THE RESISTANCE OF TREATED RUBBERWOOD PARTICLEBOARD TO THE DRYWOOD TERMITE *Cryptotermes cynocephalus* Light.

Ketahanan Papan Partikel Terhadap Serangan Rayap Kayu Kering Cryptotermes cynocephalus *Light.*

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ABSTRAK

Papan partikel banyak digunakan sebagai bahan mebel dan dalam jumlah terbatas digunakan sebagai bahan bangunan yang tidak menyangga beban. Kelemahan papan partikel sebagai bahan mebel dan bahan bangunan tersebut adalah mudah diserang organisme perusak kayu, misalnya rayap karena bahan bakunya berasal dari kayu dengan kelas awet rendah. Oleh karena itu perlu dilakukan pencegahan serangan rayap pada papan partikel dengan meningkatkan ketahanannya. Tujuan penelitian ini adalah untuk mendapatkan kadar bahan pengawet alfametrin minimum yang ditambahkan dalam ramuan perekat fenol formaldehida, yang cukup efektif untuk mencegah serangan rayap kayu kering pada papan partikel.

Dalam penelitian ini papan partikel dibuat dari limbah serutan kayu karet yang dibedakan antara partikel kasar dengan partikel halus. Perekat yang digunakan adalah fenol formaldehida dengan kadar perekat 12% dari berat partikel kering. Kedalam perekat fenol formaldehida cair ditambahkan larutan bahan pengawet alfametrin dengan kadar 0%; 0,25%; 0,50%; 0,75%; dan 1%. Kandungan bahan aktif alfametrin dalam larutan bahan pengawet yang digunakan adalah 15 g/l. Pengujian ketahanan papan partikel dilakukan terhadap rayap kayu kering. Di samping itu dilakukan juga pengujian ketahanan kayu karet utuh sebagai pembanding. Hasil penelitian menunjukkan bahwa kadar alfametrin 0,50% atau lebih dari berat fenol formaldehida cair pada pembuatan papan partikel kasar maupun halus sudah cukup efektif untuk menahan serangan rayap kayu kering, mortalitas mencapai 100%, dan kelas ketahanan papan partikel meningkat dari kelas III menjadi kelas I. Papan partikel tanpa bahan pengawet (kontrol) mempunyai kelas ketahanan lebih tinggi (III) dari pada kelas ketahanan kayu karet utuh (IV).

Kata kunci: Papan partkel, fenol formaldehida, alfametrin, rayap kayu kering

ABSTRACT

Particleboard is widely used for furniture and in a limited quantity for light construction. However, particleboard is susceptible to wood destroying organisms, particularly termite. Durability improvement using preservative or insecticide is therefore required to improve the quality of

particleboard. This study examined an experiment of enhancing the resistance of rubber wood particleboard using alphamethrin mixed with phenol formaldehyde glue.

Rubber wood wastes resulting from planning works were separated into two sizes; i.e. coarse particles and fine particles. The particles were then mixed with glue and pressed to manufacture the particleboard. The glue used was liquid phenol-formaldehyde at 12% resin content based on the oven-dry weight of rubber wood particles. Alphamethrin solution a.i. 15 g/l was added to phenol-formaldehyde at four different concentrations, i.e. 0.25%; 0.50%; 0.75% and 1%. The particleboard resistance against dry wood termite was evaluated by counting mortality and weight loss.

Results revealed that incorporating alphamethrin at 0.50% or greater into phenol formaldehyde glue during particleboard manufacture, both in coarse and fine particles, proved to be effective to prevent the dry wood termite infestation. At this concentration the termite mortality reached 100%. Preservative treatment significantly increase in durability class of particleboard, i.e. from class III (untreated) to class I.

Keywords: Particleboard, phenol formaldehyde, alphamethrin, dry-wood termite

I. INTRODUCTION

Particleboard has been known widely in Indonesia as reflected in its ever increasing uses by the community for furniture, audio boxes, and construction materials in the last few years (Hadi and Febrianto, 1991 and Sutigno, 1997). The development of particleboard industry has significantly supported the goverment efforts in optimal utilization of forest resources, particularly wood items. Particleboard industry could utilize low quality wood, and wood wastes of almost any size and species. The particleboard manufactured from low-durable wood particles will be vulnerable to wood destroying organisms when it is used as furniture and construction materials. Service life of such particleboard is relatively short, meaning more wood materials will be required after sometime. In increasing efficiency of forest resources, preservation treatment is considered as an essential effort to prolong the service life of particleboard.

