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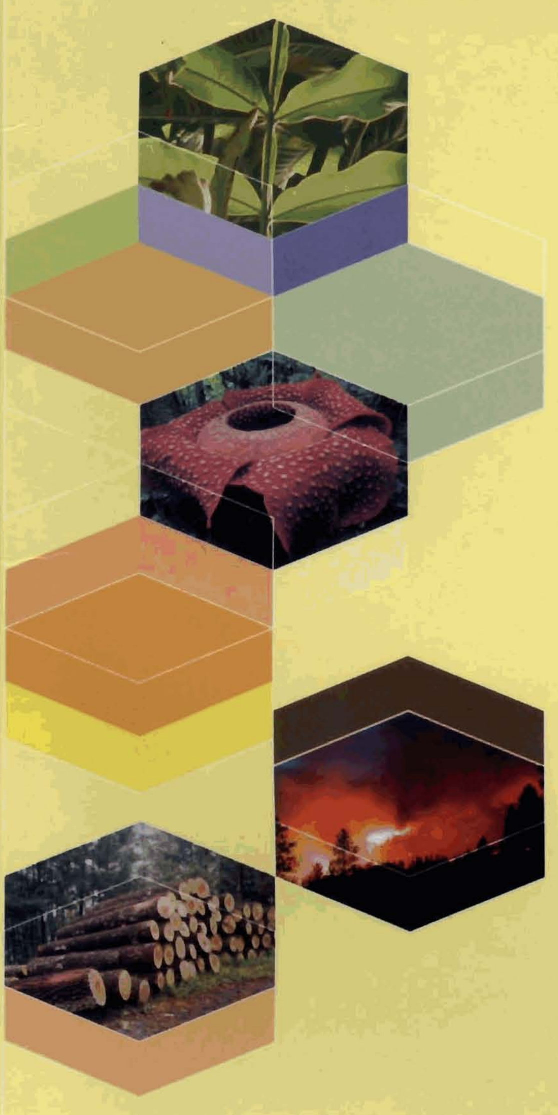

THE ROLE OF DICUMYL PEROXIDE (DCP) IN THE STRENGTHENING OF POLYMER COMPOSITES

(PERANAN DICUMYL PEROXIDE (DCP) TERHADAP KEKUATAN KOMPOSIT POLIMER)

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Abstrak

Telah dilakukan sebuah penelitian mengenai sifat fisis dan mekanis komposit dari polipropilen daur ulang dan serbuk kayu dengan menggunakan *Maleic Anhydride* (MAH) sejumlah 6% (dari berat polipropilen daur ulang) dan *Dicumyl Peroxide* (DCP) pada berbagai tingkat konsentrasi (5%, 10%, 15%, 20%, 25% dari berat MAH). Dari penelitian tersebut diperoleh hasil bahwa sifat fisis dan mekanis dari komposit tersebut semakin meningkat dengan adanya penambahan konsentrasi DCP. Penambahan konsentrasi DCP sejumlah 15% (dari berat MAH) memberikan hasil yang terbaik. Nilai kerapatan, kadar air, daya serap air, pengembangan tebal, *modulus of rupture* (MOR), *modulus of elasticity* (MOE), keteguhan rekat internal, dan kuat pegang sekrup dari komposit yang dihasilkan masing-masing sebesar 0,72 g/cm^3; 0,82%; 8,34%; 0,69%; 126 kg/cm^2; 15352 kg/cm^2; 3,47 kg/cm^2; 67,6 kg/cm^2.

Kata kunci: komposit, serbuk kayu, polipropilen daur ulang, *Maleic Anhydride* (MAH), *Dicumyl Peroxide* (DCP).

Abstract

The physical and mechanical properties composites from Recycle Polypropylene (RPP) and Wood Flour (WF) were investigated under Maleic Anhydride (MAH) amount of 6% (based on RPP) and various Dicumyl Peroxide (DCP) concentration (5%, 10%, 15%, 20%, 25% based on MAH weight). The physical and mechanical properties composites of the obtained composites greatly affected by DCP concentration. It was found that addition DCP in the amount 15% (based on MAH weight) respectively gave the best results. The values of density, moisture content, water absorption, thickness swelling, modulus of rupture (MOR), modulus of elasticity (MOE), internal bond (IB), and screw holding power of the composites respectively are 0,72 g/cm^3; 0,82%; 8,34%; 0,69%; 126 kg/cm^2; 15352 kg/cm^2; 3,47 kg/cm^2; 67,6 kg/cm^2.

