

A note on properties of corrugated boxes from rice straw and hessian

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SUMMARY

The paper deals with the evaluation of rice straw and hessian pulps for corrugated boxes. The results on the properties of corrugating medium and liner made on pilot scale from a blend of chemical pulps from rice straw and hessian (70% rice straw plus 30% hessian pulps) have been described. The suitability of these papers for making corrugated boxes was evaluated. It has been found that the corrugating medium and liner made from a 70:30 blend of pulp are suitable for making five ply boxes (two plain facings with one fluted ply in between).

The puncture resistance of the box board and top-bottom compression strength of the boxes made out of above mentioned corrugated medium and liner show better properties as compared to those prepared from paper made from commercial bamboo kraft pulp.

INTRODUCTION

With rapidly increasing industrial growth in all sectors in our country, the demand of packaging materials is bound to go up accordingly. Among packaging materials paper product find unique position and corrugated boxes are among those which find plenty of use in transporting fragile goods etc.

The starting material for making corrugated boxes is a kind of paper which in turn is essentially a product made of cellulose fibres. The raw materials which provide cellulose fibres for paper are wood, bamboos agricultural waste etc. Among these wood and bamboos are hardly sufficient to cater to the needs of paper industry for meeting the ever increasing demand of cultural papers. Therefore for producing paper for packaging, one has to look for fibrous raw materials other than wood or bamboo. Agricultural residues have been found quite suitable for producing corrugating medium for boxes for packaging. The main drawback of M.G. paper from agricultural residues (wheat/rice straw) is its low strength properties for producing corrugated boxes of requisite crush resistance and stiffness. To improve upon these, some long fibre cheap raw material is almost necessary for blending with straw or other pulp.

The present paper deals with the investigations carried on the suitability of blends of rice

straw pulp, and waste hessian pulp for making corrugated boxes.

EXPERIMENTAL

Raw Material Preparation

The raw materials (about two tonnes of rice straw and a half tonne of waste hessian bags) were supplied by M/s Punjab State Co-operative Supply and Marketing Federation Ltd. Chandigarh (MARKFED). The production of corrugating medium and liner was carried out on our pilot plant and subsequent box making and testing in Timber Mechanics Branch in this institute.

Rice straw was cut by chaff cutter to smaller fragments (2-4 cm. long) and hessian bags were reduced to small pieces (4-4 cm long and 1-2 cm wide) by cutting manually for pulping experiments. Before charging the cut raw materials into the digester, the moisture content was also determined as usual.

Production of Pulp

Rice straw (200 kg oven dry basis) was loaded into a directly heated rotary globe digester (2 r.p.m)

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for cooking. The conditions of cooking were as follows :

Total chemicals as NaOH,	6%
Material to liquor ratio.	1:3
Maximum cooking temp.,	162°C
Time of cooking,	4 hr (including 1 hour required to reach 162°C)

After completion of the cooking schedule the contents of digester were brought to atmospheric pressure by releasing the digester pressure. The contents were then discharged into a pit. Three batches of such cooking were made to obtain sufficient quality of pulp for further processing.

Similarly waste hessian was cooked under the following conditions :

Total chemicals NaOH	5.0%
Materials to liquor ratio	1:3
Maximum cooking temperature	162°C
Time of cooking	4 hr (including 1 hour required to reach 162°C)

The pulps from rice straw and waste hessian thus obtained were washed separately and wet laps were taken out on the machine. The hessian pulp was disintegrated in banning beater before wet lapping.

Stock Preparation

Rice straw pulp and waste hessian pulps were blended in the proportion 70/30. The blended material was beaten in banning beater to 185 ml C.S.F. After beating 2% rosin soap and 10% alum were added.

Paper making

Paper for both liner and corrugating media were made on the Fourdrinier pilot paper machine at a speed of 50 m/min from 70/30 blends of rice straw and hessian pulp. The paper suitable for both liner and corrugating media ran smoothly and had a good formation.

