Characterization physical, mechanical, thermal and morphological properties of Colophony

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***Abstract*--This study aims to determine the characteristics of pine resin as an alternative to resin on composites. Pine resin is pine species studied were merkuzii Jungh. et deVries that grew up in KPH East Bali. Pine resin is very difficult to freeze at room temperature. The pine resin used in the study was heated at 170^{0}C for 150 minutes and with a 400 rpm magnetic stirrer speed. Further testing is done to determine the physical, mechanical, thermal and morphological properties of pine resin. Turpentine content in pine resin will decrease with heating treatment. There was a change of color due to heating and the mechanical nature of pine resin very brittle with SEM observation showed no pore in pine resin.**

Keywords: pine resin, characterization, colophony

I. INTRODUCTION

Pine resin is a renewable resource that comes from nature. Pine resin is a non-timber forest product from pine trees, obtained by tapping pines. Most pine trees grown in Indonesia are Merkusii Pinus (Pinus Merkusii Jungh et et deVries) including Pine Tree that grows in KPH East Bali ((C. I. P. K. Kencanawati et al. 2017). Pine Tree is a type of industrial plant which is a raw material for paper pulp industry, wood producers, resin production, and land conservation on critical lands (Wiyono et al., 2006).

Pine resin has hydrophobic characteristics (dislikes water), soluble in neutral solvents or non-polar organic solvents (ethyl ether, hexan, and oil solvent) (Djatmiko 1973), (Wang et al., 2011). Pine resin is a type of oleoresin (a mixture of resin and tree oil) containing terpenoid compounds, hydrocarbons and neutral compounds when distilled to produce 15-25% turpentine ($C_{10}H_{16}$) and 70-80% gondorukem and 5-10% impurities (Barabde et al. 2005) (Riwayati 2005). The color of pale resin, clear and sticky and when evaporated turned into fragile.

The process of pine resin distillation will produce Gondorukem (Colophony), according to Kutsek 2005), there are three types of gondorukem based on its source namely, gondorukem resin (gum rosin), gondorukem oil (tall-oil rosin), and wood rosin (gondorukem wood). In Indonesia gondorukem produced is gondorukem that comes from the resin of pine trees. Indonesia is the world's third largest producer of gondorukem after China and Brazil which contributes 8% more to world gondorukem production, while the annual production volume of Indonesian gondorukem is about 60 thousand tons which consists of 80% for export and 20% to meet the needs domestic market (Tambunan 2010). Gondorukem produced directly exported to several countries such as the United States, India, Cameroon, France and the Netherlands.

The utilization of gondorukem (Colophony) is as a mixing agent in sizing agent, printing ink factory, varnish, and adhesive (Kirk-Othmer 2007). In the Zhaobang (1995) report, gondorukem esters of pine resin processing are widely used in the printing ink industry, coating industry, and the adhesive industry. In research (Puica and Oancea 2008) the use of gondorukem as a glue shows the value that the value of fractal colophony of 1.3319 which means that colophony has a level of regularity of grains / aggregates are less regular, making it easier for other substances to be absorbed into the grain structure or in other words has good adhesiveness. Based on the characteristics of the properties of gondorukem it is possible use as a matrix in the composite, given the potential for the development of natural composites is very high (C. Kencanawati et al. 2017).

II. METHOD

The research relates to the characteristics of pine resin generated from Merkusii Pine trees grown in KPH East Bali by conducting density test, tensile test, TGA and SEM.

(a) (b)

