำหรับการพัฒนาให้เป็นฉนวนกันความร้อน

คำสำคัญ: ฉนวนกันความร้อน หญ้า น้ำยางพารา การนำความร้อน

Introduction

The growing environmental awareness throughout the world has triggereda shift towards developing environmentally friendly materials from renewable resources. Thermal insulation plays an important role in contributing to the energy savings in the building by heat gains and losses through the building envelope (Al-Homoud, 2005). A study reported that effective building insulation alone will save over one hundred times the impacts of carbon foot print from material usage and disposal, irrespectively of the materials used (Schmidt et al., 2004). With new regulations and increasing demand for alternative materials, development of materials which can provide both thermal. A study has been reported on the development of insulation materials from sheep wool fibers with comparable properties as that of conventional materials (Zach et al., 2012). In another recent study, authors highlighted the quantity issues of alterative sheep wool materials available in the market to meet the demand for the building sector, although sheep wool materials are very good insulators (Corscadden et al., 2014). One of the problems associated with the sheep wool insulation materials is their susceptibility to higher moisture content and resultant drop in their performance (Kehrer et al., 2003; Abdou et al, 2013)

Several authors have analysed the thermal degradation of different natural fibres and composites that include such fibres (Chapple et al., 2010). A thermal analysis of cellulose derivatives/starch blends with different sisal short fibre content, and found that the addition of the sisal fibres produced no significant effect on the thermal degradation of the composite materials in comparison with the matrix alone (Alvarez et al., 2004; Yao et al., 2008) Some resercher investigated the thermal decomposition processes of 10 types of natural fibres commonly used in the polymer composite industry. These fibres included wood, bamboo, agricultural residue, and bast fibres. (Dorez et al., 2008) considered cellulose, hemp, fiax, sugar cane and bamboo as natural fibres, and polybutylene succinate (PBS) as polymer matrix. The treatments of fibres prior to their use in composites have also been analysed in terms of possible changes in their thermal degradation properties. For example (Rana et al., 1997) used a simple solvent and catalyst acetylation method on jute fibres and obtained that the thermal stability of acetylated jute was higher than the untreated jute.

The aim of the experimental study was to determine which ratio of grass and water timber has the value of physical properties and which has the best insulation with the low thermal properties.

Objectives

1. To determine the appropriate ratio of grass and water timber to produce insulation.
2. To investigated the physics and thermal properties.

Materials and methods

Materials

1. Grass.
2. Sodium hydroxide (NaoH 5%)
3. block size 15x15x3 cm^3
4. Water timber
5. Beakers 3000 ml
6. The glass substance
7. Vernier resolution of 0.01 mm

8. Thermometer resolution of 1°C

9. Force gauge

10. Heat oven

Methods

Part 1 Fiber preparation

Take grass to cutting for 2 cm. Then take it boiling for 30 minute with sodium hydroxide (NaoH 5%). Dried at a temperature of 100°C.

Part 2 Insulation formulation

1. Mixed fiber grass (from part 1) and water timber with ratio of 60:40 by weight.

2. Take mixed fiber grass and water timber into block size 15x15x3 cm^3

3. Take grass insulation to bake at 100°C for 3 hours. (Figure 1)

Part 3 Analysis

1. Tensil

The sample of 15x15x3 cm^3 were tied with rope and tied one side with holder of force gauge and another side tied with base of force gauge, after that rotating the force gauge until the sample are separate.

$$\sigma = \frac{F}{WD} \qquad [1]$$

σ = stresses (N/m^2)

F = the force (N)

W = the is width of a rectangular piece of test. (m)

D = Is the width of a rectangular piece of test. (m)

2. Water absorption

Prepared the sample of and measured weight of them then, take the sample to soak of water for 24 hour and measured weight again

$$W_a = \left[\frac{W_1 - W_2}{W_1} \right] x100 \qquad [2]$$

w_a = water absorption (%)

w_1 = weight of sample before soak of water (g)

w_2 = weight of sample after soak of water (g)

3. Density

Prepared the sample of and measured the weight and volume. Then calculated the density for equation (3)

$$p = \frac{m}{v} \quad [3]$$

p = density (g/cm^3)

m = mass (kg)

v = volume cm^3

4. Thermal conductivity

The sample measured by ASTM C177

5. The rate of thermal conductivity

Follow equation (4)

$$Q = -KA \frac{dt}{dx} \quad [4]$$

Q = The rate of thermal conductivity (W)

K = Thermal conductivity ($W/m.$)

dt = Different of temperature (outside and inside of room) (°C)

dx = Different of temperature of thickness (cm^3)

Results

Table 1. summarises the results obtained for the three ratio of grass and water timber, average over three ratio sample of each type.

