

Effect of Regular Fluting and Cross Fluting on the Physical Properties of Corrugated Fibre Board Box Used for Packaging of Frozen Shrimp

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Abstract : Regular fluted and cross fluted corrugated fibre boards are being used by the fish processing industry as shipping container for the packaging of frozen shrimp for export. The effect of regular fluting and cross fluting boards on the physical properties of corrugated fibre board was studied. Also studied the stacking stability of cubical type and cuboidal type of corrugated fibre board boxes. Five ply corrugated fibreboard box of the sizes 330 mm x 320 mm x 310 mm was prepared using 125 gsm Kraft paper and 120 gsm Kraft paper in a factory making corrugated fibre board. The physical properties like bursting strength, puncture resistance and compression strength were studied after conditioning the samples. Regular fluting and cross fluting do not have any effect in bursting strength and puncture resistance of the respective boards. But there is an improvement in the compression strength for the regular fluting boards compared to cross fluting. Total work done to reach the maximum compression strength is more in regular fluted boards than cross fluted boards. It has been found that the cuboidal shaped corrugated fibre board boxes have better compression strength than the cubical shaped corrugated fibre board boxes.

Introduction

Of all the packaging materials used in the fish processing industry, Bureau of Indian standards has laid down quality specifications for the corrugated fibre board boxes for export of sea foods and froglegs (IS: 6715-1972). Two of the common defects reported in the master cartons used for export of frozen shrimp from India are low mechanical strength and tendency to get wet. They are easily weakened by deposit of moisture caused by temperature fluctuations during loading, unloading and other handling stages (Gopakumar, 1993). Regular fluted and cross fluted corrugated fibre boards are being used by the fish processing industry as a shipping container for the

packaging of frozen shrimp for export. No data is available on the effect of regular fluting and cross fluting on the physical properties of corrugated fibre board and also on the stacking stability of the cubical type and cuboidal type of corrugated fibre board boxes. The purpose of this study is to find out the effect of regular fluting and cross fluting on the properties of corrugated fibre board box and stacking stability of cubical type and cuboidal type of corrugated fibre board boxes.

Materials and Methods

Five ply corrugated fibre board box of the sizes 330 mm x 320 mm x 310 mm was prepared using 125 gsm kraft paper in a factory making corrugated fibre board. The physical properties of the boards were studied after conditioning the samples described in IS: 1060(1966).

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Table 1. Physical properties of five ply corrugated fibreboard made out of 125 gsm and 120 gsm Kraft paper adapting regular fluting and cross fluting

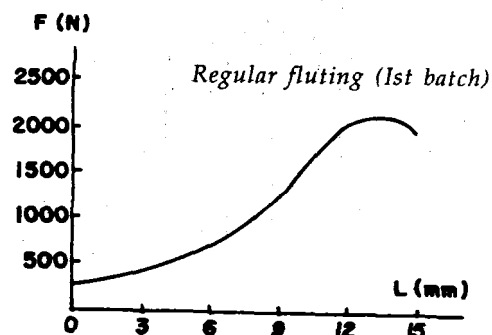
| Details | Regular fluting | | Cross fluting | |
|-----------------------------------|-----------------------------------|-----------------------------------|-----------------------------------|-----------------------------------|
| | 5 ply made of 125 gsm Kraft paper | 5 ply made of 120 gsm Kraft paper | 5 ply made of 125 gsm Kraft paper | 5 ply made of 120 gsm Kraft paper |
| Moisture content | 8.2 | 8.4 | 8.0 | 8.2 |
| Bursting strength kg/sq.cm | 8.5 to 9.5 | 8.5 to 9.5 | 8.5 to 9.5 | 8.5 to 9.5 |
| Puncture resistance (Beach units) | 160 to 170 | 150 to 160 | 160 to 170 | 150 to 160 |
| Compression Strength (Newtons) | 2225 to 2250 | 2105 to 2130 | 1760 to 1785 | 1710 to 1728 |

Bursting strength was determined as per IS:1060 (1960). Puncture resistance was determined according to IS: 4006 (1972). Compression strength of the box was determined using Zwick Universal Testing machine as per ASTM (1973). Moisture was determined by drying the sample in an oven at 100°C till constant weight.

