疏伐杉木製造高級水果包裝襯墊紙之研究

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【摘要】台灣慣用塑膠及保力龍等不可分解之環境污染材料或舊新聞紙保護蘋果、梨、枇杷及蓮霧等高級水果。基於此因，利用疏伐杉木材按中性亞硫酸法製造高收率半化學紙漿混以含部份長纖維廢紙可製出具可撓性及可回收並適合包裝高級水果之如意伸包裝紙。

【關鍵詞】杉木、包裝紙、中性亞硫酸製漿法、塑膠、保力龍。

Good practice of pulped thinned China fir for protecting delicate fruits

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【**Abstract**】In Taiwan, delicate fruits such as apple, pear, loquat and apple are mostly protected with plastic cushion nets or polystyrene which are not biodegradable. Based on this reason whether a stiff and flexible fruit protection paper could be made from thinned China fir (Cunninghamia lanceolata) by neutral sulfite pulping process was studied in this experiment. This flexible wrapping paper made from thinned China fir mixed with long-fiber containing waste paper that we designed has the advantages of adaptable to the shape of fruit and recyclable when compared with those of plastic, old newsprint paper and polystyrene wrapping materials.

【**Key words**】China fir, wrapping paper, neutral sulfite semi-pulping process(NSSC), plastic, polystyrene

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I . INTRODUCTION

In Taiwan, wrapping materials for delicate fruits such as pear, apple, loquat and wax apple etc., are mostly made from plastic or polystyrene which are not biodegradable products. Taiwan is short of wood supplies for pulping industry. So there is a growing interest in the utilization of thinned China fir due to a local thinned wood oversupply. During recent years, the production of wood pulps from local wood chips with emphasis on thinned wood became aware of the foresters. The government, well aware of the situation is keenly interested in diversifying the uses of thinned China fir.

It seems to be not likely to use thinned China fir in wood technology because of its knotty and coarse texture. The aim of this study is search for a suitable China fir pulping process for making wrapping paper to replace the non-degradable ones.

II MATERIALS AND METHODS

Raw materials

Two raw materials were used

*Thinned China fir wood: with diameters of 5-6cm, were obtained from Hui-Sun experiment area, Nantou Hsien, Taiwan. *Old Newsprint Paper (abbreviated as ONP) :was obtained from a local paper mill.

Preparation of the raw materials prior to cooking

The Thinned China fir chips were air dried and then hand-sorted for removing from irregularities and bark.

Preparation of the NSSC pulps

Put 150 gram (o.d. weight) of thinned China fir chips in a 2-Liter laboratory autoclave-type digester. Add calculated amount of cooking liquor (Na_2SO_3: Na_2CO_3=4:1, liquor ratio = 4:1) to the digester. Time to 170℃ is 1.5 hours. Time at 170 ℃ is 1.5 hours. After the pulping was terminated, the autoclave was cooled and the contents gently defibrated in a double disc refiner (Lien-Shen Inc., Taiwan). Washing was made on a 200-mesh screen with fresh water. After washing, the NSSC pulps were dewatered in a centrifuge and stored in a cooler (5℃) for handsheet making.

Handsheet making and physical testing

150 g/m^2 and 200g/m^2 handsheet (25 x 25 cm^2) were prepared in accordance with Tappi 205 om-88 method "Forming handsheets for physical tests of pulp". We also added Epoxy (a wet strength agent, solid content: 10%) of 0.1,0.2%(on o.d. pulp) to the pulp for increasing water resistance and wet strength for the wrapping paper. In order to increase the water resistance of wrapping paper, we add 0.2% epoxy with 1% rosin size and 2% alum (on o.d sample) to the pulp as well. After this, the epoxy-containing papers were heated in a hot press at 110℃ for 2 minutes under a pressure of 45Kg/cm^2. Tensile strength, folding endurance and water absorption (Cobb test) were measured by related Tappi standard methods.

