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GRAFTING POLYPROPYLENE WITH MALEIC ANHYDROUS (MAH) AS PARTICLE BOARD ADHESIVE (PARTICLE BOARD)

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ABSTRACT

This study evaluates the properties of particleboards made from palm oil stems by adding PP-g-MAH adhesives in the form of freeze-dried and pure samples. Modulus of rupture, modulus of elasticity, tensile strength, swelling thickness and absorption of water from the board was evaluated based on the Indonesian National Standard. Broken modulus and internal bond strength increase with an increasing number of PP-g-MAH connections. The swelling thickness and water absorption decreased with an increasing percentage of PP-g-MAH. Surface roughness and fracture strength increased with the addition of PP-g-MAH, Fourier transforms infrared spectroscopy was also considered. Based on the findings in this case that the addition of PP-g-MAH adhesive material can improve the overall properties of the particleboard.

Keywords: Grafting Maleic Anhydrous, Polypropylene, PP-g-MAH, Particle Board Adhesive

INTRODUCTION

The development of environmentally friendly product materials is being pursued in the last few years, along with the many environmental problems that arise today. The raw material for wood needs is increasing along with the increasing development needs of wood-based raw materials while the raw material for the world's wood resources is getting depleted. The development of particle boards is interesting to attract world researchers to do it. MAH contamination has been widely carried out including anhydrous Maleic with Ethylene-propylene diene monomer (EPDM), grafting and modification of polypropylene, transplanting methyl methacrylate with cellulose and polypropylene with ionizing UV radiation, adding polypropylene benzoyl peroxide is a good technique as a control in the transplant reaction[1]. Termination of a chemically induced chain in polypropylene results in a polypropylene cross bond. Under these circumstances, the macroradical combination becomes much faster. Another technique used is grafting the polyfunctional monomer where the part is more stable in grafting, thereby reducing the possibility of fragmentation and increasing the likelihood that the reaction will run more easily. Polypropylene chemicals tend to undergo separation which causes difficulty in opening bonds by grafting with other materials because polypropylene has high molecular weight and melting temperature. The peroxide initiator is used to provide functional free radicals to become polymeric bonds. Previous research explained that transplanting PP-glycidyl methacrylate (PP-GMA) having reactivity to a story based on an analysis of believing reactivity was more directed to polypropylene.

The oil palm stem particle board panel is in desperate need of a binder that has good physical and mechanical properties. The choice of the binder usually depends on the end-use of the particleboard. In

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the process of making particle boards without adhesives made from cane sugar-containing cellulose, lignin, it has been patented. The particle bonding is achieved by the presence of sugar, carbohydrates carried out at a temperature of 180°C. It shows particle bonding as a result of pressing which is bonded with the amount of cellulose, lignin at high temperatures[2].

Based on the above description, it is deemed necessary to research the manufacture of particleboards without using formaldehyde-based adhesives in this study to make and characterize particleboards from Elaeis Guineensis Jacq oil palm stem powder with Maleic anhydrous polypropylene grafting based adhesive. It is expected that the adhesive material forms a chemical bond with cellulose so that a better quality particle board is produced that meets the Indonesian National Standards (SNI 03-2105-2006)[3].

EXPERIMENTAL

Materials

Materials used include polypropylene Innovex PT. Petrochemical Nusantara Interindo, benzoyl peroxide Aldrich Chemical Company inc. Milwaukee, WI 53233 USA, divinylbenzene Schucharot OHG 85662 Horenbrunn Germany, palm oil plantations in Southeast Aceh District, Merck Maleic anhydride, Merck.

Degradation of Polypropylene with Benzoyl Peroxide

The temperature of the internal mixer is set at 170°C. Weighed as much as 25.50 grams of polypropylene and then put it into the internal mixer. Heated for 60 minutes, so that the polypropylene melts. Added BPO of 4.50 grams AM. Then heat for 5 minutes. Turned off the internal mixer PPd and the BPO mixture is released from the internal mixer and then cooled. Washed with 96% ethanol. Filtered with filter paper. The sediment is taken and dried in an oven at 50°C[3]

Formation of PPd with Maleic Anhydride

Weighed as much as 28.50 grams of PPd. Weighed 0.90 grams AM. Inserted into the internal mixer at 165°C. Heated for 30 minutes. Add 0.60 BPO and heat it for 5 minutes. The results of grafting are removed and cooled in water[4–7]

Purification of PPd with Maleic Anhydride

Weighed as much as 2 grams of PPd-g-AM. Reflux with 100 ml xylene until dissolved. Added 40 ml of acetone. Filtered with filter paper connected to a vacuum pump. Deposited under wet PPd-g-AM. Wash again with methanol repeatedly. Dried in an oven at 120°C for 6 hours. PPd-g-AM was dried and characterized by determination of rafting degree, FT-IR and TGA. The same is done for the next sample.