Figure 1. (a) Pine resin tapping and (b) Tapped resin

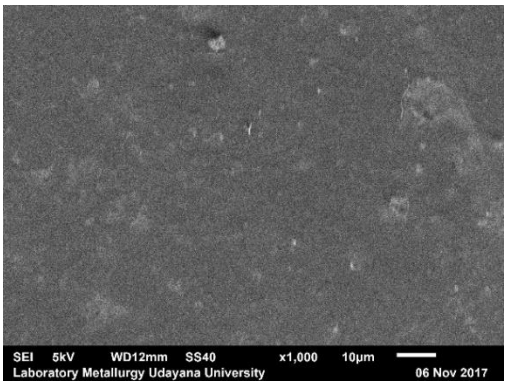

Figure 2. SEM of Colophony

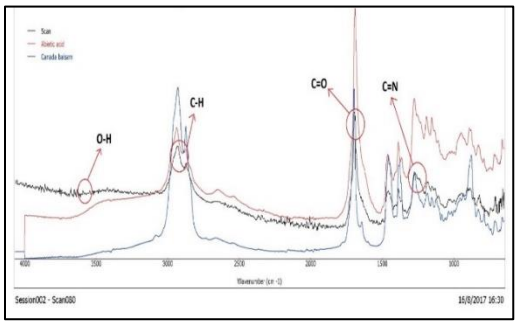

Figure 3. Spektrum FTIR of Colophony

The first step is tapping pine resin from Jungh merchantine pine tree. et deVries with drill tapping methods, as this method can further preserve pine trees when compared with the tapping method with the goakan system. Furthermore, pemasanasan accompanied by stirring of pine resin with magnetic strirrer at temperature 1700C and holding time 90 minutes and speed of magnetic strirrer 400 rpm, then spilled distillation of distillation on wood mold that has been coated by aluminum foil. Then test density according ASTM D792, tensile strength test according to ASTM D 638-02 standard, TGA 701 ASTM D7582 MVA in Biomass and FTIR testing. Scanning Electron Microscope (SEM), JSM-651OLA, was used to observe the morphology of microstructure of AC's.

III. RESULTS

Characterization of gondorukem (Colophony) including of density, tensile strength, proximate and morphology microstructure have been obtained at previous work [21] and shown in Table 1, Table 2, Table 3 and Fig. 1 respectively.

Table 1. Characteristics physic of Colophony

Characteristics	Colophony
Bentuk	Liquid
colour	white/pile yellow
solubility	Hidrophobic
Softening Point	65 – 75^{0}C
Density (gr/cm^3)	1,11 – 1,12
Other	Adhering

Table 2. Characteristics mechanic of colophony

Characteristics	Colophony
Tensile Strength (Mpa)	0,077 ± 0,06
Tensile Modulus (Gpa)	0,009 ± 0,001
Max Strain (%)	1,71± 0,03

Table 3. Proximate analysis of Colophony

Karakteristik	Colophony
Moisture (%)	2,42 – 3,93
Ash (%)	0,01 – 0,03
Fixed Carbon (%)	0,01 – 0,05

IV. DISCUSION

From the distillation of pine resin obtained colophony which form more liquid when compared with raw material, with pale yellow color and is hydrophobic that is not soluble in water. The pine resin begins to soften at temperatures between 65^{0}C - 75^{0}C, this characteristic indicates that colophony at room temperature is solid to semi-solid. If Colophony high temperatures will melt and when the temperature drops Colophony will again become hard (solid) so that Colophony is a thermoplastic material. In addition, the viscosity will change according to the temperature changes that occur. The higher the colophony temperature, the viscosity will be lower or more dilute. From the characteristic hard coatings, colophony with low viscosity will be beneficial because colophony will cover up the other material better and evenly. However, with over heating it will damage the molecules of colophony so it will become brittle and fragile. This can be seen from the

mechanical test of colophony with its tensile strength of 0.077 Mpa and maximum elengation of 1.71%.

The highest water content (%) of the highest colophony is 3.93%, which indicates very little possibility of catching up when the colophony is in a swelling state. The content of ash in colophony maximum amount of 0.03%, it shows that when the decomposition of colophony then the end result will produce ash of 0.03%. Carbon Levels The bound colophony of the test showed the highest mean value of 0.05%.

SEM observations show a smooth and evenly distributed morphology colophony, indicating that the coating and gluing of the colophony is excellent in the absence of voids or vacancies. Figure 3 shows the results of the FTIR test on colophony, FTIR analysis was performed to determine the functional groups contained in colophony such as hydroxy group (OH) with wavelength 2964.08 m^{-1}, alkane (CH) group with wavelength 1453.79 m^{-1}, carboxylic group CO) at a wavelength of 1095.76 m^{-1} and an amide group (CN) at a wavelength of 1339.02 m^{-1}.

V. CONCLUSIONS

From this research can be concluded that:

1. Colophony belongs to the thermoplastic class of material because it will undergo changes in form with the occurrence of temperature changes.
2. Colophoni has coating properties and adhesion is smooth and evenly distributed.
3. The occurrence of shrinkage because swelling is very small because the colophony has hydrophobic properties.

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