International Journal of Chemical, Materials and Biomolecular Sciences
ISSN: 2415-6620
Vol:6, No:5, 2012

A Study on Mechanical Properties of Fiberboard Made of Durian Rind through Latex with Phenolic Resin as Binding Agent

W. Wiyaratn, A. Watanapa

***Abstract*—**This study was aimed to study the probability about the production of fiberboard made of durian rind through latex with phenolic resin as binding agent. The durian rind underwent the boiling process with NaOH [7], [8] and then the fiber from durian rind was formed into fiberboard through heat press. This means that durian rind could be used as replacement for plywood in plywood industry by using durian fiber as composite material with adhesive substance. This research would study the probability about the production of fiberboard made of durian rind through latex with phenolic resin as binding agent. At first, durian rind was split, exposed to light, boiled and steamed in order to gain durian fiber. Then, fiberboard was tested with the density of 600 Kg/m^3 and 800 Kg/m^3. in order to find a suitable ratio of durian fiber and latex. Afterwards, mechanical properties were tested according to the standards of ASTM and JIS A5905-1994. After the suitable ratio was known, the test results would be compared with medium density fiberboard (MDF) and other related research studies. According to the results, fiberboard made of durian rind through latex with phenolic resin at the density of 800 Kg/m^3 at ratio of 1:1, the moisture was measured to be 5.05% with specific gravity (ASTM D 2395-07a) of 0.81, density (JIS A 5905-1994) of 0.88 g/m^3, tensile strength, hardness (ASTM D2240), flexibility or elongation at break yielded similar values as the ones by medium density fiberboard (MDF).

***Keywords*—**Durian rind, latex, phenolic resin, medium density fiberboard

I. Introduction

AT the present time, furniture industry which relies on wood as its raw material for production has flourished [1]. Wood is therefore considered vital for the growth in this industry. However, there is more interest in global warming effect and campaigns for green areas as well as anti-deforestation in every country. As such, there is a tendency to use raw materials from some materials left over by agricultural operation or consumption as replacement for natural wood. These alternatives for wood included chaff, straw, corn shaft, pineapple rind and durian rind.

W. Wiyaratn is with the Production Technology education Department, Faculty of Industrial Education and Technology, King Mongkut's University of Technology Thonburi, Bangkok, Thailand (e-mail: wisitsree.wiy@kmutt.ac.th).

A. Watanapa is with the Production Technology education Department, Faculty of Industrial Education and Technology, King Mongkut's University of Technology Thonburi, Thailand (corresponding author to provide : e-mail: anucha.wat@kmutt.ac.th).

Durian is one of Thailand's favorite fruits as such there are more durian farms in Eastern and Southern Thailand. There is also technology to support durian industry for the whole year. Therefore, the elimination of durian rind becomes the problem since more durians are consumed and processed [2]. As a consequence, the remaining durian rind which does not cause heat conduction and has more fiber could prove useful as replacement for wood.

Glue which is used in wood furniture industry is mainly urea-formaldehyde [3] since this type of glue is cheap, easy to use and could act as a good binding agent for all kinds of woodwork. This is because this type of glue has formalin as their main composite material but this chemical is odorous and toxic for body [4]. There is also evaporation of formaldehyde from furniture for around 20 to 40 years and as such the standards of regulation for formaldehyde in woodwork have been established in European and Asian countries [5]. This research would adopt the type of glue which reduces the evaporation of formaldehyde rather than urea-formaldehyde. Therefore, latex with a small amount of phenolic resin is used instead [6] in order to increase the binding property. Moreover, this kind of resin is a good insulator which could resist the heat. This research was aimed to study the probability about the production of fiberboard made from durian rind through latex with phenolic resin as binding agent.The durian rind underwent the boiling process with NaOH [7], [8] and then the fiber from durian rind was formed into fiberboard through heat press. This means that durian rind could be used as replacement for plywood in plywood industry by using durian fiber as composite material with adhesive substance. This is because it was found that durian fiber has been used in many products such as fiberboard [7], paper [8], and heat insulator [9]. Moreover, durian rind has always been in consideration for many types of industry. That is the reason why durian rind is of interest in this research.

