

# Fluting Paper Vs Liner



**Pankaj Shah**  
Partner  
Mehta Paper Industries

## Abstract:

The corrugated industry in India started in mid-50's. Due to small volume and rather slow production speeds (~25 meters/minute), one common grade – liner - was used for both purposes. This served economy and inventory management purposes.

This practise continues even today, barring few exceptions. Low BF paper is used as fluting. Imports of fluting paper is negligible. Fluting paper – as a separate grade serving its specific function – is not widely available in India.

In developed countries, liner paper and fluting paper are two different grades and have distinct roles. Fluting papers are of two types – semi chemical medium and waste based medium.

Time has come to look at this closely and identify ways to overcome constraints for production of “fluting paper” on wider scale.

This article will highlight FOUR distinct roles of fluting paper and FOUR distinct reasons why liner paper and fluting papers are different.

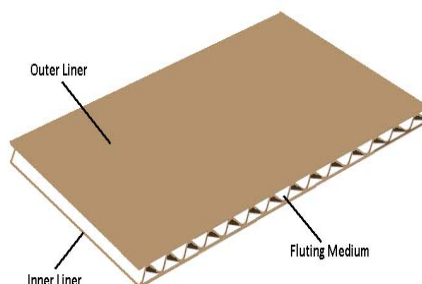
**Keywords:** Fluting Paper, Liner Paper, Stiffness, Bursting Strength

## Introduction

Corrugated boxes, as transport pack, has a unique role to play in Supply Chain.



## CORRUGATED BOX



## CORRUGATED BOARDS

Corrugated boards are made of 2 ply or Single face (1 liner + 1 fluting), 3 ply or Single wall (2 liners + 1 fluting medium), 5 ply or Double wall (3 liners + 2 fluting media) or 7 ply Triple wall (4 liners + 3 fluting media) papers.

Such corrugated boards are converted into corrugated boxes using various processes as scoring, slitting, cutting, printing, folding, stitching etc.

Industry volume is now approaching 9 million tonnes/year and production speed of corrugating machines now exceed 250 meters/minute.

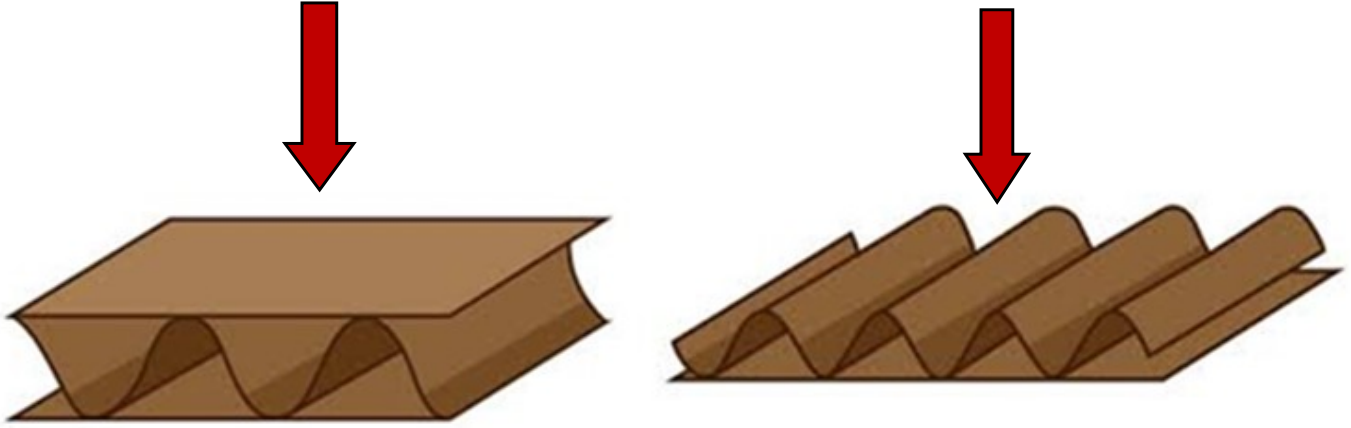
## ROLE OF FLUTING PAPER

In civil construction, we know that large diameter column is stronger than small diameter column.

