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Lignin Isolation from Coconut Coir with Variation of Time and Concentration of NaOH in Process of Alkaline Delignification

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ABSTRACT

Coconut coir is a solid waste coconuts that contain lignin to be used as raw material for various chemical industries. Lignin is taken by alkaline delignification stage and continued with the isolation of lignin using acidification. The process of alkaline delignification coco using NaOH solution with varying concentration of 15-35 % and processing time 60-150 min. Phase of lignin isolation using 20 % H_2SO_4 solution followed by a purification process. Analysis result of lignin using Klason method obtained the highest yields of 37.16 % by using 25 % NaOH and processing time of 120 min.

KEYWORDS

Alkaline delignification, Coconut coir, Lignin.

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INTRODUCTION

Coconut coir is a lignocellulosic material containing hemicellulose by (0.250 %), cellulose (43.44 %), lignin (45.84 %), pectin (3.00 %) and water (5.25 %) [1]. The amount of lignin content in coco was potential to be isolated in order to separate it from lignocellulose.

Lignin is a polymer compound which can be used as raw material polymer product and source materials of low molecular weight chemicals in the chemical industry and can be sulfonated into lignosulfonates as well as excellent raw material for the manufacture of synthetic fibers such as nylon.

Simatupang *et al.* [2] have isolated lignin with empty palm oil fruit as feedstock procedure highest lignin yield 16.42 % using 20 % NaOH and 120 min processing time. Lubis [3] also made the isolation of lignin from black liquor pulp cooking process soda and sulfate pulp yield obtained 27.74 % using 20 % H_2SO_4 solution. A good lignin content in coco was expected to achieve higher lignin isolates on particular process conditions. For that reason, research on lignin isolation from coconut husk with alkaline delignification process followed by the isolation process was being conducted.

EXPERIMENTAL

Raw materials such as coconut husk and supporting chemical materials in the process of alkaline delignification are 96 % ethanol solution of 15, 20, 25, 30 and 35 % NaOH, 20 % H_2SO_4 and 0.01 N Aquadest.

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Preparation of raw materials: Coconut coir was dried for one week and then dried in an oven temperature of 110 °C for 2 h. After the raw material dried then the size was reduced to approximately 3 cm.

Delignification process: 50 g of coconut coir, a cooking solution with a ratio of 20:1 v/b (cooking solution = 96 % ethanol: distilled water = 1:1) and adding NaOH as much as 15 % of the weight of the sample into a batch reactor. Furthermore alkaline delignification process was carried out at 170 °C for 1 h. The process was repeated for variations by the addition of 20, 25, 30 and 35 % NaOH. The process was repeated for 90, 120 and 150 min.

Isolation of lignin [4]**:** Leachate sample resulted from alkaline delignification diluted with distilled water 1:2. Further step is to acidify the samples with 20 % sulfuric acid at pH 2 while heated at 60 °C and allowed to stand for 12 h. Washing the precipitate lignin using 0.01 N H_2SO_4 continued washing with distilled water and then filtered. Furthermore, lignin deposition that had been washed dried at 50-60 °C for 26 h until constant weight to produce lignin powder in a form of flour. Lignin flour was analyzed with Klason method [5].

RESULTS AND DISCUSSION

Isolation of lignin from coconut husk with the alkaline delignification process aimed to get the largest yield of lignin by varying the NaOH at different concentration ranging from 15, 20, 25, 30 and 35 % and processing time of 60, 90, 120 and 150 min. The yield of lignin was a percentage of product obtained from the comparison of initial weight with the final weight.

Effect of alkaline delignification process of coco to the lignin yield produced can be seen in Fig. 1. The lowest yield of lignin at 3.72 % in lignin isolate with 150 min processing time using 35 % NaOH. While the highest lignin yield was 37.16 % in lignin isolate with 120 min processing time using 25 % NaOH. In general the increasing level of lignin yield occurred from 60-120 min time and then decreased at the time of 150 min. Delignification at the beginning of the process, the alkaline solution served as cooking solution successfully degraded lignin contained between the cells of the fiber, while the lignin which is located in the cell of new fiber wall partially dissolved after cooking time increased.

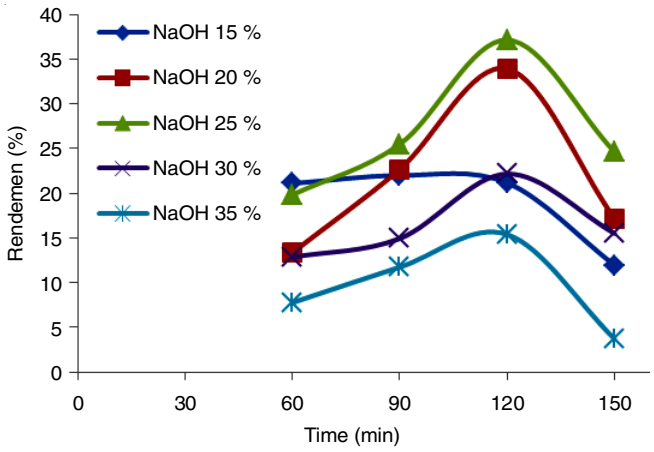

Fig. 1. Graph of the processing time *vs.* % yield of lignin

The increased time of cooking affects delignification process. Increased cooking time causes the dissolved lignin to increase and impregnation process between the solvent with coco become more perfect [6]. But the long duration of cooking time triggered the degradation of lignin constituent compounds resulting in lower yield [2]. Beside the lignin degradation, it was expected that degradation of redundant non lignin components occurred and dissolved in a solution of cooking, so the longer the cooking time the less yield of lignin.

Fig. 2 showed the relationship between the NaOH concentrate in coco cooking solution to the yield of lignin produced. The yield of lignin increased as the amount of 15-20 % NaOH and decreased at 30 % NaOH.

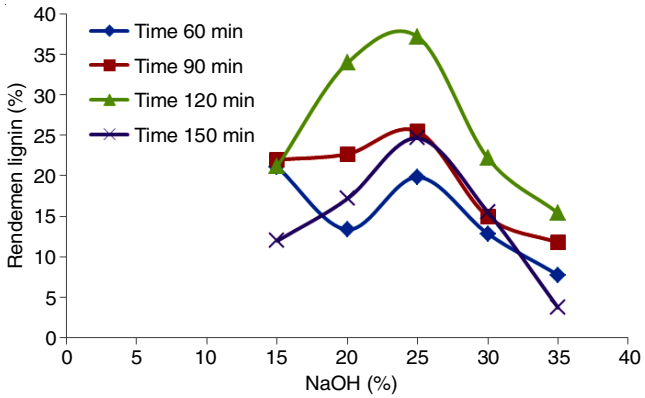

Fig. 2. Graph of % NaOH *vs.* % yield of lignin

Increasing NaOH concentrates facilitated the break of lignin compound bond so lignin dissolved easier in a solution of cooking. This condition led to the increased total solids in the black liquor so the lignin yield levels also increased. Meanwhile the decline in the yield of lignin began to occur at 30 % NaOH solution because the solubility of NaOH in water is low so in the process delignification the cooking solution was already saturated. This is the reason that the delignification process did not run well caused the decrease of lignin yield.

From the graph it is clear that the best conditions obtained the highest levels of lignin yield in 25 % concentrate with a cooking time of 120 min for 37.16 %.

Conclusion

Based on the results, the time and NaOH concentration affected lignin isolation process of coconut coir with alkaline delignification methods. Lignin yield of 37.16 % was obtained at alkaline delignification process using 25 % NaOH and processing time of 120 min.

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