II. Procedure

A. Review

This research would study the probability about the production of fiberboard made of durian rind through latex with phenolic resin as binding agent. To manufacture heat insulator from durian rind, fiberboard with the density of 600 Kg/m^3 and 800 Kg/m^3 would be made using latex with

phenolic resin as binding agent. The formation would be done at the ratio of 1:1, 2:1, 3:1 and 4:1. Then many mechanical properties would be tested such as the hardness, the density and the water absorbability.

B. Raw Materials

1. Durian rind
2. Latex with 60% concentration and low ammonia from the Center of Latex at Kasetsart University
3. Phenolic resin from Siam Chemical Company Limited
4. Azadirachtin or neem tree chemical

C. Research Procedure and Experiment

The procedure in the production of fiberboard from durian rind through latex with phenolic resin as binding agent could be divided into the following steps.

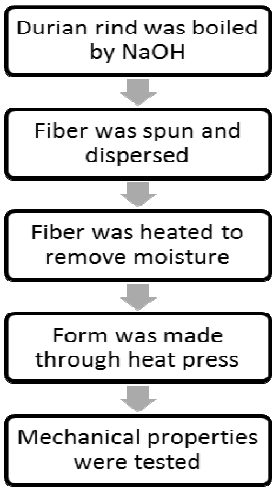

Fig. 1 Research procedure and experiment

Fig. 2 Dry durian rind before boiling

Fig. 3 Durian rind fiber after boiling

III. Results

In this section, the results from the production of fiberboard made from durian rind to manufacture heat insulator through latex with phenolic resin as binding agent for the fiberboard with the density of 600 Kg/m^3 and 800 Kg/m^3 to do the formation at the ratio of 1:1, 2:1, 3:1 and 4:1 to test the mechanical properties were shown below.

A. Results about the microstructure of fiberboard made from durian rind through latex with phenolic resin

According to the photos about the microstructure of fiberboard made of durian rind through latex with phenolic resin captured by stereo microscope, it was found that the ratio of 1:1 from the fiberboard with the density of 600 Kg/m^3 and 800 Kg/m^3 showed the binding density compared to other ratios.

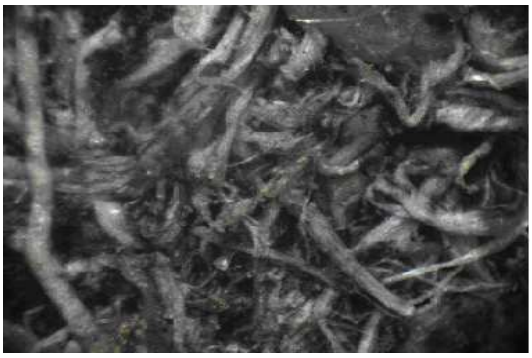

Fig. 4 Microstructure of fiberboard made of durian rind through latex with phenolic resin with the density of 600 Kg/m^3 at the ratio of 1:1 and 30x magnifying power

Fig. 5 Microstructure of fiberboard made of durian rind through latex with phenolic resin with the density of 800 Kg/m^3 at the ratio of 1:1 and 30x magnifying power

B. Results about the tensile strength

After the comparative experiments of the tensile strength of the fiberboard made of durian rind through latex with phenolic resin as binding agent at the ratio of 1:1, 2:1, 3:1 and 4:1 with the density of 600 Kg/m^3, the values were 1.23, 1.24, 0.51 and 1.05 respectively. With the density of 800 Kg/m^3 at the ratio of 1:1, 2:1, 3:1 and 4:1 the values were 2.75, 1.74, 1.78 and 2.06, respectively. The ratio of 1:1 showed the best tensile strength with the value of 2.75 as shown in Fig. 6.

