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The Scoring Properties of Duplex Board

Packaging has come to occupy an important place in our national economy as our industries in general and consumer industries in particular have made rapid growth during the last few decades. Of various packaging materials, paper board is still the most widely used material for making Cartons for various consumer products. Duplex Board and Pulp Board are the two types of board generally converted into Cartons, its Scoring characteristic and properties are very important besides its stiffness, flatness, uniformity of caliper etc. Sometimes the top liner of Duplex Board bursts during scoring and folding, there is so called cracking problem. Such cracking of Board at the time of Carton manufacture becomes subject of dispute between the Board manufacturer and consumer. This article is mainly aimed to analyse this problem.

A good Duplex board as packaging material should have two quite different physical properties, viz rigid state where the composing layers are well bonded and a flexible state so that layers get partially delaminated without cracking on front liner during scoring process. Even though high speed sophisticated machines are now being used for scoring and folding, in actual practice scoring is still done by rule of

thumb by Carton manufacturer and confined to the skill of their craftsman in our country. Under these circumstances good duplex board may be declared bad as little or no effort is made to improve age old scoring practices.

The authors of this article have conducted correlative studies on PATRA (Now known as PIRA) Crease Tester to evaluate creasing quality of the board during its manufacture with actual performance of the board on the carton making machines. Various properties of Duplex board and guidelines for making cartons without cracking defect have been evaluated.

Properties of Duplex Board with good creasing quality.

High stiffness and strong top and back liners are essential for board with good creasing quality. The strength properties of top liner are of paramount importance in creating conditions for effecting crack free creasing. The front liner cracking occurs due to tension developed in it as the rib is formed on the inside and is compressed during folding. A stronger and more extensible Pulp if used in top liner can prevent cracking. A lower basis weight for the same thickness of Duplex board can be another way of reducing the cracking problem. Board containing high percentage of poor quality waste paper is found to be poor in creasing. The resistance to cracking of back liner can

be improved with better ply adhesion. The front liner cracking is worse at lower moisture content so that overdrying, on Board making machine, of the board should be avoided. Moisture content in the board at the time of carton making is yet another important factor affecting creasing quality. Very dry board tends to crack on creasing. The following characteristics of the board have been found out to render it free from cracking defects.

1. Front liner 20 to 25%
2. Breaking length of 2500 m.
front liner in M. D. (Min.)
3. Ash in front liner Max. 15%
4. Moisture content of 5.0-7.0%
Duplex Board

Scoring-Description of Process.

Cartons are cut from Duplex/Pulp Board by rotary, flat bed or platen creasing and cutting machines. In such machines one assembly known as positive consists of cutting knives of height 0.934" and creasing rule of height 0.914". The rule widths are 2 points (0.028") for boards greater than 0.020" thickness i. e. upto 400 GSM and 3 pt (0.042") for boards of substance higher than 400 GSM. The negative carries a make ready of creasing grooves which is perfectly aligned with creasing rules so that on pressing, the rule forces board into the grooves. During this process the board undergoes considerable stretch and strain within the confines of creasing grooves. The purpose of creasing is to weaken the

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board along the crease to get right angle corners in the cartons. This weakening should not be excessive to damage the board. It should also be not too little so that the force required to hold two faces at right angles along the crease is excessive and the side walls of the cartons are curved. The ultimate quality of scoring depends on

- (1) The width of the creasing rule.
- (2) The depth of the crease and
- (3) Width of the creasing groove.

The above can be varied under certain restraints to get the best results. The depth of crease depends on the difference of height between creasing rule and cutting knives, and the make ready thickness.

The cracking problems with the Cartons can not be associated solely to board quality. Scoring should be done carefully so that the creases are well defined and grooves should be cut in a harder make ready. In India most of the carton makers cut make ready on Duplex Board, a very compressible material resulting in poorly defined creases. A treatment of groove edges with shellac solution can be done to get a harder make ready. It is of paramount importance to get a good rib to form inside the folds, without this cracking can not be overcome even on good quality board.

Variables in Scoring Affecting Creasing Quality.

(a) Creasing Rule :

The selection of appropriate rule depends on thickness of board to be used. In practice a 2 point (0.028") rule for boards upto 0.022" thick board and 3 point (0.042") rule for

boards of thickness upto 0.035" is used. In general the rule thickness should be more than the thickness of the board. Use of uneven rules with dents causes improper creasing thereby resulting in fracture of front liner.

(b) Groove Width :

The groove may be cut to any desired width. A craft rule is to set the groove width equal to the rule width plus twice the thickness of the board. By narrowing the groove width the creasing conditions become severe. The grooves are widened to reduce cracking. If grooves are too wide then ends of cartons do not meet, creasing problem during pasting. The volume also of a carton is reduced as more area is covered by the crease.

(c) Crease Depth :

The creasing quality depends too much on crease depth. The condition may be made more severe by increasing the depth causing fracture of front liner. The PATRA, has recommended that the crease depth should not be more than the thickness of the board. This rule is being followed by most of the converters in India. If the creasing depth is very low proper delaminations of front liner and back liner does not take place and which may result in

bursting of front liner on folding.