1. Physical properties

- Tensile

One of the objective was to obtain good insulation property in the sample in addition to the thermal insulation property. All developed samples showed good tensile are showed figure 1. The lowest value was 7.614 Mpa. Ratio of (60:40) and highest was 8.628 (ratio of 80:20)

- **Water absorption**

All natural fibers (including fiber from animal origin) absorb moisture when they are exposed to the environment, especially during high humidity condition It the insulation sample absorbs the moisture to a considerable extent , it significantly affects the thermal insulation property and its ability to perform the intended function of providing insulation. The results of absorption in this sample show in figure 2. All sample absorbed 3-6% of moisture, litter higher than the specific requirement of 2%.

- **Density**

The density of sample is presented in figure 3 There are 0.020 - 0.021 g/cm^3, which shows that the density of the insulation is similar. Thus, the ratio of grass and water timber may not be sufficient to reveal such difference.

Table 1 Formulations of physical and thermal insulation

ratio	Time	density (g/cm^3)	Water absorption (%)	Tensile (MPa)	The rate of thermal conductivity (W)	Thermal Conductivity ($W/m.K$)
60:40	1	0.021	5.769	8.634	0.00729	0.0493
	2	0.021	5.769	7.602		
	3	0.021	5.769	6.608		
	Average	0.021	5.769	7.614	0.00729	0.0493
70:30	1	0.021	6.060	8.54	0.00544	0.0196
	2	0.021	6.060	8.626		
	3	0.021	6.060	8.598		
	Average	0.021	6.060	8.588	0.00544	0.0196
80:20	1	0.020	3.125	8.970	0.00928	0.0351
	2	0.020	3.125	8.468		
	3	0.020	3.125	8.448		
	Average	0.020	3.125	8.628	0.00928	0.0351

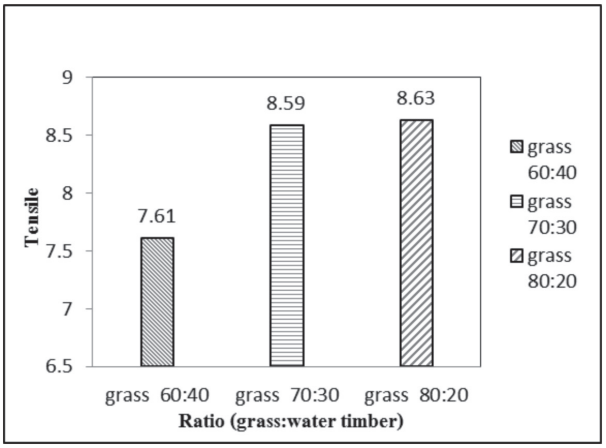

Figure 1 The tensile of grass insulation with various ratio.

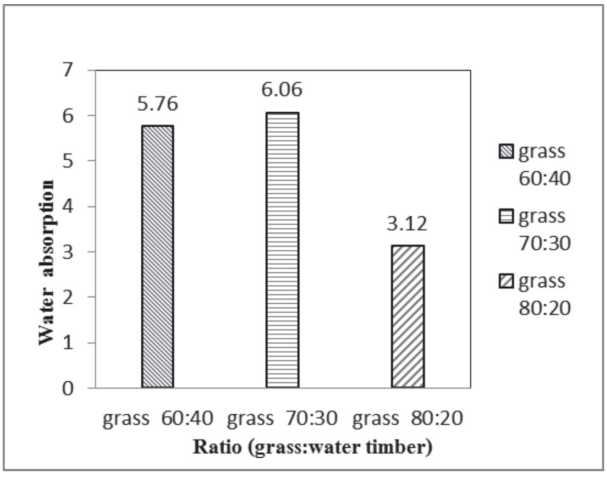

Figure 2 The absorption of grass insulation with varlues ratio.

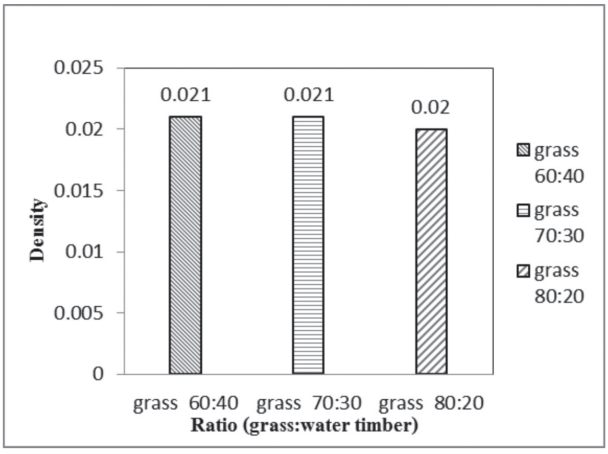

Figure 3 Analysis of density with varlues ratio

2. Thermal properties

- Thermal conductivity

The three ratio of thermal conductivity insulation materials presented in figure 4 were analysed with Test properties of thermal insulation.. The results showed that thermal conductivity as a function of times ware increased until the time of 3300 s the thermal conductivity were stable. The highest value of thermal conductivity was 0.0493 w/m.K. for ratio 60:40 the sample ratio 70:30 was lowest value of thermal conductivity. (0.0196 w/m.k)