Corrugated box making

The five ply boxes (two plain facings with one fluted ply in between) were made on pilot plant corrugator and box making machine of Timber Mechanics Branch of this institute. The fluting was done using B flute (narrow) machine which possessed 50-55 flutes per running 30 cm. Starch based adhesive was used for pasting the liner and

corrugating media to obtain the required five ply material for box making.

The boxes of three different dimension were made from the paper containing mixture of 70% rice straw and 20% hessian pulp furnish. The testing of boxes was carried out at 30.5°C and 58% humidity. For comparison boxes made out of bamboo pulp (unbleached commercial) were also tested.

RESULTS AND DISCUSSIONS

The characteristics of the pulps obtained from rice straw and waste hessian are recorded in table-1 and Table-2 gives the data on the strength properties of paper (corrugating medium and liner) made from a 70/30 blend of chemical pulps from rice straw and hessian. The physical properties of double faced corrugated boxes have been recorded in Table-3.

TABLE-1
YIELD AND FREENESS OF RICE STRAW AND HESSIAN PULP

Raw Material	Total pulping chemical as NaOH %	Unbleached pulp yield %	Freeness ml. CSF
Rice Straw	6	52.1	110
Hessian	5	78.8	460

TABLE-2
PHYSICAL STRENGTH PROPERTIES OF PAPER MADE ON PILOT PLANT
(70% rice straw + 30% hessian chemical pulp furnish)

Property	Corrugating medium/liner
Basis weight, g/m ²	86.1
Tensile index Nm/g MD	50.48
CD	37.71
Stretch,* MD	1.65
CD	2.82
Tear Index MD	7.12
m Nm ² /g CD	8.36
Burst index, kpa m ² /g	2.10
Air resistance, 5/100ml.	33.0
Folding endurance MD	63
(double folds) CD	33
Ring crush, kg MD	4.3
CD	6.4

Values of Ring Crush of a commercial sample of paper made from 80% bagasse mechanochemical pulp + 20% grass chemical pulp are : MD 5.5 and CD 6.0.

It will be seen from the data in Table-1 that rice straw gave a pulp of 52.1% yield with 5% caustic soda. The freeness of pulps and the blend before and after sizing were as follows :

Rice straw pulp 110 ml. C.S.F. (initial)
Waste hessian pulp 460 ml. C.S.F. (initial)
Blend of 70% rice straw and 30% 210 ml. C.S.F. (initial) waste hessian pulp.
Beaten blended pulp before addixon 185 ml. C.S.F. of sizing chemicals
Beaten blended pulp after addition of 165 ml. C. S. F. sizing.

The data on strength properties of corrugating medium and liner shows that these are quite adequate for making corrugated boxes. The mig crush of these papers is equivalent to that of a commercial paper sample a blend of from 80% bagasse mechanochemical pulp + 20% bagasse chemical pulp perusal of data in Table-3 indicates that the puncture resistance of the box board and top-bottom compression strength of the boxes made out of the above mentioned furnish show better ptoperties as compared to those prepared from bamboo pulp, excepting of that bursting strength of the box board was slightly lower than that of bamboo pulp box.

CONCLUSION

It will be seen from the experimental results that a furnish containing 70% rice straw soda pulp and 30% waste hessian soda pulp is suitable for the manufacture of both corrugating media and liner for box making.

TABLE—3
PHYSICAL STRENGTH PROPERTIES OF
THE DOUBLE FACED CORRUGATED
BOARD BOXES

Sl. No.	Regular slotted double walled CFB with internal dimension, cm.	Bursting strength of the Board, kg, cm ²	Puncture resistance of the Board, O ₂ S./inch/tear inch	Top Bottom compression strength of Box kg.
With 70% Rice straw 30% Hessian pulp an				
1.	34×25×29	8.8	152	178
2.	31×24×27	8.8	152	169
3.	36×36×22	8.8	152	183
with 100% central pulp Mill unbleached Bamboo puld				
4.	34×25×29	9.4	150	149
5.	31×24×27	9.4	150	103
6.	36×36×2	9.4	150	112