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PRODUCING PULP AND PAPER FROM DURIAN HIDES

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Abtract-A test on the production of pulp and paper from durian hides has been carried out with cooking temperature of 135 ^{O}C for a duration of 1.5 hours in a liquid of 2% : 3% : 4% NaOH with comparison of durian hide fragment : cooking liquid 1:6. Durian hides possesses grinding level of 180 CSF, cracking index of 0.6 kPa.m^2/gr and low tension index namely 15 Nm/gr. The composition of the mixture of durian hide pulp (3% NaOH) with Old Currugated Carbon (OCC) is (100%:0); (90%:10%); (80%:20%), (70%:30%). To the grinding level of 300 ml CSF, starch of 1% and sizing agent (AKD) 1% is added. Physical characteristics of the paper sheet possesses gramature of 54.5 gr/m^2, thickness 0.321 mm, tensile strength 1.13 kN/m, tearing strength 253 mN, Porosity (Bensten) 2050 ml/minute and roughness *(Bensten)* 1700 ml/minute. The paper grammage had not fulfilled basic paper specification for plastic laminated wrapping paper, SNI 14-6519-2001.

Keyword: Durian Hides, Pulp, Paper.

I. INTRODUCTION

Nowadays, Indonesia is in the ninth rank of the world pulp production with market share of 2.4% of the word market, whereas as paper producers Indonesia is in 12th rank with 2.2% market share. CEPI (Confederation of European Paper Industries) projects that world consumption on pulp would reach 233 million tons /year in 2015 with 1.8% growth /year. This indicates that the world demand on pulp and paper is still high and Indonesia still stands a very good chance to take part in the world paper and pulp market. In addition the world markets, domestic market is still open. Paper consumption per capita per year shows a growing tendency. In 2004 was still 25.3 kg, in 2005 was 25.3 kg and in 2006 went up o 25.4 kg and it is predicted that the paper consumption per capita would reach 7.0 to 8.0 % per year [1]. Plants with fiber both of wood and non-wood is basic material for pulp production (both for bleach craft pulp and dissolving craft pulp). Wood contains several chemical substances which can be divided into four main parts namely: cellulose, hemicellulose, lignin and extractive. In pulp production, as much cellulose and hemicellulose as possible is expected; whilst lignin and extractive are removed from the wood during the process. Wood chemical composition varies depending on the type but generally hardwood contains higher hemicellulose than softwood. [5]. Durian is a tropical plant from Southeast Asia. The name is also given to its eatable fruit. The name was adjusted to the hard and thorny outer part of the fruit. Popularly it is called "king of fruit". Durian is a controversial fruit.. For some people it is a tasty and delicious fruit but for some, it is not. It is not a plant of a single species but a group belonging to Durio family. North Sumatra is the biggest province durian producer in Indonesia and Langkat is biggest regency producing durian in the province. North Sumatra produces 579,471 tons of durian /year and Langkat alone produces 3,627 tons per year on 850 ha of land. 57% of the bid durian fruit is hide, and it might become serious garbage problem unless it is properly handled. Yearly North Sumatra produces 332,712 tons of durian hides which is one of the reasons why durian hides should be utilized. [9]. In lignocellulosed material utilization, raw material specific characteristics plays very important role as chemical-physical and morphological characteristics of each material differ.. the quality of produced paper sheet is heavily influenced by the characteristics of the raw material especially its density, fiber dimension and its derivatives and also its chemical component Chemical composition on the raw material influences the cooking energy consumption and chemical penetrating power; density influences pulp cooking process adjustment; and fiber morphology influences the strength of fiber weave and fibrillation. [24]. Durian hide has a very good potential to become pulp and paper raw material. That is the reason wht this research was conducted. In this research, morphological analysis on wood fiber (the dimensions and the derivatives) and physical chemical characteristics of durian hide wood fiber. With the analysis, the quality of the paper produced can be revealed.