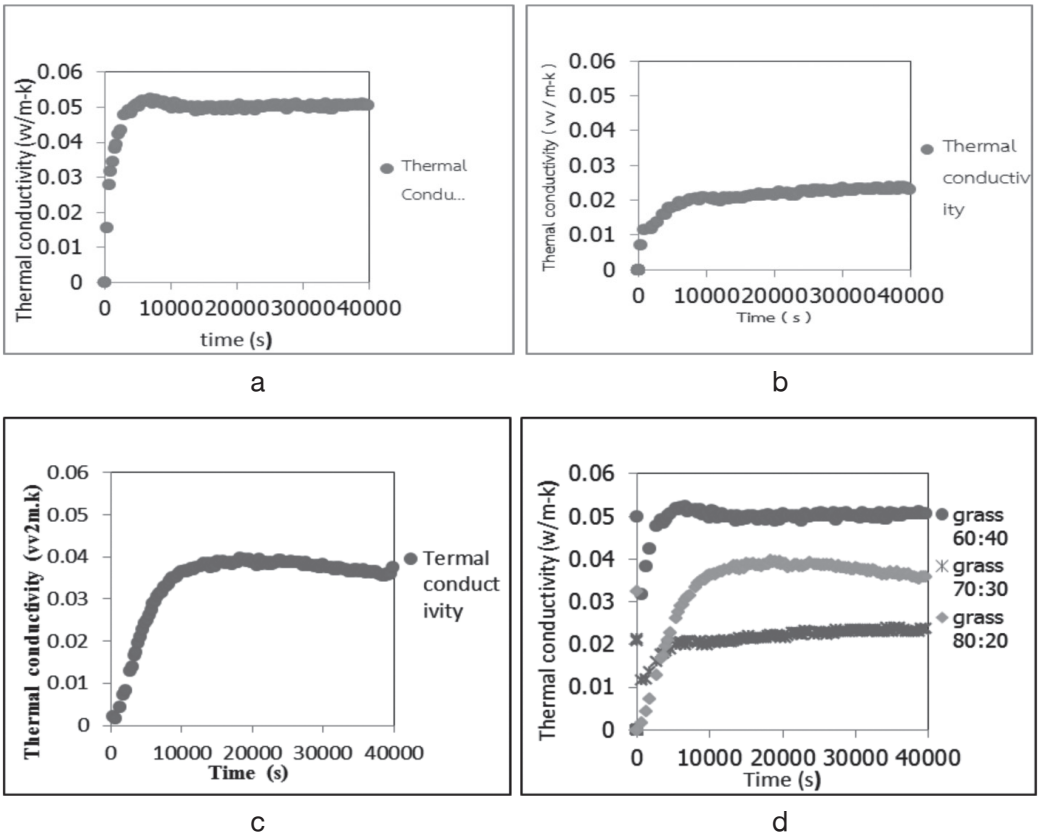

Figure 4 Thermal conductivity of sample with different ratio (grass : water timber) a. 60:40, b. 70:30, c. 80:20, d. comparedthreeratio

- **The rate of thermal conductivity**

From figure 5 showed relationship of the rate of thermal conductivity and ratio of grass and water timber. The results showed that the value of the rate of thermal conductivity were corresponding with thermal conductivity in figure 4, so, the ratio of grass and water timber with 70:30 was the insulation

Discussion

These results showed that it is possible to develop samples which show similar thermal conductivity as that of 100% waste wool fibers (Asis et al., 2015) . These sample were suitable for roof ceiling insulation application in a building.

In another paper, authors reported that the thermal insulation material made from natural row materials are suitable alternatives to the conventional materials (Palumbo et al., 2015) .

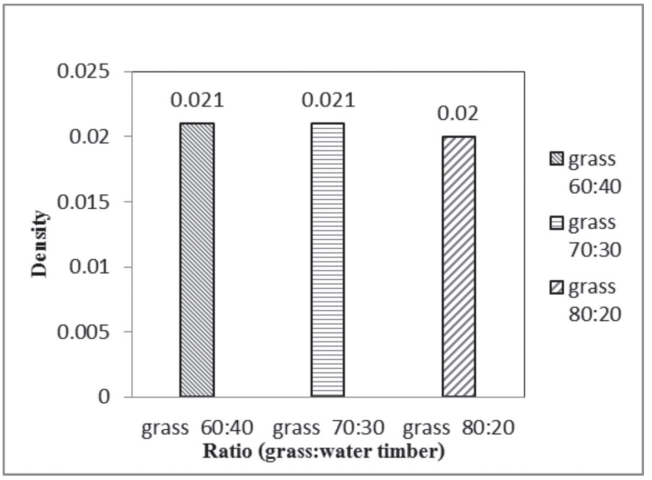

Figure 5 The relationship of the rate of thermal conductivity and ratio (grass : water timber)

Conclusion

There are three different ratio of grass and water timber were produced and tested for physics and thermal insulation. There were no significant in different the ratio of grass and water timber tested in physical properties. But there was different in thermal insulation, the ratio of grass and water timber of 70:30 was the best thermal properties.

Acknowledgment

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