Determination of the Degree of Grafting PPd-g-AM

Pad-g-AM which has been purified. Refluxed with 100 ml xylene until dissolved. Added 3 drops of water and relaxed again for 15 minutes. Added PP indicator. Titrated with 0.05 N KOH in hot conditions. Terminated if there is a color change. The volume of KOH was recorded in 0.05 and due to the degree of grafting.

RESULTS AND DISCUSSION

The results of degraded polypropylene grafting on AM produce PPd-g-AM. In PPd grafting with AM, the composition of PPd: AM: BPO is 28.50 grams: 0.90 grams: 0.60 grams. The results of AM grafting were determined by the titration method where the weight of the sediment was obtained by 1.86 grams AM and the volume of KOH used to be 4.4 ml with the degree of grafting 8.88%.

The FTIR analysis of oil palm particle board in Fig-1. The existence of a reaction or interaction can be known by analyzing changes in functional group changes in each particleboard component before and after mixing. Figure-1is the spectrum of palm oil dry powder. The wide and sharp absorption peak at wave number 3421.50 cm^{-1} is the uptake of the hydroxyl group from the cellulose of oil palm wood. The hydroxyl group wave number of cellulose ranges from 3000 cm^{-1} to 3600 cm^{-1}. The absorption peak at wave number 1608.5 is C-C absorbed. In cellulose C-C uptake ranged from 1600 cm^{-1} to 1650 cm^{-1}[11,8]. Wavenumber 2935.5 cm^{-1} is C-H uptake which is amplified by absorption at 1373.2 cm^{-1} and 1423.5 cm^{-1}. Wavenumber 1045.5 cm^{-1} is the absorption of C-O bonds from cellulose.

Uptake peak 3345.21 cm^{-1} is the uptake of the hydroxyl group from oil palm wood cellulose, which shifts the wave number 3421.50 cm^{-1}. The absorption peak at wave number 1722.07 cm^{-1} is the absorption peak of the carbonyl ester group formed from the reaction of the malware group to the hydroxyl group of wood powder, cellulose and this is evidenced by the reduced intensity of absorption of the cellulose hydroxyl group[9]. In Fig (a) is a spectrum of particle immersion boards at a temperature of 60°C with a composition of palm oil, PPd-g-AM, divinylbenzene, benzoyl peroxide, polypropylene 80: 20: 10: 2: 40. FT-IR spectra divinylbenzene monomers show important peak peaks at 1630 cm^{-1}, 1595 cm^{-1} and 1576 cm^{-1}. Grafting of divinylbenzene in polypropylene was characterized by loss of double bonds at 1630 cm^{-1}, 1595 cm^{-1}, and 1576 cm^{-1}. Wavenumber 3345.2 cm^{-1} is the peak of hydroxyl absorption of wood fiber cellulose, wave number 1604.90 cm^{-1} is the uptake of aryl [10–12] group and wave number 1722, 07 cm^{-1} is a carbonyl group of esters formed from the reaction of Maleic anhydride PPd-g-AM with the cellulose hydroxyl group[13].

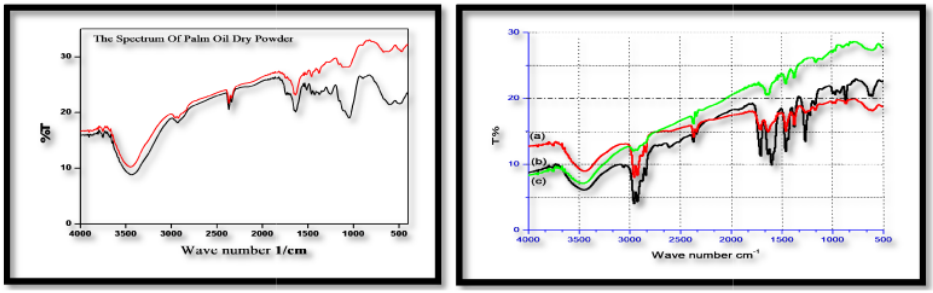

Fig.-1: FTIR Graph Palm Oil of (a) Wood Powder and (b) FTIR PP-g-MAH

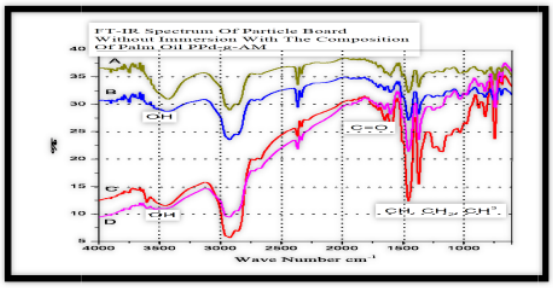

Fig.-2: FT-IR Spectrum of Particle Board without Immersion with the Composition of 70:30:10:2:40