II. EKSPERIMENT

Material used are durian hides dried up in the open air to obtain the same level of hydrogen content. Hydrogen content is determined in order to calculate hydrogen content of the raw material. This process is done using *oven* in accordance with Indonesian National Standard (SNI). The research covers raw material preparation, raw material cooking process, pulp sheeting, physical pulp characteristics determination, paper producing and quality determination. The raw materials used in this research are dried up in open air in order to obtain similar hydrogen content. Raw material hydrogen content is determined in order to calculate dry level of the raw material. Hydrogen contents determination is done using oven method as in Indonesian National Standard. For the sake of chemical analysis of the raw material, the fragment is pollinated. Pollination was done by using Wiley instrument and sieved until 40-60 mesh size is obtained. Cooking process was carried out with soda in rotary digester with adjustable temperature. Durian hide fragment was weighed with minimal weight of 500 gr, put into a digester with NaOH with fragment ratio: NaOH 2%, 1:6. Then the digester was sealed and heated using electricity at 135 ^{0}C for as long as 1.5 hour. It took 15 minutes to reach the 135 ^{0}C. after 1.5 hour, the electricity was

disconnected and then cooled down for ± 1 hour. The digester was opened and the pulp was poured down into a big pail. The pulp was then washed up 3 - 4 times until durian hide pulp free from lignin was obtained or until he pulp was no longer oily. The same way was done to NaOH 3% and NaOH 4% so that three type of durian hide pulp was obtained. Further the fiber was loosened using agitator and the screened. The total yield and the screened yield of the produced pulp was determined and then the kappa nominal can be determined too. The same steps were carried out to NaOH 3% and NaOH 4% and the kappa nominal of the pulp from durian hide can be seen in the following Table 1.

Table 1. Cooking Result

No	Raw Material	NaOH (%)	Total Yield	Kappa Nominal
1	Durian Hide	2	64.19	80.74
2	Durian Hide	2	65.20	80.34
3	Durian Hide	3	63.76	71.62
4	Durian Hide	3	62.57	73.09
5	Durian Hide	4	58.47	43.15
6	Durian Hide	4	50.87	43.64

Table 2. The Comparison of Durian Hide Characteristics with Required Wood Characteristics for Pulp Raw Material

No.	Wood Characteristics	Pulp Quality			Durian Hide
		Good	Fair	Lack	
1	Fiber Length	>1.600	0.900-1.600	<0.900	1.89
2	Lignin Content	<25%	25 – 30 %	>30 %	18.79
3	Pollen Content	<5%	5 – 7 %	>7%	2.26
4	Holocellulos Content	>63%	60 – 65 %	<60%	61.53

From Table 2 above durian hides are categorized as good wood requirements for pulp raw material; only cellulose content is considered fair. For physical characteristic test, prior to the sheeting, pulp was loosened again in unloaded Valley beater Grinding level was determined on the basis of grinding period which was measured using CSF (Canadian Standard Freeness Tester) based on SNI 1SO 5267- 2 : 2001, IDT, Pulp- Testing drainage part 2. Canadian Standard Freeness method and then physical characteristics of the pulp sheet was carried out. Physical characteristics test includes tearing index, cracking index tension index which was done in accordance with SNI 14-0493-1998. The test of paper tearing index was SNI 14-0493-1998 ; the test of cracking index of the pulp and paper sheet was SNI ISO 1924-2 : 1994, HDT and the test of tension characteristics was on Part 2: Permanent Elongation Speed Method.In producing base paper for plastic laminated wrapping paper, pulp was loosened again in Unloaded Valley beater and then mix with 1% starch and 1% Alkyl Ketene Dimer (AKD) sizing agent .Further the physical strength of the base paper for plastic laminated wrapping paper was tested in accordance with SNI 14-6519-2001 including grammage, thickness, tension index , tearing index porosity and roughness. The test was carried out in accordance with SNI ISO536-2010 Paper and Cartoon. The test of grammage was SNI ISO534-2011 Paper and Cartoon and the test of thicknes, density and specific volume was SNI ISO 1924-2:1994, IDT, testing tension index - Part 2: Permanent Elongation Speed Method; SNI 14-0436-1998. The test of tearing index was SNI ISO 0932, 1; 2008 Paper and Cartoon and The test of roughness was Part 1: *Bentsen* method

III. RESULT AND DISCUSSION

The result of the cooking shows total yield (%) and kappa nominal as shown in the following Table 3. As indicated in the kappa nominal, durian hide pulp is categorized as semikia pulp.

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No	Raw Material	NaOH (%)	Total Yield (%)	Kappa Nominal
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5	Durian Hide	4	58.47	43.16
6	Durian Hide	4	59.87	43.64

Table 4 The results of Physical Characteristics of Durian Hide Sheet

No	Testing Parameter	Unit	Pulp KD (NaOH 2%)	Pulp KD (NaOH 3%)	Pulp KD (NaOH 4%)
1	Initial Grinding Level	mL CSF	170	180	230
2	Tearing Index	mNm^2/g	8	9	9
3	Cracking Index	$kPa.m^2/g$	0.5	0.6	0.6
4	Tension Index	Nm/g	13	15	12

The testing of physical characteristics of durian hide includes: tearing index, done in accordance with SNI 14 -0436-1989, cracking index, done in accordance with SNI, tension index done in accordance with SNI 14-1989 and initial grinding level. The data of physical characteristics of durian hides is shown in the following Table 4.