In corrugated boards, when held vertically, “flutes” act as columns. Strength of corrugated boards, is the ‘column’ strength provided by the ‘flutes.’

It follows that farther apart the liners, greater the column strength of the boards.

**ROLE 1 – KEEP LINERS APART SO AS TO MAINTAIN “COLUMN” SIZE.**



Corrugated boards, during further converting processes such as printing, punching etc, are subjected to ‘flute crushing’ forces.

Therefore, fluting paper needs to resist crushing forces. Measured in Machine direction (MD).

**ROLE 2 – RESIST ‘CRUSHING’ FORCES .... SO, THE CALIPER OF THE BOARD IS MAINTAINED (AND COLUMN STRENGTH IS LEAST COMPROMISED).**

Fluting paper, moisture and temperature adjusted, enters two gear like rollers and converts from linear to fluted shape, under stress. It needs to be ‘pliable’.

Once formed into flute shape and adhesive attached to liner on both sides, fluting paper is expected to be ‘stiff’ enough to resist ‘deformation’ due to crushing forces.

Drawing a) is normal flute. B) is slightly deformed. C) is more deformed and d) is excessively deformed. Such deformation is to be avoided by using easily pliable but stiff fluting paper.

Any deformation or loss of board calliper, means loss of ‘column’ strength.

**ROLE 3 – FLUTING PAPER TO BE PLIABLE ENOUGH TO FORM FLUTES & THEN, STIFF ENOUGH TO RESIST DEFORMATION.**

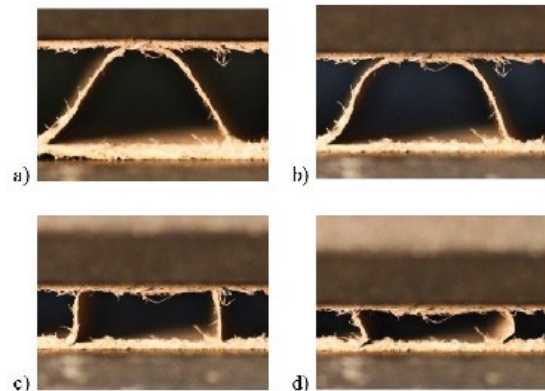
Fluting paper, as in between layer, gets adhesive bonded to both the liners.

So, fluting paper should have ability to absorb liquid water-based adhesive at machine speed.

Developments in corrugated machinery over the years have resulted in increase in machine speed from ~ 25 mtrs/min to >> 250 mtrs/min.

In other words, the machine speed is now 10X or more.

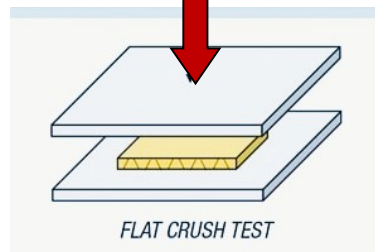
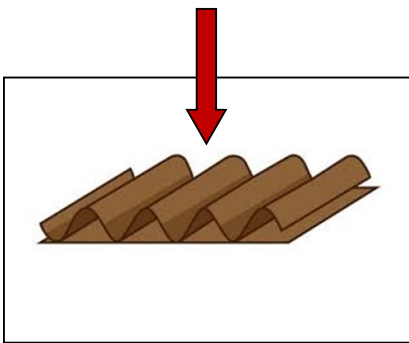
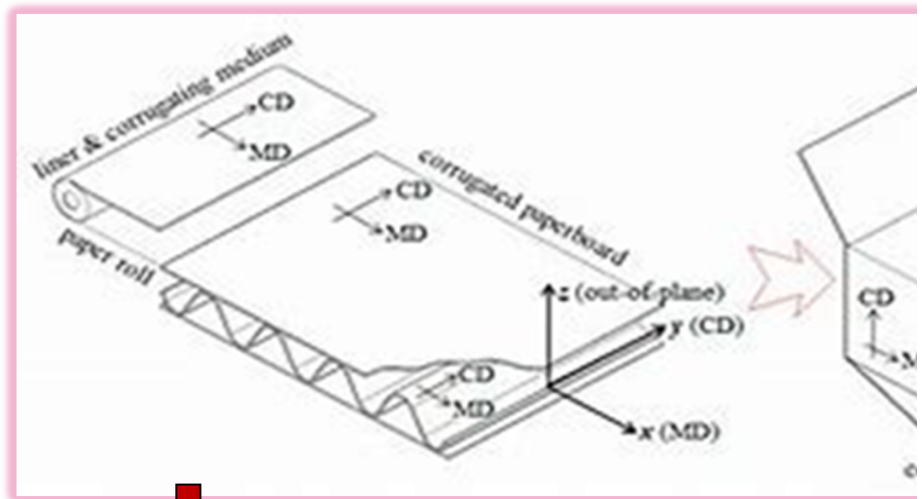
**Role 4 – FLUTING PAPER NEEDS TO ABSORB LIQUID ADHESIVE AT MACHINE SPEED.**