This report presented results of a study on increasing particleboard resistance to dry wood termite by adding preservative agent (alphamethrin) into liquid phenol formaldehyde which then used in manufacturing particleboard.

II. MATERIALS AND METHODS

A. Materials

Materials used in this study consisted of two basic components, i.e, particles of rubber wood (*Hevea brasiliensis* Muell.Arg.) and glue liquid of phenol formaldehyde.

B. Methods

1. Preparation of rubber wood particles

Wood particles were collected from planning works underwent on pieces of rubber wood. The particles were then sieved through screener to separate them into coarse and fine particles. The coarse one were particles which retained on 5-mm square wire screen,

while the fine one were particles which passed through the 5-mm square wire screen but retained on 2-mm square wire screen. The rubber wood particles were dried in oven to reach 4% moisture content.

2. Particleboard manufacture

Type of particleboard produced was a single-layered particleboard, where the coarse and fine rubber wood particles were separately used as its composing matters. Particleboard dimensions prepared in this study was 30-cm by 30-cm by 1.5-cm. The amount of liquid phenol-formaldehyde (PF) adhesive used was 12 percent on the basis of dry-weight particles, while the hardener para formaldehyde was 1 percent of the weight of PF. Alphamethrin preservative was added to the PF glue at four levels, consecutively 0.25%, 0.50%, 0.75%, and 1% in its liquid form. The mixture of PF glue and alphamethrin was intensely agitated until becoming homogenous. The mixture was then sprayed on the rubber-wood particles prepared for the reconstitution of particleboard mat. The mixed stuff consisting of alphamethrin-PF glue and rubber-wood particles was molded into particleboard shape at predetermined dimension, and then pressed using a hot-press machine at 35 kg/cm^2 specific pressure and 160^{o}C temperature for 10 minutes. Targeted density of the resulting particleboard was 0.70 g/cm^3. Three particleboard mats were produced for each alphamethrin level.

3. Testing the resistance of particleboard to dry-wood termites

Pieces of coarse and fine particleboard were each cut to specimens of 5.0 cm (length) by 2.5 cm (width) by 1,5 cm (thickness). The particleboard specimens were placed horizontally so the largest face was in contact with a glass tube (1.8-cm diameter and 3.6-cm height), into which fifty dry wood worker termites were introduced. A seal between specimens and glass tube was made using wax. The dry-wood termites could not move out of the glass tube during investigation other than tunneling the blocks. This set up was maintained for12 weeks in the dark room.

C. Observations

Assessments used to measure particleboard resistance against attack included termites mortality (the mortality data were transformed into Arcsin√ %) and weight loss of the sample. The weight loss data were used to determine the resistance class of particleboard as described in Supriana and Howse (1982) and Martawijaya (1996), as follows:

Table 1. Classification of wood resistance against the dry wood termite *Cryptotermes cynocephalus* Light

Class	Resistance	Weight loss (mg), due to the attack by *Cryptotermes cynocephalus* Light.
I	Resistant	0 – 25
II	Moderately resistant	26 – 50
III	Non-resistant	51 – 75
IV	Susceptible	> 75

Further observation was made on the degree of infestation using scoring method developed by Padlinurjaji, *et. al*. (1988) as simplified in Table 2.

Table 2. Scale and degree of termite infestation

Degree of infestation by dry wood termite	Condition of sample	Value/Score
A	Intact, no infestation	0
B	The presence of former drilling by insect	1 – 20
C	Light infestation, with the formation of rather narrow (not wide) channels	21 – 40
D	Heavy infestation, with the formation of wide and deep channels	41 – 60
E	Extremely heavy infestation, the structure was severely damaged (approximately 50% of the samples portion has been eaten)	61 – 80

Source: Padlinurjaji, *et.al* (1988).

III. RESULTS AND DISCUSSION

The effect of alphamethrin concentration on mortality and weight loss were highly significant (Table 3). The higher concentration, the higher the termite mortality and the lower the samples weight loss.

Table 3. Summarized analysis of variance of particleboard resistance to dry wood termite (*Cryptotermes cynocephalus* Light.)