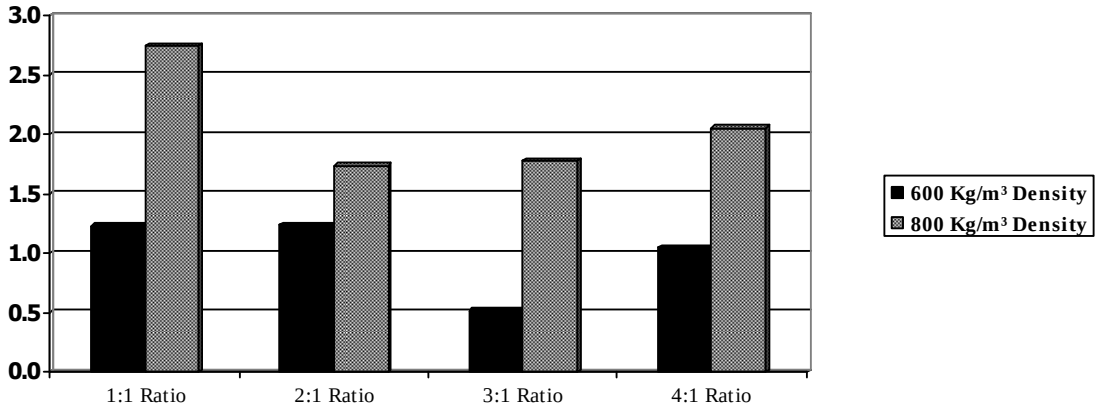

Fig. 6 Results about the tensile strength of the fiberboard made of durian rind through latex with phenolic resin with the density of 600 Kg/m^3 and 800 Kg/m^3 at the ratio of 1:1, 2:1, 3:1 and 4:1

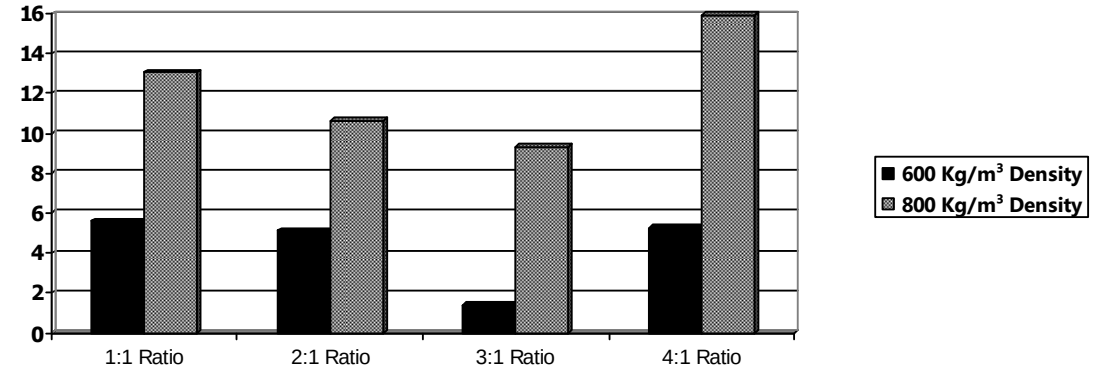

Fig. 7 Results about the elongation at break of the fiberboard made of durian rind through latex with phenolic resin with the density of 600 Kg/m^3 and 800 Kg/m^3 at the ratio of 1:1, 2:1, 3:1 and 4:1

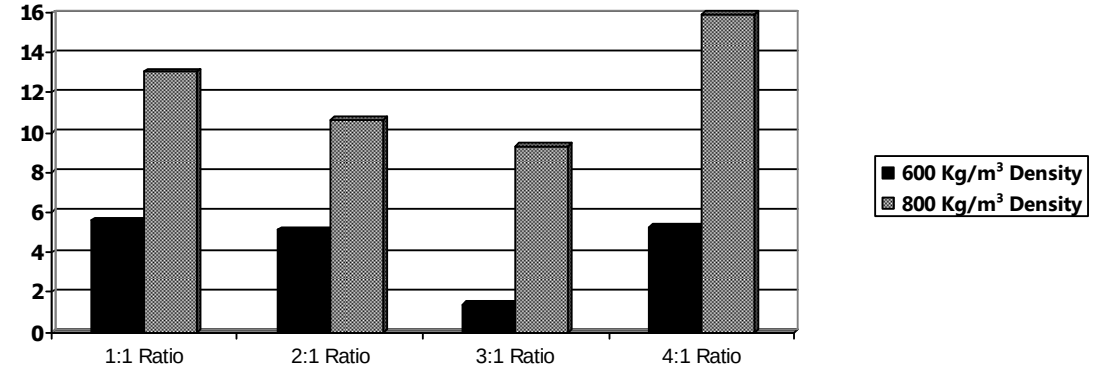

Fig. 8 Results about the hardness shore A of the fiberboard made of durian rind through latex with phenolic resin with the density of 600 Kg/m^3 and 800 Kg/m^3 at the ratio of 1:1, 2:1, 3:1 and 4:1