To find the effect of cubical and cuboidal shaped box on the compression strength of the box 5 ply corrugated fibre board box (CFB) of the size 320 mm x 320 mm x300 mm (currently used cartons) and 475 mm x 315 mm x 210 mm were prepared in a factory making corrugated fibre board box. Compression strength of these boxes were determined using Zwick Universal testing machine as per ASTM (1973).

Results and discussion

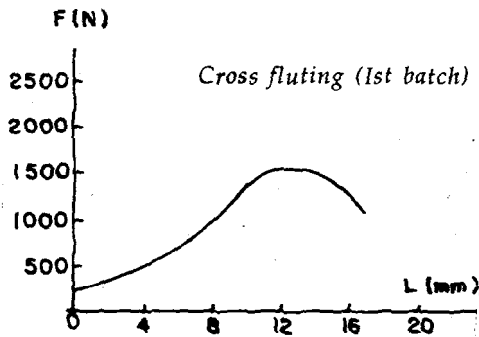
Table 1 shows the effect of regular fluting and cross fluting of corrugated fibre boards. Regular fluting and cross



- Grammage of kraft paper used. - 125 gsm
- Compression strength of the regular fluting CFB box. - 2110 N
- Total work done under the curve. - 22.1 Nm.
- Work done to reach the maximum Compression strength - 14.7 Nm.

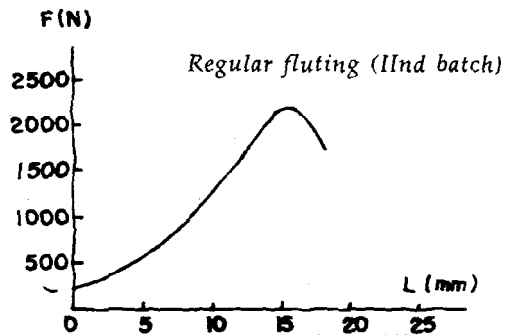
Fig. 1a. Load deformation curve of 5 ply corrugated fibreboard box (CFB) of the size 330 mm X 320 mm X 320 mm using regular fluting boards.

fluting boards do not have any effect in bursting strength and puncture resist-



Grammage of kraft paper used. - 125 gsm
 Compression strength of the cross CFB box. - 1778 N
 Total work done under the curve. - 16.8 Nm.
 Work done to reach the maximum Compression strength - 12.3 Nm.

Fig. 1b. Load deformation curve of 5 ply corrugated fibreboard box (CFB) of the size 330 mm X 320 mm X 310 mm using cross fluting boards.



Grammage of kraft paper used. - 120 gsm
 Compression strength of the regular fluting CFB box. - 2231.5 N
 Total work done under the curve. - 22 Nm.
 Work done to reach the maximum Compression strength - 16.1 Nm.

Fig. 2a. Load deformation curve of 5 ply corrugated fibreboard box (CFB) of the size 330 mm X 320 mm X 310 mm using regular fluting boards.

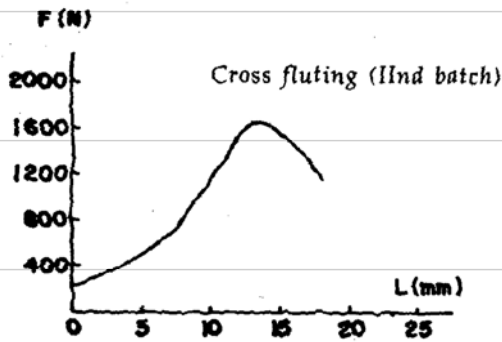
ance. But there is an improvement in the compression strength for the regular fluting compared to cross fluting.

