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BLEACHED CHEMICAL PULP FROM KENAF

REPORT NO. 10
CHEMICAL PULP FROM KENAF WOODY CORE

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CHEMICAL PULP FROM KENAF WOODY CORE

By Chien Chu*, Naiyana Niyomwan*, and Anchalee Puangvichit*

SUMMARY

Pulping of kenaf woody cores by chlorine process and sodium bisulphite process was compared. Chlorine pulping gave higher yield but lower strength than the sodium bisulphite pulping.

Kenaf woody core chips were crushed and chlorinated twice at 60°C for one hour in chlorine water at liquor ratio 6:1 with 6% chlorine in the first stage and 8% chlorine in the second stage. Each chlorination was followed by alkali extraction with 3% caustic soda on chips and hypochlorite bleaching with 2% available chlorine. Between chlorinations the partially bleached pulp was disc refined. The yield of final pulp was 70% with 65% brightness and initial freeness S-R 470 ml.

Pulp strength test at freeness 360 ml S-R showed breaking length 5,089 m, tear factor 71, burst factor 19, bulk 1.44, and folds 33. The pulp quality appears better than rice straw NSSC pulp in respect to strength.

Sodium bisulphite pulping of kenaf woody core with 20% sodium bisulphite at 150°C for 4½ hours gave 53% yield. The pulp was bleached to 89% brightness with 8% chlorine in C/E/H sequence. The bleached yield was 82% on unbleached pulp.

The bleached pulp with initial freeness S-R 760 ml and final freeness 455 ml after 4 minutes beating gave good pulp strength featuring breaking length 5,255 m, tear factor 85, burst factor 28, bulk 1.26, and folds 76. The pulp is comparable to bleached bagasse kraft pulp.

INTRODUCTION

Kenaf woody cores are waste from decortication of kenaf stalks for bast ribbons. Prospective establishment of kenaf retting centres for ribbon retting would afford large production of kenaf woody cores as a by-product. Two processes for pulping kenaf woody cores for chemical

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pulp in small or medium sized paper mills without chemical recovery system are explored. One is chlorine pulping process and the other, sodium bisulphite process.

The chlorine pulping process stems from the prevailing surplus chlorine of alkali industry in Thailand. The surplus chlorine has to be disposed at some cost. The chlorine pulping process can take advantage of the surplus chlorine, otherwise the pulp mill may switch over to other process or generate its own chlorine by electrolysis of salt. Then both caustic soda and chlorine can be produced from salt and consumed as pulping agents in the mill.

The chlorine pulping process involves chlorination of kenaf woody core chips followed by alkali extraction and hypochlorite bleaching. The chlorination, alkali extraction and hypochlorite bleaching treatment are repeated.

The sodium bisulphite process for kenaf stalks was reported in this series of study*. The process gives high yield of pulp with good bleachability and strength. Therefore, the process should apply as well to kenaf woody cores.

EXPERIMENTAL AND RESULTS

1) Pulp preparation by chlorine pulping process

Thai kenaf woody cores prepared by stripping kenaf stalks were shredded into 2 cm chips and crushed. Chlorine treatment of the crushed chips was done in a 2-litre polyethylene bottle heated in a water bath to keep the temperature at about 60°C in the bottle. Chlorine gas was generated by acidifying to pH 3.0 sodium hypochlorite solution containing the necessary amount of available chlorine. Chlorination was

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*CHU, Chien; NIYOMWAN, Naiyana; and PUANGVICHIT, Anchalee (1971).—Bleached chemical pulp from kenaf by sodium bisulphite process. Report no. 2 on Classified Investigation no. 2 (Confidential). Mimeographed. (Bangkok: ASRCT.)

done in two stages each stage lasting about 60 minutes. After the first chlorination with 6% available chlorine and liquor ratio 6:1, the treated chips appeared brightened and were washed. Hot alkali extraction of the washed chips was applied at liquor ratio 10:1 for one hour at 70°C with 3% caustic soda on chip weight. The extracted chips with darkened colour were bleached with sodium hypochlorite solution containing 2% available chlorine as usual for 3 hr at 40°C. The partially bleached crude semi-pulp was refined in a disc refiner and further chlorinated at 60°C for one hour with 8% chlorine on chip weight. The chlorinated pulp was washed and extracted with 3% caustic soda at 70°C for one hour.

The pulp was finally bleached to 65% brightness at 40°C for 3 hours with sodium hypochlorite containing about 2% chlorine on chip weight. The bleached pulp was washed and treated with 0.2% SO_2 solution for 30 minutes before final rinsing with water. The bleached pulp had high yield of 70% on chip weight but low initial freeness of S-R 470 ml.

2) Pulp preparation by sodium bisulphite process

Thai kenaf woody chips were cooked with 20% sodium bisulphite based on chip weight at liquor ratio 3:1 in an autoclave with electric heating. The heating was controlled as follows:

Heat to 120°C in $1\frac{1}{2}$ hour,

Keep at 120°C for one hour,

Heat to 155°C in $\frac{1}{2}$ hour,

Keep at 155°C for $4\frac{1}{2}$ hours,

At the end of cooking, the digester was cooled and vented. Some free SO_2 gas was noted. The crude pulp was washed and refined in a laboratory disc refiner to break up pulp lumps for final washing in a centrifuge. The yield of pulp was 53%.