Key words: composites, wood flour, Recycle Polypropylene (RPP), Maleic Anhydride (MAH), Dicumyl Peroxide (DCP).

INTRODUCTION

In generally, particleboards have low strength dimension stability. So it only used in interior and not more loading for a long time in use. This problem can be solved to try to make particleboards with thermoplastic resin. In the previous report, the physical and mechanical properties composites that resulted of sawdust-recycle polyprophylene (RPP) by the various particle size and sawdust-recycle polyprophylene ratio not optimal, because the interfacial reaction between the lignocellulose and thermoplastic very difficult occurred without compatibilizer and initiator (Febrianto *et al.*, 2001).

There are several methods that can be used to enhance interfacial reaction between the lignocellulose and thermoplastic. The use of dispersing and coupling agent, pretreatment of fibers by encapsulation or grafting and coating fibers with chemicals have all been shown to result in improvement of interfacial adhesion between the composites component (Febrianto *et al.*, 1999, Febrianto, 1999, Takase *et al.*, 1989). Mechanical properties (Tensile strength, Breaking elongation and Modulus young) of moulded wood flour with polyprophylene and Polylactic Acid (PLA) affected by kind and various initiator concentration (Febrianto, 1999, Han, 1990).

In the previous investigated, about particle boards that composed of Jeunjing (*Paraserianthes falcataria*) sawdust and recycle polyprophylene (RPP) with various Maleic Anhydride (MAH) concentration amount of 0-12% (based on RPP weight) and Dicumyl Peroxide (DCP) concentration amount of 10% (based on MAH weight) can be improve the physical and mechanical properties (Febrianto *et al.*, 2002). In this paper, the physical and mechanical properties (i.e density, moisture content, water arbsorption, thickness swelling, modulus of rupture, modulus of elasticity, internal bond and screw holding power) composites composed of sawdust-recycle polyprophylene under various concentration of dicumyl peroxide are investigated.

MATERIALS AND METHODS

Materials

The materials used in this experiment were Wood Flour (WF) of Jeunjing (*Paraserianthes falcataria*) with the size of 20 mesh, Recycle Polyprophylene (RPP), Maleic Anhydride (MAH), Dicumyl Peroxide (DCP).

Methods

Compounding the composites. The ratio of WF (moisture content ≈ 7%) and RPP was 50:50 (w/w). The concentration of Maleic Anhydride (MAH) amount of 6% (based on RPP weight) and Dicumyl Peroxide (DCP) concentration amount of 0-25% (based on MAH weight). RPP was devided into 2 parts. 70 parts of RPP with 10 parts of WF were hand-mixed and used as core of the composites. Subsequently MAH and DCP when added to the mixture. 30 parts of RPP was used proportionally as the surface and back layers of the composites. The mixture was then hot-pressed. The pressing temperature, pressure and time were set at 180^{0}C, and 23 atm, for 25 minute respectively. The composites were then cooled at room temperature for 7 days. Figure 1 showed the flow chart of composites manufacture.

The evaluation of physical and mechanical properties of composites. The physical (i.e., density, moisture content, water arbsorption, and thickness swelling) and mechanical (i.e., modulus of rupture, modulus of elasticity, internal bond and screw holding power) properties of composites were tested based on JIS A 5908 (1994).