Practical experience has shown the following:-

- (a) The severity of creasing increases as the groove width decreases (Crease depth and board caliper being constant).
- (b) The severity of creasing increases with increasing crease depth (groove width and caliper constant), but the front liner may get cracked if creasing depth is very low.
- (c) Machine direction creases can sustain more severe scoring than cross direction creases.
- (d) Defective creases result from
 - (i) Over mild conditions which lead to front liner fracture
 - (ii) Over severe conditions which lead to cracking of the top liner and Back liner of the Board.

The authors have observed that in India scoring conditions are subjected to various restrictions. They are mainly due to the limitations of carton size and design. Most of the converters use 1.5 pt creasing rule instead of 2 pt rule. The groove widths are also narrower than the ideal settings.

The following creasing conditions, on PATRA Tester (Table II) based

Normal Settings for Creasing :

Table I

Board Caliper Range	Width of Rule	Depth of Crease	Width of Grooves.
(inches)			inches.
0.014 to 0.018	2 pt (0.028")	70-80% of the Board caliper	0.055
0.019-0.022	2 pt.	70-80% of the Board caliper	0.075
0.023-0.030	3 pt. (0.042")	do	0.095
0.030-0.035	3 pt.	do	0.095

Table II

Board Thickness. inches	Width of Rule pt.	Depth of Crease inches	Width of Grooves inches
0.016-0.017	1.5	0.011	0.050-0.055
0.018-0.019	1.5	0.013	0.055-0.060
0.020-0.021	1.5	0.014	0.060-0.065
0.023	1.5	0.016	0.070-0.075

on extensive survey of the processes of carton making in this country, have been found to have a very good correlation with actual carton making processes.

Creasing quality of Board-check at time of Manufacture

Till recently the mills presumably made good board but converters would brand it as bad, since none were following standard test methods for testing creasing quality. There are a number of instruments for testing creasing quality viz PATRA (PIRA) Carton Board Creaser, Karl Frank Crease Tester, BRDA Scoreability tester etc. The authors have found that tests performed on PATRA Crease Tester give good correspondence with actual conditions on the carton making machine. The two main variables in creasing are depth of the crease and the width of creasing groove. These two are accurately reproducible on this tester. This instrument helps both the mill and carton makers in checking creasing quality. It guides carton makers to establish condition for cutting and creasing and thus the trial and error in make-ready is also reduced.

The creasing quality of board can

be well evaluated on patra Crease Tester. The depth of Crease is varied from zero and onward at fixed groove width and rule thickness. As per conditions given in Tables I & II. The minimum crease depth is determined where no cracking in the board is observed. Thus upper and lower limit for Crease depth are found. A good quality board will show no cracking at various crease depths ranging widely where as poor quality board will crack at crease depth of narrow range.

Effect of Ink :

The Board is printed and varnished before creasing operation. These two operations change the surface characteristics of the board radically. The surface becomes stiffer and prone to Cracking. This is one of the reasons for getting Cracking in the Carton made from the board after printing while same board did not reveal cracking defect when it was tested by PATRA Tester at the time of manufacture and before printing. In order to have exact replica of Carton making the authors have conducted numerous experiments and evaluated the Creasing conditions as given in Tables I & II. Further test strips were printed on a small proof

press with quick drying inks viz Flexo printing Red or Gravure Red ink. A proof press is available in India from printing material dealers at a very low price. Red ink gives a good contrast against the front liner of Duplex Board thus Cracking if any is readily detected with naked eye.

Effect of Varnish :

The application of varnish to surface of board makes it stiffer thus changes the Creasing quality of the board. After varnishing it may develop Cracking tendency. During the application of varnish, its quantity should be properly controlled. Any excess application of Varnish may give to Cracking of Board during scoring operations.

Amount of varnish applied should be approximately 1.5 gm/m² and not more.

Effect of Moisture on Cracking :

Moisture content in board is yet another important factor for cracking. The cracking is most pronounced in the dry season. The change in relative humidity from 30% to 80% was found to expand the creasing range. At lower R. H. the flexibility of board is reduced. Thus it has greater tendency of cracking at low moisture content. A moisture content 5 to 7% in Duplex Board has been found to be ideal for carton making. The best results are obtained on preconditioned board punched under controlled conditions of humidity. In India most of the converters do not have any arrangement for humidity control or preconditioning. Water can

be uniformly applied on the back side of board by the varnishing machine on full sheet after printing before carton making. This method has been found to be quicker, Cheaper and effective, especially when it is not possible to have controlled humidification. At the same time excessive moisture has to be avoided as it creates curling and over lapping problems.

The convertors have generally very tight delivery schedule and can not afford to have much down time on their machine for make ready only.

Hence the carton makers do not take proper care to make changes in make ready to avoid cracking of front liner and complain to the mill about the cracking of the board on creasing and folding. The mills in turn go on using more and more expensive furnish in an attempt to produce the board that does not crack on scoring. All this loss at both ends is due to attention not being paid by the board mill to strict checking on the creasing quality of board at the time of manufacture and also want of initiative on

the part of the convertors as to how to do scoring for best result.

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