The pulp was bleached with 8% available chlorine by C/E/H sequence in the usual way as described in previous reports of this series of study. The bleached yield was 82.4% based on the unbleached pulp. The bleached pulp had initial freeness of S-R 760 ml.

3) Handsheets preparation and physical tests

The pulp by chlorination process with low initial freeness of S-R 470 ml was beaten in 45 seconds in a Valley beater to S-R 362 ml. The pulp by sodium bisulphite process with initial freeness of S-R 760 ml was beaten to 455 ml in 4 minutes.

Sizing materials consisting of 0.3% Whiten, an optical whitener, 1.5% rosin size and 3.0% alum were added separately to the two beaten pulps. Handsheets prepared from the two sized pulps were dried at 90°C for 5 minutes and conditioned for 24 hours at 23°C and 50% relative humidity in a conditioned room.

Physical tests of the handsheets were made in accordance with TAPPI methods in respect to basis weight, bulk, tearing strength, breaking length, bursting and brightness. The results were compared with rice straw NSSC pulp and bagasse polysulphide pulp prepared by the laboratory as shown in Table 1. The kenaf core bisulphite pulp appears better than the bagasse polysulphide pulp in respect to tear factor and folding endurance. The kenaf core chlorine-alkali pulp has better strength than the rice straw NSSC pulp. It was noted that in addition to unusually low initial freeness, the chlorine-alkali pulp also has low opacity, but no quantitative measurement of this property could be made.

DISCUSSION

The total amount of chemicals applied in the chlorine pulping process was about 18% chlorine and 6% caustic soda based on raw material. A 70% bleached yield was attained. This corresponds to 34.5% chemicals based on the bleached pulp. The process should be viable if surplus chlorine is available at low cost or integrated production of chlorine and caustic from salt is made.

The low initial freeness and low opacity of pulp are unique with this process. For cultural paper, the pulp could blended with high opacity pulps such as wood pulp. Otherwise, proper filler such as titanium dioxide or coating should be applied to improve the opacity. For paper board, the question of opacity is not a problem and the pulp can be used.

TABLE 1. COMPARISON OF SEVERAL BLEACHED PULPS AND PAPERS

Physical test	Kenaf core sodium bisulphite pulp	Kenaf core chlorine alkali pulp	Bagasse polysulphide pulp	Rice straw NSSC pulp	Commercial bagasse kraft pulp	Paper of Kanchanaburi paper mill (bamboo pulp)
Initial freeness S-R, ml	760	470	690	700	-	-
Freeness S-R, ml	455	362	420	455	250	-
Basis weight, g/m^2	61	60	76	75	50	55
Tear factor	85	71	66	64	44	99
Breaking length, m	5,255	5,089	6,338	4,618	5,081	1,940
Burst factor	28	19	38	23	35	11
Bulk, ml/g	1.26	1.44	1.20	1.59	-	1.57
Folding endurance	76	33	28	1	-	3
Brightness, %	89	65	74	90	88	70
Cook No.	657B	643	549	470	-	-
Paper No.	362	358	276	-	-	-
Cooking yield, %	53	-	58	74	-	-
Bleached yield, %	43	70	51	57	-	-
Chlorine applied, % on pulp	8	18% on chips	7	9	-	-

The bisulphite pulp has better opacity and higher strength but lower yield than the pulp by chlorine process. The stoichiometric amount of sulphur and caustic soda for preparation of sodium bisulphite solution would amount to about 6% sulphur and 8% caustic soda or a total of 14% chemicals on chips for pulping, or 33% on bleached pulp. Thus the cost of chemicals for pulping would be quite small even without a chemical recovery system.

Cost of chemicals in bisulphite pulping and chlorine bleaching

The bleached pulp would need about 33% pulping chemicals on pulp weight. The cost of pulping chemicals per M.T. of bleached pulp may be estimated with allowance of 10 per cent margin as follows:

Caustic soda	200 kg @1.5 baht	300 baht
Sulphur	160 kg @1.0 baht	160 baht
	Total	460 baht

The cost of bleaching chemicals per M.T. of bleached pulp with 82% bleached yield can be estimated as follows:

100 kg chlorine gas	@3.0 baht	300 baht
30 kg caustic soda	@1.5 baht	45 baht
40 kg lime	@0.8 baht	32 baht
	Total	377 baht

The above total cost of pulping and bleaching chemicals for bisulphite pulp would amount to 837 baht. If the pulp mill makes its own chlorine by electrolysis of salt with by-product steam power, the cost of chlorine and caustic soda could be reduced.

CONCLUSIONS

1. Chlorine pulping of kenaf woody cores with a total of 14% chlorine in two stages at 60°C for one hour with alkali extraction and hypochlorite bleaching with 2% available chlorine after each chlorination stage gives 70% yield of pulp with 65% brightness.

2. Sodium bisulphite pulping of kenaf woody cores with 20% sodium bisulphite at 155°C for 4½ hours gives 53% yield of pulp. The pulp can be bleached to 89% brightness with 8% chlorine on pulp in C/E/H bleaching sequence with a bleached yield of 82%. The bisulphite pulp is stronger than the chlorine pulp.

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