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Survey of the Properties of Waxed Duplex Cartons Used in Frozen Shrimp Industry

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Waxed duplex cartons collected from different prawn freezing factories were evaluated for their physico-chemical properties such as bursting strength, puncture resistance, water proofness, tearing strength, tensile strength, elongation, moisture content, thickness, weight of the carton, dimension, wax content and saponifiable matter. The results are discussed from the point of view of formulation of standards for this most widely employed packaging material for frozen fishery products in the country.

Proper packaging for frozen fish is essential for controlling the detrimental effects of oxygen and desiccation by barring the entry of air and escape of moisture. Another property to be looked into is its capacity to protect the contents from flavour contamination, entry of microorganisms, mechanical damage and exposure to light. Folding paperboard (duplex board) carton is the most important primary package used in the export of frozen sea foods. These cartons are given a wax coating for protection of the contents from loss of moisture. The material used for the purpose is a solid bleached sulfate board. Frozen blocks weighing 2kg are packed in such cartons lined with 100/125 gauge low density polythene sheet. Ten such waxed cartons are in turn packed in 5 ply corrugated fibre board boxes which serve as shipping container. About 4 crores of waxed duplex cartons are used annually by the frozen fish export trade in India. ISI specifications have not been formulated for this widely used packaging material for frozen sea foods and froglegs. The present study deals with an extensive survey of the waxed cartons used in the packaging of frozen fishery products as a primary package with respect to their mechanical and chemical properties.

Materials and Methods

Waxed cartons used in frozen shrimp export as a primary package were collected at random from 36 different factories in and around Calicut, Cochin, Quilon, Bombay, Kakinada and Veraval. They were tested for bursting strength, puncture resistance, tensile strength, tearing strength (both in machine and cross directions), elongation, moisture content, thickness, weight of the carton, dimension, wax content, saponifiable matter and water proofness. The samples were conditioned before testing by the method of IS: 1060 (1966). Moisture was determined by drying the sample in an oven at 100°C. Bursting strength and water proofness expressed in terms of Cobb 30′ value, thickness, tearing strength in both machine and cross directions, tensile strength and elongation were determined as per the IS mentioned above. Punture resistance was determined according to IS: 4006 (1972). The wax content was determined by the method in the appendix B of IS: 3962 (1967).

Results and Discussion

Variations of moisture in 36 waxed cartons are summarised in Table 1. Values of bursting strength in kg/cm² are shown in Table 2 and those of puncture resistance in beach units in Table 3. Water proofness of the samples expressed in terms of Cobb 30′ value is presented in Table 4. The values of tensile strength expressed in terms of kg f/1.5 cm width/18 cm length and elongation expressed in terms of increase in length are presented in Table 5. Results of analysis of cartons for wax content and saponifiable matter are given in Tables 6 and 7. Tearing strength both in machine and cross directions are presented in Table 8.

Total weight of each carton was recorded (Table 9), thickness of the carton (Table 10), and volume (Table 11).

It may be seen from Table 1 that there is considerable variation in the moisture of the cartons. Moisture in boards is a very important factor affecting physical strength, flexibility, sheet forming characteristics, weight, dimensional stability, rigidity, tearing strength, tensile strength, folding endurance and elasticity. Majority of the samples studied were found to have moisture between 8 and 10%. Very low moisture indicates the poor storage facility for these packaging materials in the factory. The higher the moisture, the poorer are the physical strength characteristics.

It is observed from Table 2, that 50% of the cartons are having bursting strength above 6 kg/cm². The waxed carton should have a bursting strength as high as possible so that it can withstand handling and storage conditions. It is seen from Table 3 that 67.4% of the cartons are having a puncture resistance above 26 beach units. The puncture resistance is reflective of the paperboard quality. Usually in the primary package the problem of puncture does not arise. It is encountered only during handling conditions by corner hit on the container before filling in the master cartons.

Table 4 shows that 80% of the waxed cartons are having Cobb value below 46. Cobb value must be low as the cartons are likely to come in contact with moisture in the frozen storage due to water condensation. It is interesting to note that low Cobb values are associated with higher wax and saponifiable matter (rosin) contents. The sample which had 6.84% wax and saponifiable matter of 5.4% showed the lowest Cobb value, namely, 2.84 among the samples studied. Another one with 9.65% wax and 2.5% saponifiable matter had a Cobb value of 6.112. A third one with 1.99% wax and 6.55% saponifiable matter had a Cobb value of 4.65. This shows that with a higher saponifiable matter and less wax, low Cobb values can be achieved. But some amount of wax should be present in the carton as otherwise the frozen product sticks hard to it with any glaze water freezing in between. Hence the proper amount of wax and saponifiable matter should be present in the carton to achieve the desired Cobb value.

Table 5 shows the tensile strength of the carton and elongation expressed in terms of kg f/1.5 cm width/18 cm length and centimeters respectively. In food packaging operations, tensile strength of a flexible packaging material is important as it determines the resistance to rupture when subjected to pulling force. High tensile strength for packaging materials are required to hold heavy packaged items. The values in Table 5 indicate that majority of the cartons are having tensile strengths between 6.08 to 9.08 kgf/ 1.5 cm width/18 cm length. Only one out of 35 cartons is having tensile strength above 20 kg f.

