

Screw-withdrawal Properties of batai (*Parentheses falcataria*) Particleboard

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Abstract

In this study batai (*Parentheses falcataria*) was use as raw material for the production of particleboard and its screw withdrawal properties was determined. Particleboard with sizes of 35 x 35 x 12 mm and a target density of 550 kgm⁻³ was produced with 1 % wax addition. Results of the study showed that only resin content showed significant effects on the screw withdrawal properties. Particleboards of core particle size of 1.0 mm and 2.0 mm showed no significant influences on screw withdrawal test. Boards made with/without wax addition also showed no significant influence on screw withdrawal property. In conclusions, all particleboards produced from batai wood failed to meet the strength requirements specified in JIS A 5908.

Keywords: screw- withdrawal, batai, particleboard

INTRODUCTION

Beginning of the early 1980's, the wood industry had experienced the shortage of forest timbers for their production. Good timber remained scarce day by day due to indiscriminate felling of timber from the forest. Gradual decline of availability of large logs for lumber and conversion into veneer and plywood makes the industries to look for alternatives. Thus, research and development have brought out a suitable substitute to timber and plywood called particleboard. Miller (1997) reported that in Europe, a German wood scientist Willhelm Klauditz with his advance research on timber and timber product invented the first particle board in the world. Initial efforts was only to use saw mill waste mainly saw dust and wood shavings to process particleboard.

In Malaysia, the particleboard industry has been heavily dependent on the supply of rubberwood but due to the stiff competition by the furniture industries, the raw material has been hard to get. *Acacia mangium* and hardwood wastes are also being utilized as supplement to rubberwood. In view of this raw material crisis, other raw material sources should be looked for and exploited. The government through MTIB has promoted the plantation of certain species to be use as raw material for the wood industry. Batai is one of the eight species recommended. In this study batai will be use as raw material for the production of particleboard and its screw withdrawal properties will be analysed.

In making the wood goods, the screws are the mechanical connection components that provides more practical and easier connection are recently used. The rigidity of the wood goods is substantially dependent on the screws and the screw withdrawal capabilities of the wood materials used in their production. For this reason, the determination of the screw withdrawal strengths of the wood composite materials is essential for both the manufacturer and the consumers due to safety reasons (Atar et

al., 2009). This paper reports on the findings of the effects of particle size, resin and wax content on the screw-withdrawal properties of particleboard made from batai.

MATERIALS AND METHOD

Raw Materials Preparation

Batai (*Paraserianthes falcataria*) trees were obtained from a private company in Kedah. Three trees were harvested with diameter breast at height (DBH) of 26.7cm, 28.4cm and 27cm respectively. Debarking was done manually and the logs were then sawn lengthwise into 1 x 1 inch x 8 feet and send to the wood chipper to be converted into chips. The chips are flaked to produce smaller wood particles. The particles were then sent to the vibrator screen machine to screen into requires size. The particles that will be used in this process are 1.0 mm and 2.0 mm. After screening, the particle undergoes oven drying.

Panel Manufacturing

The adhesive used in the study is Urea Formaldehyde (UF) supplied by a local manufacturer. To improve water resistance a 1% wax addition was used. The target density of the board is 550 kg/m³. The particles was placed in the mixer and sprayed with the adhesive and wax until they attained a homogenous mixture. Then the mixture was manually moulded into a mat with the size of 35 cm × 35 cm. The mould is being pre-press for about 2 minutes. The pre-presses were to reduce the danger of disturbance of the graded structure while transferred to the hot press. The consolidated mat was then hot pressed at the temperature of 165°C and pressure of 1800 psi. The finished board was let to cool and then cut into the required sizes for testing.

Panel Testing

The particleboards were conditioned in a room and then they were trimmed and cut into the required test specimens 100 mm × 50 mm. The screw withdrawal test were carried out according to the JIS* A 5908: 2003 (B 1112).

Statistical Analysis

The Statistical Package Social Science (SPSS) technique was used in determine effect of the impregnation process on the screw withdrawal strength in particleboard. Analysis of Variance (ANOVA) was used to analyze the significant of particle size, resin content and wax on the screw-withdrawal properties.

RESULTS AND DISCUSSIONS

Screw Withdrawal Property

The strength of screw withdrawal is shown in the Table 1. All boards produced with a resin content of 8%, 10% and 12% with the particle size 1.0 mm and 2.0 mm and with/without wax addition at the target density board 550 kg/m³ were not able to meet the minimum strength requirement of JIS A 5908.