No	Methods of assessment	Value
1.	Mortality	331,55**
2.	Weight loss	10094,32**

Remark : ** Highly significant (P= 0.95)

Table 4 showed that mortality of dry-wood termites on solid rubber wood was 47.33%. Termite mortality on the untreated particleboards constituted of coarse and fine rubber-wood particles, were consecutively 57.33% and 55.00%. The termite mortality on the corresponding particleboard reached 100% at 0.75% alphamethrin concentration. The effect of alphamethrin is somewhat weaker than that observed when using permethrin. Previous investigation revealed that termites mortality reached 100% on the rubber wood particleboard treated with permethrin at 0.50% concentration or greater (Sulastiningsih, *et. al*. 1999).

Table 4. Durability of rubber wood particleboard against dry wood termite using Duncan's multiple range test

Alpha-methrin concen-tration.%	Durability criteria									
	Mortality %		Weight loss mg		Resistance class		Infestation rate			
	Fine	Coarse	Fine	Coarse			Fine		Coarse	
	(X ± S) [1)]	(X ± S) [1)]	(X ±S) [1)]	(X ± S) [1)]	Fine	Coarse	V	G	V	G
Solid wood	47.33±1.75 a	47.33±1.75 a	75.13±0.31 a	75.13±0.31 a	IV	IV	49.33	D	49.33	D
0.00	56±4.19 b	57.33± 4.30 b	74.33±1.15 a	74.60±1.22 a	III	III	35.67	C	28.33	C
0,25	90.00± 1.92 c	87.00±3.19 c	19.57±0.90 b	20,07±0.49 b	I	I	23.67	C	22.33	C
0,50	92.00± 8.77 c	92.67±3.95 c	15.27±0.75 c	15.77±0.64 c	I	I	11.67	B	13.67	B
0,75	100± 0 d	100± 0 d	12.23±1.94 c	13.50±0.20 c	I	I	3	B	0.5	B
1.00	100± 0 d	100± 0 d	2.1± 0.60 d	1.70± 0.40 d	I	I	0	A	0	A

Remarks :
X = mean value; S = standard deviation; V = value; G = grade
[1)] Mean values followed by the same letters are not significantly different from others
[2)] 0 percent can be regarded as control (without alphamethrin).

Durability of solid rubber-wood could be categorized as class IV, since its weight loss was 75.13 mg. Weight loss of the control particleboards constituted of either coarse or fine rubber-wood particles were 74.60 mg and 74.33 mg, respectively. These control particleboards could be categorized as class III in their resistance to dry wood termite attack. This showed that particleboard had better durability than the solid wood. There might be particular chemical compounds in the PF glue which able to resist termite attack. Woworontu *et.al* (1971) stated that phenol could emit a typical smell and produce strong antiseptic characteristics, thereby functioning as activity regulator of the particular enzymes as well as being toxic to the insects. The corresponding particleboards treated with 0.25% alphamethrin concentration were categorized as class I. However, the termite mortality of the treated particleboard at 0,25% alphamethrin were 87% (coarse particles) and 90% (fine).

Capability of preservatives to prevent particleboard from termite attack could be expressed as the value (scores) and severeness of attack. The higher the concentration of preservative, the lighter termite attack occurred on the tested samples of particleboard constituted of either coarse or fine particles. This phenomenon could also be seen on the smaller average scores corresponding to the extent of termite attacks. Data assessment assisted by the Kruskal-Wallis tests on the degrees of termite attack revealed that the efficacy of alphamethrin was significantly different depending on its concentration. In this regard, the higher the concentration of alphamethrin, the lower degree of dry-wood termite attack.

Results of this efficacy trial revealed that the use of alphamethrin at 0.75% enabled the treated particleboard to reach 100% mortality of the dry-wood termites. As such, the particleboard constituted of either coarse or fine rubber-wood particles in their resistance was categorized as class I.

Previous study (Sulastiningsih, *et al*; 2000) revealed that particleboard constituted of coarse or fine rubber wood particles at the alphamethrin levels similar to those implemented in this investigation could be classified as medium-density particleboard. Physical and mechanical properties of the tested particleboard could comply with the Indonesian Standard and Japanese Standard requirements.

IV. CONCLUSIONS AND RECOMMENDATION

A. Conclusions

1. The use alphamethrin at 0.75% content in the manufacture of particleboard reconstituted of either coarse or fine rubber wood particles could resist termite attack.
2. The treatment could increase the resistance of the corresponding particleboard from class III to class I.
3. Particleboard made from untreated rubber-wood particles had a better durability (class III) than the corresponding solid rubber-wood (class IV).

B. Recommendation

It is recommended that the use of alphamethrin preservative added to the phenol-formaldehyde should have concentration above 0.50% to obtain an effective rate of termite resistance , thereby prolonging the service life of particleboard..

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