**SUMMARY: ROLE OF FLUTING PAPER**

1. KEEP LINERS APRT SO AS TO MAINTAIN ‘COLUMN’ STRENGTH
2. RESIST ‘CRUSHING’ FORCES .... SO, THE CALIPER OF THE BAORD IS MAINTAINED (AND COLUMN STRENGTH IS LEAST COMPROMISED).
3. FLUTING PAPER TO BE PLIABLE ENOUGH TO FORM FLUTES & THEN, STIFF ENOUGH TO RESIST DEFORMATION
4. FLUTING PAPER NEEDS TO ABSORB LIQUID ADHESIVE AT MACHINE SPEED.

FLUTING PAPER IS DIFFERENT FROM LINER



CONCORA MEDIUM TEST

As mentioned earlier, fluting paper needs stiffness to maintain its shape and size. Stiffness should be adequate to resist crushing force in machine direction (MD).

The relevant test for measuring such resistance is called Concora Medium Test (CMT) for fluted paper and Flat Crush Test (FCT) for corrugated boards.

Both CMT and FCT measure strength in Machine Direction MD.

CMT is deemed to be a bit laborious so some prefer alternate tests such as RCT or SCT. These normally measure strength in Cross direction CD which is at 90 degrees from MD.

So, any correlation between MD and CD strength tests are MD/CD ratio dependant.

**DIFFERENCE ONE: STRENGTH MEASUREMENT FOR FLUTING IS CMT OR FCT, WHICH ARE BOTH IN MD. STRENGTH MEASUREMENT FOR LINER IS [EITHER EARLIER BS, which measures both directions, OR] NOW MORE PREVALENT RCT AND ECT, WHICH ARE BOTH IN CD.**

Bursting Strength (BS) and Burst Factor (BF) of paper and corrugated boards have been age old test methods to assess the strength.

In USA, each corrugated box bears a stamp of box manufacturer and its Bursting Strength, Basis weight of facings (liners), size and content weight caps.

- Let's take the above example. BS = 200 pounds/sq. inch
- This is equivalent to 14 kg/cm<sup>2</sup>
- It also states both liners must be of 42 + 42 = 84 lbs/MSF basis weight.



- This equates to 205 + 205 gsm.
- USA liners have standardized BF of 35.
- So, the BS calculation is 205 gsm x 35 BF x 2 liners = 14.35 kg/cm<sup>2</sup>

So, in this example, Bursting Strength of the board was achieved by both liners only.

Fluting paper is NOT expected to contribute to Bursting Strength of the boards.

This is another change. In India, low BF liner is used as Fluting paper. Hence, some contribution is expected from fluting. 50% or 33% or..... some %.

### **DIFFERENCE TWO: FLUTING MEDIA IS NOT EXPECTED TO CONTRIBUTE TO BS**

Fluting paper is 'adhesive bonded' on either side to liner using liquid water-based adhesive. It should have ability to absorb adhesive at machine speed.