Load deformation curve [fig. 1(a) and Fig.1(b)] of 5 ply corrugated fibre board shows that the compression strength of the cross fluted board is 15% less than the Regular fluted board in case of box prepared from 125 gsm Kraft paper. The compression strength of the Cross fluted board is 23% less than regular fluted board in case of board prepared from 120 gsm Kraft paper [Fig. 2(a) and Fig.2(b)]. Total work done under the curve is 24% more in the case of Regular fluted boxes compared to Cross fluted boxes prepared out of 125 gsm Kraft paper, 21% more in case of Regular fluted boxes compared to cross fluted boxes prepared out of 120 gsm Kraft paper. The above result shows that more number of master cartons can be stacked in a frozen storage godown if one uses regular

fluted corrugated fibre board box. The stackability of the master carton is increased using regular fluted boards.

The presently used corrugated fibre board box is regular slotted container (RSC) conforming to style FEFCO 0201 which can hold 10 unit cartons in the fashion (2 x 5), two per layer and in five layers [Fig.3(a) and Fig. 3(b)]. The compression strength of this type of box is only 2280 N. The compression strength of the cuboidal type of box using the same grammage of paper found to be 2711 N i.e. an increase of 16% compared to cubical shape of box which is currently used. Total work done under the curve is 18.94 Nm in case of cubical type of cartons and 43.73 Nm in case of cuboidal shaped cartons i.e. an increase of 57%. Also the number of duplex cartons which can be accommodated in the cubical cartons are less than the cuboidal shaped cartons.

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Grammage of kraft paper used. - 120 gsm
 Compression strength of the cross CFB box. - 1720 N
 Total work done under the curve. - 17.3 Nm.
 Work done to reach the maximum Compression strength - 10.6 Nm.

Fig. 2 b. Load deformation curve of 5 ply corrugated fibreboard box (CFB) of the size 330 mm X 320 mm X 310 mm using cross fluting boards.

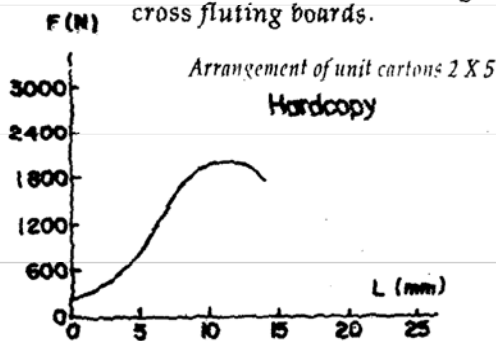


Fig. 3 a. Load deformation curve of 5 ply Corrugated Fibre Board box (CFB) of the size 320 mm x 320 mm x 300 mm RSC Fefco 0201 (currently used cartons)

References

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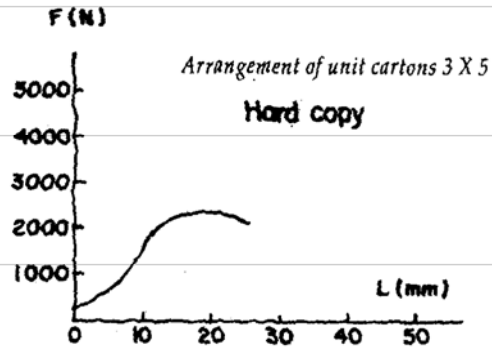


Fig. 3 b. Load deformation curve of 5 ply Corrugated Fibre Board box (CFB) of the size 475 mm x 315 mm x 210 mm RSC Fefco 0201 type

Conclusion

Regular fluting board alone should be used as a shipping container and not cross fluting in the manufacture of corrugated fibre board for export of frozen shrimp. Corrugated fibre made out of regular fluting is found to have more compression strength compared to cross fluted boards. The cuboidal shaped box has more compression strength than cubical type of boxes and can hold more duplex cartons and hence effect cost savings.