According ISO 5264/1 Pulp Laboratory Beaing Part 1, Valley Beater Method grinding standard of pulp to produce sheet is up to 300mk CSF. This the reason why physical characteristics of pulp, tearing index, cracking index and tension index are tested at initial grinding level. Below standard initial grinding level of durian hides is for pulp of LBKB / Leaf, Bleached, Craft ,Pulp (SNI 14-6107-1999),the specification of white craft pulp of softwood) as big as 650 ml CSF. Because pulp was not grinded , tearing index of durian hide pulp is relatively high $\pm$ 9$mNm^2.g$ relevant to the fiber length (1,89 mm) .On the other hand cracking index and tension index are low due to the loose tight of the fiber. In order to improve the quality of pulp sheet of durian hides, the pulp was then mixed up with OCC pulp grinded up to 300 ml CSF, but the result wa still fairly low. The data of physical characteristics determination are shown in the following Table 5.

Table 5. The Result of Physical Characteristics Determination of the Mixture Durian Hide Pulp (NaOH 3% and Old Corrugated Carton OCC)

No	Testing Parameter	Unit	Pulp KD 100% + OCC (0%)	Pulp KD 90% + OCC (10%)	Pulp KD 80% + OCC (20%)	Pulp KD 70% + OCC (30%)
1	Tearing Index	mNm^2/g	7	6	7	7
2	Cracking Index	$kPa.m^2/g$	0.6	0.6	0.7	0.7
3	Tension Index	Nm/g	15	17	18	20

Table 6. Physical Characteristics of the Paper Sheet

No	Parameter	Unit	SNI 14-6519-2001	Pulp KD	Pulp KD + Starch 1% + AKD 1%
1	Grammage	g/m^2	70 ± 2.8	53.6	54.5
2	Thickness	mm	0.110 – 0.142	0.234	0.321
3	Tensile Strength, AM	KN/m	Min. 1.96	1.08	1.13
	SM	KN/m	Min. 1.63		
4	Tearing Index, AM	mN	Min. 392	228	253
	SS SM	mN	Min. 416		
5	Porosity (Bendsten)	ml/Menit	Max. 1000	2000	2050
6	Roughness (Bendsten), WS	ml/Menit	Max. 1700	2138	1700

Because the pulp sheet quality is low, the pulp is the made into base paper for plastic laminated wrapping paper which do not require very high standard specification. The result shows that paper pulp of durian hide does not meet the specification of base paper for plastic laminated wrapping paper as suggested by SNI 14-6519-2001. The result of the test on physical characteristics of the paper sheet like gramateur, thickness **t**ension strength, cracking index, porosity *(Bendsten)*,roughness *(Bendsten)* can be seen in the following Table 6.

In Table 6 ,it can be seen that the paper gramteur of durian hide pulp does not meet the specification required by SNI 14-6519-2001,because the pulp is too hard to turn into sheet, the pulp is tightly attached to wire so that sheets with higher gramateur can not be made. Also, paper thickness, tension strength and tyearing strength do not fulfill the specification of SNI 14-6519-2001. Only roughness parameter can meet the SNI 14-6519-2001 specification.

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V. CONCLUSIONS

From the data of cooking result of the raw material, pulp sheeting, paper sheeting and determining paper quality, it can be concluded that:

1. Grammage does not meet the specification of SNI 14 -6519-2001 because pulp of durian hides is hard to turn to sheets, pulp is tightly attached to wires so that higher grammage sheet can not be made.

2. Paper thickness, tensile strength, tearing index do not meet the SNI 14-6519-2001 specifications.
3. Paper roughness meets SNI 14-6519-2001 specification.
4. Durian hides has initial grinding level below 300 ml CSF and has cracking index of 0.6 kPa m^2/gr and low tension index of 15 Nm/gr.
5. Paper from durian hide pulp has met SNI 14-6519-2001 specification. Grammage, paper thickness, tensile strength, tearing index do not meet the standard. Only paper roughness can meet the specification.

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