III RESULTS AND DISCUSSION

(Ⅰ)Fundamental properties of thinned China fir

Table 1 shows that small diameter of thinned China fir thinning (about 6.0 cm) which makes it more suitable for wood pulping rather than wood technology. Low bark percentage is also desirable for pulping. Apparently lots in thinned China fir cause problems in pulping processes(1).

(Ⅱ)NSSC pulping of China fir

China fir has a long history in forestation of

Table 1. Fundamental properties of thinned China fir

Sample No.	Age	Diameter(avg.) cm	Wood, % (on o.d. weight)	No. of knots in 1 m length	Bark %
19	8	6.43	82.1	14	17.9
20	6	5.75	78.0	8	22.0
21	6	6.30	78.1	7	21.9
22	7	5.63	84.0	15	16.0
23	7	6.13	81.7	4	18.3

Table 2. Cooking conditions and pulp analysis for NSSC pulping of China fir

Cook No.	Na_2SO_3 %	Na_2CO_3 %	Yield %	Freeness mL, CSF	Brightness %
1	30	10	64.8	400	38.2
2	40	13	68.7	395	40.3
3	50	17	64.1	405	41.6
4	60	20	65.5	410	43.2
ONP (unbeaten)*				550	50.2

Taiwan. The efficient and economic utilization of aged China fir has caused problems because its knotty structure and low quality timer (1). In recent years, China fir are facing the serious problems of low price. So the pulping of thinned China fir for specialty purpose seems to be a better outlet. In order to have higher pulp yield by efficient pulping of thinned China fir in this experiment, we intend to pulp thinned China fir by NSSC process. Of course, the optimum pulping conditions could be much affected by the fundamental properties of thinned China fir. Partially chemically defiberized pulp and strength development can be obtained by NSSC process with a Na_2SO_3 dose of 60% and Na_2CO_3 dose of 20%(Table 2) in this experiment.

The NSSC process produces brighter pulp than does the kraft process (Table 2 and Ref. 2). The brightness of NSSC of the unbleached NSSC pulp is high enough that it does not require bleaching to be used as reinforcement in wrapping paper. Mixing high-brightness (ca over 50% G.E.) old newsprint paper with NSSC pulped thinned China fir results in a desirable brightness ca over 40% of wrapping paper. A higher yield of over 65% (Table 2) seemed to be better use of China fir when compared to that of kraft pulp yield of ca 45%(3).

(III)Papermaking properties when blending NSSC with ONP pulps

There is no general pattern regarding how the blends of different pulps affect papermaking properties (3). Paper strength properties are quite intricate. Thus it is important to know the quality requirements for fruit wrapping paper. Apparently sliced paper slips from old newsprint paper are not suitable for the wrapping of high-grade fruit since its unpleasant printed ink, low strengths and time consuming to cut the ONP into slips. A discrete

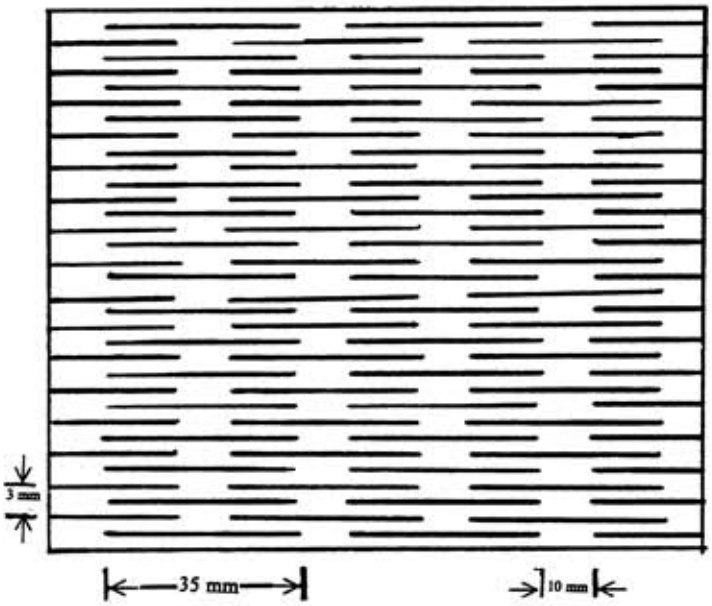

Fig. 1. Discrete sliced wrapping paper having flexible and resilient characteristics

