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Utilization of Liquid Smoke Produced Through the Pyrolysis of Cashew Nut Shells as Raw Materials For Varnish Manufacturing

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Abstract - Cashew nut shells is a waste in the cashew nut processing industry. The cashew nut shell is processed into liquid smoke by pyrolysis method. This liquid smoke can be used as a substitute for synthetic phenol. Phenol is the raw material of phenolic resin in the manufacture of varnish. This research aimed at determining the varnish characteristic obtained from the optimum condition of cashew nut shells pyrolysis by studying the effect of the addition of 0%, 10% and 20% commercial varnish at pyrolysis temperatures of 200 and 300°C. The results were obtained at 300° on 0% commercial varnish addition with the density of 1.0024 gr / ml, 1 hour pseudo drying time and 2.45 hours of hard drying time. After the addition of (10-20)% commercial varnish, it was found that the addition of 20% commercial varnish was the best condition in which volatile matter rate, density, touch dry time and hard dry time were of 45.51%, 1.05 (g / ml), 2.55 hours and 5.35 hours, respectively. All characteristics were meeting the Indonesian National Standards (SNI) for varnish type A (for interior and exterior use). This research indicated that the liquid smoke produced from the pyrolysis of cashew nut shells was a potential alternative material to be used as compound or substitute phenol in varnish manufacture.

Keywords: Pyrolysis, Varnish, volatile.

1. Introduction

Production of cashew continues to increase from year to year and consequently, it also produces waste like cashew nut shells. Cashew nut shells are a kind of by-products of cashew nut processing industry containing cashew nut shell liquid with a rendement of 30-35% yield. The main components of CNSL are of cardanol acid 94% and cardol 6% as impurity. Cardanol has a chemical structure similar to synthetic phenol, so it is possible to substitute or replace synthetic phenol from petroleum derivatives. Petroleum is a non-renewable natural resource, its reserves are depleted. Therefore, it is necessary to find alternative materials to replace other phenol sources other than petroleum.

Cashew nut shells which are by-products of the process of cashew nut breaking to take cashew nuts have not been optimally utilized and become waste in the cashew nut industry. In Muna Regency, Southeast Sulawesi, cashew nut waste is used as landfill and firewood. The use of cashew nut waste as ground material can damage the environment because the chemical compounds contained in the cashew nut waste can kill soil microorganisms. The chemical compounds are also harmful to humans because they can cause skin irritation.

Cashew nut shells are processed into liquid smoke using pyrolysis method. Liquid smoke containing CNSL in cashew nut shells is a potential alternative material to be used as phenolic substituting compounds or as substitute for phenol in varnish production. Varnish is a homogeneous mixture of one or more types (synthetic or natural resin) with drying oil, drying agent and solvent.



Varnish serves as a surface coating for protection and decoration purposes. Liquid smoke is obtained by pyrolysis process, which is a process of heating at a certain temperature of organic materials in an inert atmosphere (without the presence of oxygen). Pyrolysis is thermal destruction of biomass in the absence of air/oxygen. This leads to the production of useful liquid oil, gases and solid products. The excellence of this CNSL smoke is that it is a renewable resource where the availability of its raw materials can be assured, in contrast to synthetic phenolic compounds synthesized from petroleum whose price and existence are heavily dependent on depleting petroleum.

Previous research, conducted was making varnish from the liquid smoke of cashew nut shells. Liquid smoke used was liquid smoke with phenol 4.5% with CNSL addition to the varnish production process. In this study, researchers used the waste of cashew nut as a source of phenol to be used as raw material without using CNSL in making varnish. The use of CNSL in varnish production is substituted by the addition of 10% and 20% of commercial varnish. Varnish characteristics of the results had met a quality stipulated by SNI NO.06-1009-1989.

This research aimed at determining the characteristics of varnish obtained from the optimum condition of pyrolysis of cashew nut shells based on SNI. NO 06-1009-1989 and determining the characteristics of the varnish produced by the addition of 0%, 10% and 20% of commercial varnish based on SNI. NO 06-1009-1989.

2. Experimental Method

The main ingredient in varnish production was the liquid smoke resulted from the pyrolysis cashew nut shells. Other materials required were commercial varnish, aquades, formaldehyde 20%, NaOH 45% and ethanol 70%. Production of varnish began by making phenolic resin, i.e. reacting phenol to formaldehyde substituted by liquid smoke with a ratio of liquid smoke: phenol (b / b) is 1: 1. The substitution result was mixed with formaldehyde 20% at a mole ratio of 1: 2 and then added by NaOH 45% dropwise as catalyst until it reached pH of 8. Polymerization was carried out at 60 ° C with a 3-hour polymerization time. Condensation was done to reduce the water content for 1 hour. The finished resin was then dissolved at ethanol 70% with a ratio (b / b) of 20% of the resulting resin and then analyzed.

3. Results And Discussion

The resulting varnish was then analyzed and compared to varnish quality standard of SNI No. 06-1009-1989. The effect of pyrolysis temperature on varnish characteristics generated without the addition of commercial varnish and with the addition of commercial varnish of 10% and 20% is presented in Table 1-2.

Table 1. The effect of pyrolysis temperature on varnish density

Temperature (°C)	Density(gr/ml)		
	Commercial Varnish 0 %	Commercial Varnish 10 %	Commercial Varnish 20%
200	0.9946	1.024	1.048
300	1.0039	1.027	1.051