Table 1: Strength and dimensional properties on screw withdrawal of particleboard

Particle Size (mm)	Resin content (%)	Wax Content (%)	Screw withdrawal (N)
1	8	0	0.40
1		1	0.38
2		0	0.38
2		1	0.40
1	10	0	0.45
1		1	0.38
2		0	0.36
2		1	0.41
1	12	0	0.44
1		1	0.46
2		0	0.48
2		1	0.48
JIS STANDARD A	5908 : 2003		>0.50

Statistical Significance

The summary of analysis of variance (ANOVA) on the effect of particle size, resin content and wax additional on the screw withdrawal of particleboard properties are shown in Table 2. Resin content showed significant effects on the screw withdrawal properties. Particle size and wax addition had no significant influences on screw withdrawal. The interaction of particles sizes and resin content, particle size and wax gave positive influences but there is no interaction between resin content with wax. The interaction of resin content with particle size, resin content and wax did not show any significant influences on screw withdrawal property.

Table 2 : Summary of the analysis of variance on the screw-withdrawal properties

Source	df	Mean Square	F	Sig.
Particle size	1	5.36E-005	.015	.902
Resin Content	2	.068	19.364	.000
Wax	1	.002	.473	.493
Particle Size * Resin Content	2	.012	3.474	.034
Particle Size * Wax	1	.030	8.643	.004
Resin Content * Wax	2	.001	.153	.858
Particle Size * Resin Content * Wax	2	.009	2.584	.079

Notes: *Significant at $p < 0.01$, ns- not significant at $p < 0.05$

Effect of Resin Content

The Duncan Multiple Range t-Tests (Figure 2) showed that resin content had significant effects on screw withdrawal. The board with 12 % resin content showed higher strength. Higher resin content made increasing of strength on screw withdrawal because decrease in void spaces and increasing the strong bonded between particles (Sheikh, 2011). Furthermore, Rahim and Jamaludin (1992) reported that an increase of resin content will increase the contact areas of the particles and this in turn contribute to better adhesion between particles. The low bulk density need the small quantity of particle to full fill the space, that is why the high bulk density is good to produce particleboard. If the space is reduce can made board more compact and stable (Panshin, 1995).

Effect of Particle Size

Figure 3 shows the effect of particle size on screw withdrawal of particleboard properties. The results show that as the particle had no significant influence on screw withdrawal test. An increase in particle size creates more gaps between the particle and this reduced their ability to hold the screw in place. If the space can be reduce by making the board more compact and stable (Panshin, 1995) then the screw withdrawal properties will be higher.