Table 3. Properties of fruit wrapping paper

Sample No.	Chemicals Na_2SO_3/Na_2CO_3	Basis weight gsm	Density g/cm^3	Tensile kg/15mm	Fold times(1kg)	Water absorption Cobb(g/m^2)
1	30/10	150.1	0.82	9.7	168	151.48
2	40/13	150.5	0.80	10.0	173	169.23
3	50/17	151.5	0.70	9.6	233	173.37
4	60/20	151.1	0.91	9.1	282	167.46
5	No. 4 + 1%EPOXY	152.5	>1	11.4(dry)/ 2.4(wet)	337	123.91
6	60/20	207.7	>1	11.2/2.9	416	122.24
7	2% EPOXY	215.4	>1	18.5/4.3	468	82.24
8	2%EPOXY+1% Rosin+2%Alum	216.8	0.85	14.8/6.3	472	14.08

sliced wrapping paper shown in Fig. 1 is rather close to the plastic cushion net used and showed a flexible and resilient properties while wrapping the fruits.

It can be concluded from Table 3, where the fold reduction in the following order: sample no. 8>7>6>5>4>3>2>1, and the maximum water resistance is found at 2% EPOXY (wet strength agent) +1% rosin +2% alum.

Epoxy-containing wrapping papers, in contrast to sample 1-4, show a very strong hydrophobic behavior to protect the wrapping paper from juicy fruit and also favoring its dry tensile strength as shown in Table 3.

Table 4. Color of various dyed fruit wrapping papers

Sample No.	Dyes, formulation	CIE L*a*b*	Shade
1	Undyed[1]	76.04/4.90/15.39	Light brown
2	1%Red[2]	53.06/35.85/14.59	Yellowish red
3	1%Blue[3]	48.43/-9.74/-10.23	Greenish blue
4	0.5%Red+0.5%Blue	47.16/6.70/-3.37	Violet

1. Mixture of 50% NSSC thinned China fir pulp and 50% ONP
2. Direct Scarlet 4BS
3. Direct Sky Blue 6B

(IV) Pulp dyeing

To attract the customer, a pleasant and eye-appeal appearance for wrapping paper is essential. Selection of suitable colorants to dye the wrapping paper will upgrade the selling price of fruits. Because of the wrapping paper we made from partial newsprint paper has a characteristic gray appearance. So we dyed the mixture of NSSC and ONP pulps with red and blue direct dyestuffs to obtain and attractive appearance and intrinsic gray removal (see Table 4).

In addition to this, bluish wrapping paper gives harmonious effect for yellowish pears by complementary color principle i.e., blue is the complementary color of yellow. Due to the intrinsic brown of undyed (sample 1 in Table 4), it is not suitable to dye the wrapping paper with yellow dyestuff.

IV CONCLUSIONS

High pulp yield, brightness and better strengths for NSSC pulping of thinned China fir were demonstrated. The quality of wrapping paper made from NSSC pulped thinned China fir at the cooking conditions of Na_2SO_3/Na_2CO_3=20/60, liquor ratio=4/1 mixed with ONP with a ratio of 50/50 was suitable for wrapping of delicate fruits. Colored wrapping papers we made from some direct dyestuffs not only give a pleasant appearance but also show harmonious in color for the tinted fruits by complementary color mixing principle.

A discrete sliced wrapping paper we designed has flexible characteristics which is adaptable to the shape and size of fruits by user's desire and easy to recycling. In general, the wrapping paper with discrete sliced structure like our proposed products can enable the best-practice utilization of thinned China fir.

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