- Corrugated roll dia typically 300mm – 400mm (light colour roller)
- and circumference is about 1000 mm OR 1 mtr
- Distance between adhesive pick up and bonding with liner (between blue and green arrows) is approx 25% of circumference = 0.25 mtr
- Machine has increased to > 250 mtr/min or 250/60 = 4.17 mtr/sec
- So, the time available is  $0.25/4.17 = <0.1$  sec

Therefore, fluting paper requires capacity to absorb liquid adhesive QUICKLY.

Liner, on the other hand, is printed and receives ink on top side and adhesive on back side. Printing speed is less than corrugating speed.

Hence, different Cobb value (absorbent capacity) for liner and fluting has a logical justification.

### **DIFFERENCE THREE: COBB VALUE (ABSORBENT CAPACITY) FOR LINER & MEDIUM NEED NOT BE THE SAME.**

Fluting paper is generally NOT printed. Therefore, fluting paper need NOT have

- Uniform clean surface
- Particular shade

However, since the "fluting" process is now done on vacuum held corrugating rolls, permeability is relevant.

### **DIFFERENCE FOUR: FLUTING PAPER DOES NOT ANY PARTICULAR SHADE OR UNIFORM PRINTABLE SURFACE. BUT IT NEEDS CERTAIN PERMEABILITY.**

#### **SUMMARY: FLUTING PAPER IS DIFFERENT FROM LINER**

1. STRENGTH MEASUREMENT FOR FLUTING IS CMT OR FCT, WHICH ARE BOTH IN MD. STRENGTH MEASUREMENT FOR LINER IS [EITHER EARLIER BS, which measures both directions, OR] NOW MORE PREVALENT RCT AND ECT, WHICH ARE BOTH IN CD.
2. FLUTING MEDIA IS NOT EXPECTED TO CONTRIBUTE TO BS

3. COBB VALUE (ABSORBENT CAPACITY) FOR LINER & MEDIUM NEED NOT BE THE SAME.
4. FLUTING PAPER DOES NOT ANY PARTICULAR SHADE OR UNIFORM PRINTABLE SURFACE. BUT IT NEEDS CERTAIN PERMEABILITY.

#### **Conclusions**

- FLUTING MEDIUM NEEDS TO BE 'PLIABLE', 'STIFF', 'ADHESIVE BONDABLE', 'CRUSH RESISTANT IN MACHINE DIRECTION', 'ODOUR FREE' AND CAPABLE OF ABSORBING ADHESIVE AT SPEED OF 250+ METERS/MINUTE ON BOTH SURFACES.
- LINER NEEDS TO BE 'UNIFORM PRINTABLE', 'AESTHETIC', 'CRUSH RESISTANT IN CROSS DIRECTION', 'RUPTURE RESISTANT', 'ODOUR FREE' AND CAPABLE OF ABSORBING INK AT SPEED OF 100+ METERS/MINUTE ON TOP SURFACE & ADHESIVE AT SPEED OF 250+ METERS/MINUTE ON BOTTOM SURFACE.
- LINER AND FLUTING MEDIA ARE FUNCTIONALLY DIFFERENT GRADES.
- DEVELOPMENT TEAMS IN PAPER MILLS ARE URGED TO ASSESS VIABILITY OF PRODUCING FLUTING MEDIA ON WIDER SCALE.

QUOTES from Handbook of Pulp and Paper Technology  
by **Kenneth W. Britt**

*Liner used as fluting medium does not corrugate well.  
Consequently, gives a relatively low flat crush (soft board).*

*In the United States, all regular grade commercial corrugating medium has about the same flat crush.*

#### **References**

1. *Handbook of Pulp and Paper Technology*, Kenneth W. Britt, Copyright 1970, Litton Educational Publishing Inc, Library of Congress Catalog Card Number 71-129018, p558-559.
2. *Properties of Paper: An Introduction*, William E. Scott, Copyright 1989, TAPPI, ISBN 0-89852-052-5, p64-65
3. *The Corrugated Industry – In pursuit of Excellence*, Tony Pinnington, Brunton Technical Publications Ltd