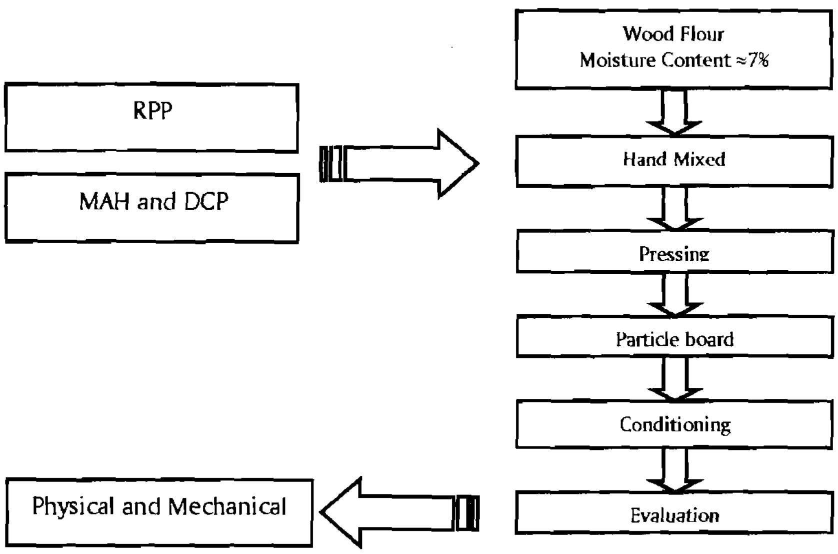

Figure 1. Flowchart of composites manufacture

RESULTS AND DISCUSSION

In previous experiment the amount of initiator DCP used was 10%. In this experiment amount of DCP used was varied from 0 to 25%. The amount of MAH was 6%, and the ratio of WF and RPP was fixed at50:50. The added effect amount of DCP on the physical (i.e., density, moisture content, water arbsorption, and thickness swelling) and mechanical (i.e., modulus of rupture, modulus of elasticity, internal bond and screw holding power) properties of composites were investigated. The results are presented in Table 1.

The physical properties of the composites, especially moisture content, water arbsorption and thickness swelling decrease with increases in DCP content, yielding minimum at 15% addition and increasing with further edition of DCP. Han (1990) said that chemical reaction of moulded product from sawdust and RPP included esterification and maleyolation. Esterification reaction among OH group from sawdust and anhydride group from MAH cause strength cr Similar phenomenon occurs on the mechanical properties. The modulus of rupture, modulus of elasticity, internal bond and screw holding power of composites become greater with DCP content increasing to 15%. This can be explained in the following ways. First, the increase in the concentration of the radical initiator increases the formation of RPP macroradical. The result enhancement to strength the composites because of the MAH addition to the RPP molecules. This also results in a lowering the molecular weight of RPP, consequently, in decrease of the strength of composites. Consequently, maximum strength of composites appears when the amount of initiator is optimal.

CONCLUSIONS

DCP as initiator can improve physical and mechanical properties. The DCP concentration at 15% gave the best result to increase the strengthening of composites. The values of density, moisture content, water absorption, thickness swelling, modulus of rupture, modulus of elasticity, internal bond, and screw holding power of the composites respectively are 0.72 g/cm^3, 0.82%, 8.34%, 0.69%, 126 kg/cm^2, 15352 kg/cm^2, 3.47 kg/cm^2, 67.6 kg/cm^2.

The comparative physical and mechanical properties that resulted with JIS A 5908 (1994), only value of MOE (15352 kg/cm^2) still not fulfil standard qualification.osslink of sawdust particle with matrix, so it can prevent of water flow.

Table 1. The physical and mechanical properties of WF-RPP composites under various DCP concentration.

Parameters	DCP Concentration (%)					
	0	5	10	15	20	25
Density (g/cm^3)	0.72	0.68	0.74	0.72	0.74	0.74
Moisture content (%)	1.10	1.05	0.94	0.82	0.97	1.03
Water arbsoption						
2H (%)	4.97	3.33	2.89	2.43	2.92	3.91
24H (%)	17.74	13.32	10.93	8.34	8.93	11.41
Thickness swelling						
2H (%)	1.13	0.91	0.58	0.42	0.97	1.11
24H (%)	1.77	1.43	1.04	0.69	1.19	1.42
Modulus of rupture (kg/cm^2)	70.75	93.25	107.44	125.62	101.25	80.00
Modulus of elasticity (kg/cm^2)	8886	9563	12760	15352	12047	9171
Internal bond (kg/cm^2)	1.07	1.54	1.87	3.47	2.42	1.45
Screw holding power (kg/cm^2)	35	57.8	61.4	67.6	64.2	48.2

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