Elongation property of a carton which is measured on the same machine as that for tensile strength, gives a measure of the toughness or resistance to rupture. Packages which are likely to undergo drops during distribution/processing require cartons of higher elongation. Table 5 indicates that one third of the cartons are having an elongation below 0.85 cm/18 cm length.

Table 1. *Moisture contents of the cartons*

Range of moisture %	Cartons falling in each range
6.7–7.7	10
7.8–8.8	17
8.9–9.9	5
10.0–10.6	4

Table 2. *Distribution of bursting strength*

Range of bursting strength kg/cm²	Cartons falling in each range
3.6–4.0	1
4.5–5.0	3
5.25–5.75	13
6.00–6.50	15
6.75–7.00	3
7.25–7.50	1

Table 3. *Puncture resistance of cartons*

Range of puncture resistance beach units	Cartons falling in each range
20.0–22.0	1
22.5–25.5	11
26.0–29.00	14
29.5–32.75	8
33.0–37.50	2

Table 4. *Water proofness of waxed cartons*

Range of water proofness Cobb 30′ value	Cartons falling in each range
2.84–24.65	19
25.00–45.75	10
46.00–66.00	5
67.00–84.95	1
406.15	1

Table 5. *Tensile strength and elongation of cartons*

Range of tensile strength kg f/1.5 cm width/18 cm length	Cartons falling in each range
6.08– 9.08	23
9.10–12.10	1
12.20–15.20	5
15.30–18.30	4
18.40–19.50	1
> 20 kg f	1
Range of elongation cm (increase in length)/18 cm	**Cartons falling in each range**
0.30–0.50	13
0.55–0.85	11
0.86–1.16	9
1.20–1.50	2
1.60–1.83	1

Table 6. *Analysis of wax content*

Range %	Cartons falling in each range
1.99– 3.99	1
4.00– 6.00	5
6.10– 9.10	24
9.15–12.15	5
12.20–12.75	1

Table 7. *Analysis of saponifiable matter*

Range %	Cartons falling in each range
0.09–2.09	11
2.10–4.10	19
4.20–6.20	4
6.30–8.30	1
8.40–9.40	1

Table 8. *Tearing strength of the cartons in machine and cross directions*

Range of tearing strength g	Cartons falling in each range	
	Cross direction	Machine direction
128–178	5	16
179–229	16	12
230–280	8	6
281–331	4	0
332–384	3	2

Table 9. *Total weights of cartons*

Range of weights g	Cartons falling in each range
63–71	17
72–77	10
78–83	7
84–89	1
90–96	1

Table 10. *Thickness of the cartons*

Range of thickness mm	Cartons falling in each range
0.3375–0.4000	12
0.4025–0.4650	14
0.4750–0.5385	9
0.5400–0.6025	0
0.6100–0.6475	1

Table 11. *Volumes of the cartons*

Range of volumes cm^3	Cartons falling in each range
2171–2500	22
2505–2905	12
2910–3310	1
3315–3523	1

It may be seen from Tables 6 and 7 that no uniformity is maintained by the different manufacturers as regards quantity of wax applied on the carton and the saponifiable matter. Variations in the wax may be attributed to wide differences in the temperature of the wax bath used, as most of the manufacturers do not employ thermostats to control the temperature. Properly waxed cartons possess the advantages of being liquid proof and reducing the water vapour transmission rate while controlling the danger of sticking when in contact with the freezer plate.

The internal tearing resistance is a very important property in packagings for foodstuffs especially when sharp edged products are packed, since even a slight tear in the material may result in the total failure of the packaging. Tearing strength is dependent on the orientation of the molecules or fibres in the packing materials. Table 8 shows that 58.3% of the cartons are having tearing strength below 229 g in cross direction, while 44% possess values below 178 g in machine direction.

The weight of the carton is related to the grammage of the paperboard and dimension of the box. Most of the cartons (75%) are having weights in the range of 63–77 g (Table 9). The weight may be specified to the manufacturers provided the dimension is maintained constant by all the processors.

Table 10 indicates that 72% of the cartons are having thicknesses below 0.465 mm, while the remaining had above 0.475 mm. Caliper or thickness is a very important quality in paperboards, since it determines almost all physical, optical and electrical properties of paper including stiffness.

The data presented in Table 11 shows that there are wide variations in the dimensions of the waxed cartons. This brings about variations in the dimensions of the master cartons. It is desirable to have uniform dimensions in the duplex cartons for the same gross weight of the contents.

The current mode of packing 2 kg blocks of frozen fishery products in the country is termed bulk/institutional pack, which the importing countries reprocess into smaller consumer packs. Hence high standards of quality are not insisted upon in such cartons, as long as the corrugated fibre board boxes in which they are packed reach the destination in good condition.

Nevertheless, it is imperative that certain minimum standards of quality are laid down for the waxed duplex cartons as the primary package. Moreover, a change over to consumer packs is absolutely essential for improving the economy of the frozen fish industry, in which case the packages have to play an important role as silent salesmen of the ware they contain, both in internal as well as external markets.

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References

IS: 1060 (1966) Part 1—*Indian Standard-Methods of Sampling and Test for Paper and Allied Products,* Indian Standards Institution, New Delhi

IS: 4006 (1972) Part II–*Indian Standard—Methods of Test for Paper and Pulp Board Packaging Materials,* Indian Standards Institution, New Delhi

IS: 3962 (1967) *Indian Standard - Specification for Waxed Paper for General Packaging.* p. 7 Indian Standards Institution (Appendix B), New Delhi