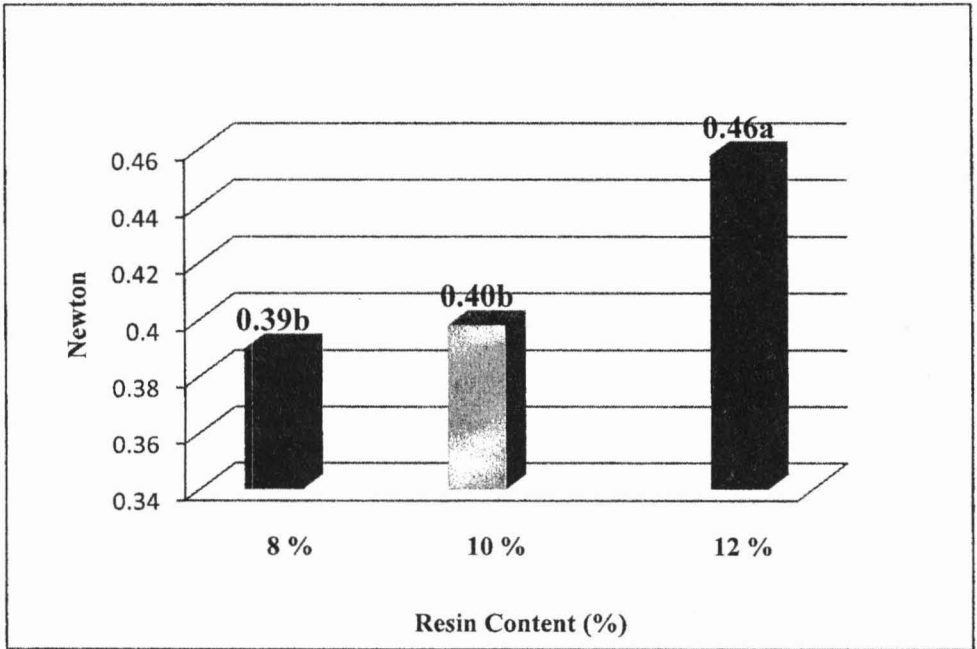


Figure 2: Effect of resin content on screw withdrawal property

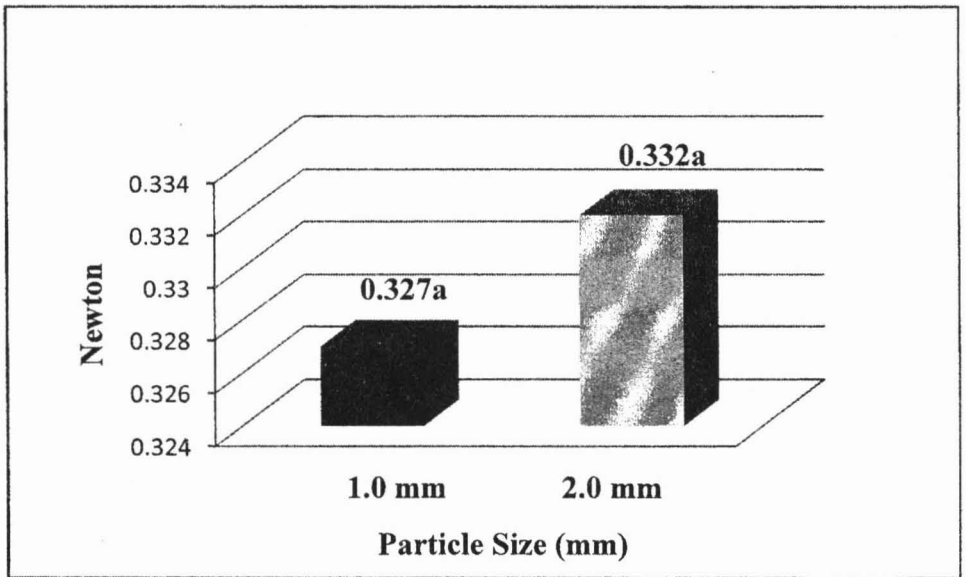


Figure 3: Effect of particle size on screw withdrawal property

Effect of Wax

Figure 4 shows the effect of wax addition on the screw withdrawal property. From the figure, the wax content level did not significantly influence the screw withdrawal.

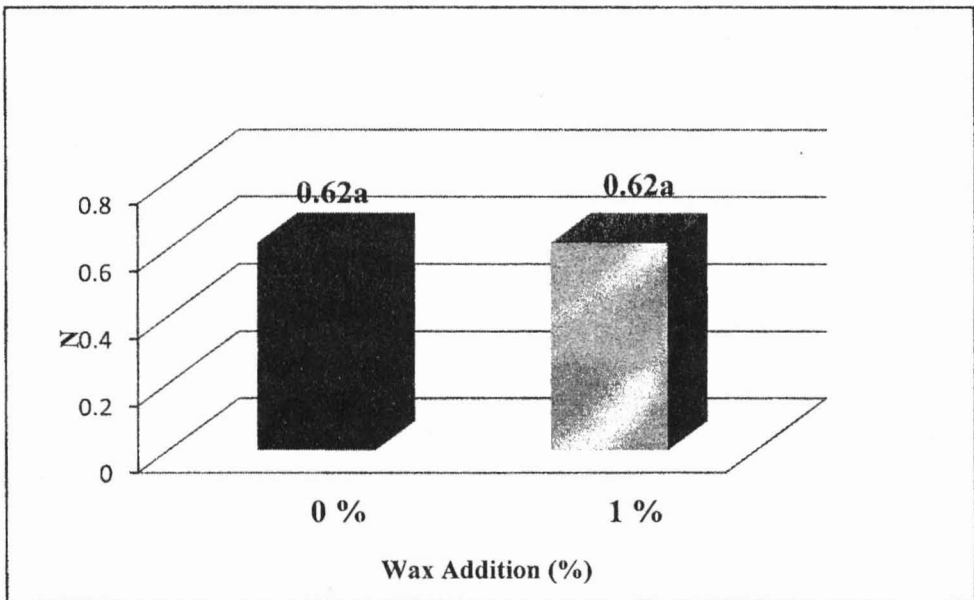


Figure 4: Effects of Wax Content on Screw withdrawal Property

CONCLUSIONS

Resin content showed significant effects on the screw withdrawal properties. Particleboards of core particle size of 1.0 mm and 2.0 mm showed no significant influences on screw withdrawal test. Boards made with/without wax addition also showed no significant influence on screw withdrawal property. In conclusions, all particleboards produced batai wood was not able to meet the strength requirements specified in JIS A 5908. Further research is required to improve the particleboard strength qualities.

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