C. Results about the elongation at break or flexibility percentage

After the comparative experiments of the elongation at break of the fiberboard made of durian rind through latex with phenolic resin as binding agent at the ratio of 1:1, 2:1, 3:1 and 4:1 with the density of 600 Kg/m^3 and 800 Kg/m^3 according to ASTM 638 standards, the values of formation with the density of 600 Kg/m^3 at the ratio of 1:1, 2:1, 3:1 and 4:1 were 55.89, 51.39, 14.07 and 52.74, respectively. With the density of 800 Kg/m^3 at the ratio of 1:1, 2:1, 3:1 and 4:1, the values were 130.79, 106.53, 93.21 and 159.4, respectively. These are shown in Fig. 7.

D. Results about the hardness shore A of fiberboard

After the comparative test about the hardness shore A of the fiberboard made of durian rind through latex with phenolic resin at the ratio of 1:1, 2:1, 3:1 and 4:1 with the density of 600 Kg/m^3 and 800 Kg/m^3 according to the ASTM-D 2240 standards, it was found that with the density of 600 Kg/m^3 and the formation at the ratio of 1:1, 2:1, 3:1 and 4:1, the values were 72.96, 80.92, 72.61 and 83.86, respectively. The best value of the hardness was 83.86 at the ratio of 4:1, followed by the hardness value of 80.92 at the ratio of 2:1. With the density of 800 Kg/m^3 at the ratio of 1:1, 2:1, 3:1 and 4:1, the values were 90.93, 92.71, 92.52 and 89.95, respectively as shown in Fig. 8.

IV. Conclusion

The fiberboard made of durian rind through latex with phenolic resin as binding agent had higher elongation at break and hardness shore A than the medium density fiberboard (MDF). As for the tensile strength, it was found that the fiberboard made of durian rind had lower tensile index than medium density fiberboard. According to the standards of JIS A5905-1994 and ASTM, the suitable condition for the formation was the ratio of 4:1 with the density of 800 Kg/m^3.

References

[1] S. Popanyasak, *Wood Furniture Industry in Thailand.* Ministry of Commerce, 2010, pp. 1–5.
[2] IT Center, Department of Agricultural Extension, *Current Situations about Agricultural Products and Trends in 2010,* IT Center, Department of Agricultural Extension, 2010, pp. 85–88.
[3] Department of Industrial Promotion, *Report on New Ideas about Furniture Made of Carton Paper*. 2009, pp. 16–18.
[4] Department of Health, *Formaldehyde—Thai Wisdom Treasure Box*. Rayong Province, Department of Health, 2010.
[5] T. Niamsuwan, *Formaldehyde: Regulations and Standards.* Faculty of Forestry, Kasetsart University, 2010, pp. 3–6.
[6] O. Sarawaree, *Enamel: Color, Vanish, and Lacquer*. Department of Materials, Faculty of Science, Chulalongkorn University, 2001, pp. 41–69.
[7] C. Busan et al., *The Production of Fiberboard from Durian Rind in Combination with Latex*, a Master's dissertation in Engineering, Department of Printing Technology Education, King Mongkut's University of Technology Thonburi, 2008.
[8] T. Panyathongcai et al., *The Development of Paper from Two Types of Durian Rind for Inkjet Printing System*, a Master's dissertation in Engineering, Department of Printing and Packaging, King Mongkut's University of Technology Thonburi, 2006.
[9] K. Buasi, *The Production of Heat Insulator from Straw*, a Master's dissertation in Engineering, Department of Material Technology, Joint Graduate School of Energy and Environment, King Mongkut's University of Technology Thonburi, 2003.