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Bleached chemical pulp
from cornstalks

RESEARCH CORPORATION OF THAILAND

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PULP AND PAPER FROM CORNSTALKS

REPORT NO. 1
BLEACHED CHEMICAL PULP FROM CORNSTALKS

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BLEACHED CHEMICAL PULP FROM CORNSTALKS

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

SUMMARY

Cornstalk as abundant farm waste in Thailand was investigated as possible source of pulp. Air-dry cornstalks were chipped and cooked by neutral sulphite process at liquor ratio 3:1 with 14 % sodium sulphite and 3 % sodium carbonate on oven-dry stalks. The cooking condition was 2-hour heating to 170°C and 2-hour cooking at 170°C. The crude pulp was refined and washed. The yield of pulp was 48 per cent.

The pulp was bleached in three-stage C/E/H sequence with a total of 7 % chlorine to brightness of 75. The bleached yield was 84 per cent on unbleached pulp or 39 per cent on oven-dry cornstalks..

INTRODUCTION

Corn is a major crop in Thailand with annual production of about one million tonnes. The season of corn harvest comes in November to January. Most of the corn is for export. The price of corn is quite low. Corn growers get little return from their cultivation. After corn harvest, cornstalks are usually wasted and burned.

Utilization of cornstalks for pulp and paper can bring some income to corn growers from cleaning, storage, and delivery to paper mills. Thailand has been importing pulp and paper. Use of indigenous raw materials for pulp production would effect import saving and more employment.

The fibre of cornstalks has a quality similar to the fibre of bagasse, which has been used mainly as fuel in sugar mills. Use of bagasse for pulp production involves substituted fuel oil and storage of baled bagasse.

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The physical characteristics of fibres of cornstalks are comparable to those of bagasse as shown below:*

| | <u>Bagasse</u> | <u>Cornstalk</u> |
|--------------------------|----------------|------------------|
| Fibre length, mm | | |
| maximum | 2.8 | 2.9 |
| minimum | 0.8 | 0.5 |
| average | 1.7 | 1.5 |
| Fibre diameter, microns | | |
| maximum | 34.0 | 24.0 |
| minimum | 10.2 | 13.7 |
| average | 20.0 | 18.0 |
| Length to diameter ratio | 85:1 | 83:1 |

As the corn production area in Thailand is quite concentrated around Lop Buri, collection of cornstalks is convenient and can be done by corn shellers as a side line. Green cornstalks are available during corn harvest season in November, December, and January. Air-dry stalks after being stripped of leaves can be stored under shed for several months without deterioration.

EXPERIMENTAL AND RESULTS

Air-dry cornstalks were chopped to about 25 mm in length and cooked at liquor to chips ratio 3:1 in a stainless steel laboratory tumbling digester with electric heating. The cooking solution contained 14 per cent sodium sulphite and 3 % soda ash on oven-dry chips. The cooking condition was 2-hour heating to 170°C and 2-hour cooking at 170°C. The digester was vented for 15 minutes and opened. The crude pulp was re-fined through a Sprout Waldron laboratory single disc refiner to open the fibre bundles. The refined pulp was washed. The yield of pulp was 47.8 per cent on oven-dry chips.

* FOUAD, Youssef (1962).—Some problems in pulping rice straw. In: "Proceedings of the Conference on Pulp and Paper Development in Asia and the Far East held in Tokyo, 17-31 October 1960." vol. II. (United Nations/FAO: Bangkok.)

The pulp was bleached in three stages to brightness 75. The first stage was chlorination at 3 % pulp consistency for half an hour at 30°C with 4 % chlorine prepared from sodium hypochlorite solution acidified to pH 1.8. The second stage was caustic extraction at 10 % pulp consistency with 1 % caustic soda at 60°C for half an hour. The third stage was hypochlorite bleaching at 10 % pulp consistency for 3 hours at 40°C in sodium hypochlorite solution with 2 % available chlorine. Finally the pulp had an acid wash at 5 % pulp consistency in 0.5 % sulphur dioxide solution for half an hour at 30°C. The bleached shrinkage was 20 per cent with a bleached yield of 38.5 per cent on the basis of oven-dry cornstalks.

The bleached pulp with an initial S-R freeness of 910 ml was beaten in a laboratory Hollander beater for six minutes to 240 ml S-R freeness. Handsheets were prepared from the pulp furnished with 1 % rosin size and 2 % aluminium sulphate. After the sheets were conditioned for 24 hours at 23°C and 50 % relative humidity, physical tests were done in accordance with TAPPI standard methods. The results, compared with the data for rice straw and bagasse, are as follows:

| | Bleached corn-stalk NSSC pulp (240 ml freeness) | Bleached rice straw NSSC pulp ^{1/} (300ml freeness) | Bleached bagasse kraft pulp ^{2/} (280 ml freeness) |
|--------------------------------|--|---|--|
| Basis weight, g/m ² | 76.26 | - | 75.94 |
| Breaking length, m | 7280 | 5900 | 7796 |
| Burst factor | 36.8 | 41 | 43.0 |
| Tear factor | 59.7 | 46 | 14 |
| Brightness | 75 | 75 | 75 |

^{1/} Data from Department of Science, Ministry of Industry.

^{2/} ASRCT research project, high yield bleached bagasse pulp prepared at the laboratory.

DISCUSSION

The experimental results show the possibility of making bleached chemical pulp by neutral sulphite process from dried chipped cornstalks. The quality of cornstalk pulp compares favourably with that now made from rice straw and bagasse, although with lower yield from cornstalks.

The test data show that the pulp from cornstalks is quite similar to that from bagasse. Handsheets from corn pulp had slightly lower breaking length and burst factor than those from bagasse, but the tear factor and folding endurance of the corn sheets were significantly better than those from bagasse. Hence cornstalks can supplement bagasse for pulp production. The corn harvest season comes just before the main sugarcane milling season. Therefore pulp and paper mills using bagasse as raw material may consider cornstalks as an alternative raw material.

The bleached pulp from cornstalks appears to be of somewhat better quality than bleached rice straw pulp. The high initial freeness of bleached pulp from cornstalks is a further advantage over bleached rice straw pulp, the low freeness of which causes some difficulty in washing the straw pulp. Therefore corn straw pulp could be combined with rice straw pulp with considerable advantage in papermaking. The corn harvest season coincides with the rice harvest, but the collection and storage of cornstalks should not be more difficult than for rice straw. A mill test with cornstalks would be very useful in determining its commercial possibilities including what the mill could afford to pay for this raw material.

Economic investigation is needed of the costs of collecting, transporting, and storing cornstalks, so that the possibility for worthwhile return to the grower can also be assessed.

CONCLUSION AND RECOMMENDATIONS

Bleached chemical pulp, comparing favourably in quality with similar pulps from rice straw and bagasse, can be made from cornstalks by a neutral sulphite process.

The potential of cornstalks as a pulping raw material should be studied further in a mill test to determine the commercial value of cornstalks at the mill site. Economic investigation should also be made to estimate the returns to the grower after allowance for costs of gathering, cleaning, and transporting cornstalks.

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