The Results of Testing of Dry Bending Strength (MoR) and Flexural Elastic Modulus (Moe)

Data on the results of testing of dry bending strength (MoR) and modulus of flexural elasticity (Moe), water absorption, density and thick development are as follows:

Table-1: Data From Particle Board's Characterization

Sample	1	2	3	4	5
MoR (Kgf/cm^2)	191.88	258.16	304.72	311.93	158.78
MoE (Kgf/cm^2)	5113.31	9499.30	10288.54	9108.73	5842.96
Water absorption (%)	0.62	0.58	0.55	0.52	0.68
Density (g/cm^3)	0.60	0.56	0.46	0.48	0.58
Thick Swelling (%)	0.51	0.48	0.48	0.49	0.51

The increase in the price of this moor is due to the occurrence of ester bonds between the male anhydrous group and the hydroxyl group from KKS cellulose (Caulfield, 2005). An increase in the amount of PPd-g-AM subsequently results in a decrease in MoR prices. It is estimated that there has been an excess of PPd-g-AM resulting in two phases, namely the powder phase KKS and PPd-g-AM phase. The existence of this phase separation will affect the flexural strength of the particleboard. When compared with the MoR price

of SNI 03-2105-2006, the minimum MoR requirement is 107 kgf / cm^2, the resulting particle board value meets the requirements[13,14].

Morphological Analysis using SEM (Scanning Electron Microscopy) Test

From the SEM photo, it can be seen that the mixing of oil palm wood powder with PP-g-AM has shown a strong interaction between oil palm wood fibers and PPd-g-AM, although there are still visible cavities between palm fiber wood fibers. Figure-2, Particleboard without optimum immersion in sample 3 with a comparison of variations in KKK concentration: PPd-g-AM: DVB: BPO: PP (70: 30: 10: 2: 40). In picture X = 228, Y = 343 and Value = 148, it appears that the surface is homogeneous, but there are still ribs in one part of X = 345, Y = 323 and Value = 25 with cavity sizes H = 50 this is probably due to not fully interaction between the palm oil powder particle board with PP-g-MAH[9,13].

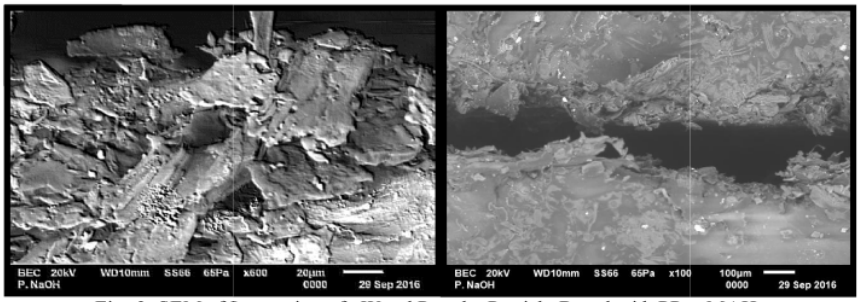

Fig.-3: SEM of Interaction of Wood Powder Particle Board with PP-g-MAH

CONCLUSION

The maximum MoR value for 1% NaOH immersion particleboard is 430.11 kgf /cm^2, density is 0.54 g / cm^3, water absorption is 0.58%, and development is 0.47% thicker. For the maximum value of MoE particle board at immersion is 10931.35 kgf / cm^2 density 0.63 g / cm^3, water absorbency 0.61%, development thickness of 0.49% when viewed from SNI 03-2105-2006, the MoE value does not meet the standard where a minimum of 20400 kgf / cm^2. FT-IR analysis showed that there had been a reaction between KKS: PP-g-AM: DVB: PP: 3345.21 cm^{-1} particle uptake BPO was uptake of hydroxyl groups from oil palm wood cellulose which shifted to wave number 3421.50 cm^{-1}. The absorption peak at wave number 1722.07 cm^{-1} is the absorption peak of the carbonyl ester group formed from the reaction of the malware group to the hydroxyl group of wood powder, cellulose and this is evidenced by the reduced intensity of absorption of the cellulose hydroxyl group. From the analysis of the optimum SEM photo on the particle board shows a more homogeneous surface. The optimum TGA analysis on particleboard samples shows the appearance of two peaks of the thermogravimetric curve produced. In the first stage 144.72 - 166.13°C the decrease in mass was 5,596% (0.6966 mg) and at 200-358.23°C there was a decomposition of mass decreases of 30.15% (3,753 mg) at 310.56°C and residues of 10.97% (1,365 mg).

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