

## PACKAGING PAPER – NEW FORMING FABRIC DESIGN FOR OPERATIONAL EXCELLENCE



Barathi.G

### Summary :

*The paper and forest-products industry as a whole is growing, albeit at a slower pace than before. Of the various grades package market is growing all over the world. The paper & paperboard packaging industry has been growing with the global packaging market. With increasing environmental issues of landfill and degradation of packaging material, a shift has been seen from plastic to more use of paper & paperboard in the packaging industry.*

*With increasing disposable income of people in developing countries and more dependence on convenience food, the packaging industry is booming in the Asia-Pacific region. In India, the agro based segment produces 1.64 million MT of packaging, 0.78 million MT of W & P. The recycled segment produces 3.43 million MT of packaging, 0.87 million MT of W&P and 0.81 million MT of newsprint. The wood segment produces 2.53 million MT of W&P, packaging is 0.84 million MT. This clearly shows that in packaging sector, use of recycled furnish is in increased trend.*

*But whenever we look for growth, there will be challenges also. In the packaging paper industry, the major challenges are availability of raw material, High cost of energy, Environmental issues and less operational efficiency. These challenges are being addressed by the paper industry by adopting new/improved technology.*

*This article discusses the such effort on to improve Quality of the Packaging paper with reduced cost through 3 E's – Efficiency (Maximum utilization of raw material), Energy (More output by better off-couch dry sheet) and Environment (run clear back water and less load on ETP) through new concept of forming fabric- Ultrapack - in recycled Packaging Paper machines which is the need of the hour. It will be discussed in detail of the concept, benefits, and laboratory studies with some real case studies in this article.*

### LITERATURE REVIEW

#### *Indian Paper packaging Industry – Opportunities & challenges:*

The packaging industry, as per almost all reports and market surveys, is growing stronger mainly because of improved consumption practices all across the globe. With the growth of Paper packaging in India, we expect the following opportunities in Paper packaging demand.

- Economic and income growth, population growth (changing demographics – urbanization, increasing of young population), rapidly changing life styles, improving living standards, etc.

- Demand for better quality packaging of FMCG products marketed through organized retail, rising healthcare spends, over-the-counter medicines and increasing preference for ready-to-eat foods are the key demand drive for paper board
- Make in India will further boost demand for packaging.

However, the below-said are the challenges for Paper Packaging Industry:

- ♦ Rapid changes in technology and automation
- ♦ Shortage and rising cost of Raw material
- ♦ Rising Energy costs

- ♦ Regulations on Environment
- ♦ Costly skilled manpower
- ♦ Increased Quality standards – for direct and high speed printing requirement

As global companies set up their manufacturing bases in India to meet the growing demand for consumer and white goods – the need for high quality boxes is appearing evident. In house printing on corrugated is becoming imperative. To meet the above-said challenges is the need of hour to operate at reduced cost & improves the quality of paper through 3 E's way, i.e., Energy, Environment and Efficiency.

### *Paper making – In effective way:*

As we understand the “Wet end is the heart of Paper machine”, it is also true that “Forming section is the heart of wet end”. The optimization in forming section leads for effective operation and reduce cost in the further stages of paper making. Many final paper quality parameters are decided by the forming section while sheet forming. Once sheet formed, the most of the properties cannot be changed.

The requirement of packaging paper makers from the forming fabrics are,

- Forming fabrics for packaging grades must drain well, be mechanically robust and provide long life for economical operation.
- Forming fabrics must have good mechanical retention for effective usage of raw materials and fewer fines lost to back water system.

- Forming fabrics must give good dimensional stability of paper by good formation and good sheet surface property to feed for high speed automated printing needs.

### *Packaging paper & forming fabric – Present scenario:*

Though first paper mill set in 1856 at India, the synthetic forming fabric being used from 1950's onwards, till that time metallic wires were in use. Over 50 years, the paper making forming fabric moved to latest upgraded forming fabrics in cultural variety as the demand of Quality increases. But for Packaging grade paper, most of the paper makers are in use of Single layer forming fabric.

The reason for using Single layer forming fabric lies on the Drainage character need for Recycled furnish. The requirement of Packaging paper needs high drainage and there were compromise on quality of surface till date. The reason was the

Indian produced paper used either in fluting market or for low grade carton boxes. But emerging demand of quality Liner and food grade packaging pushes the Paper makers to look for enhanced quality of paper.

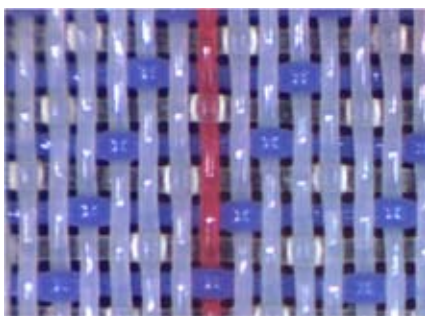
But, in addition to the above, forming fabrics are often judged to be successful or unsuccessful in numerous other ways like:

- ♦ Retention
- ♦ Drag load (power amps).
- ♦ Sheet release
- ♦ High Off-couch sheet solids.

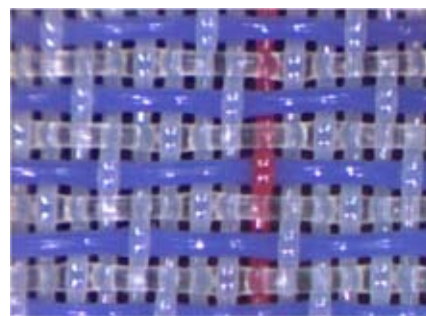
### *Existing Single Layer (5 Shaft or 8 Shaft)*

The standard Single layer forming fabric for Packaging grade are 5 Shaft/8 Shaft Single layer. Single layer fabric (SL) is a fabric made of one strand system on the machine direction and one strand system on the cross machine direction.

Figure 1: 5 Shaft Single Layer forming fabric



PAPER SIDE



MACHINE SIDE

#### Characteristics of Single Layer Fabrics

- Most versatile Design
- Easy to drain
- Easy to keep clean
- Suitable to make all types of paper

There are many designs in Single layer like 4 shed, 5 Shed and 8 shed, etc.

The limitations in the Single layers are:

- Less Dimensional Stability on high speed and wide machines.
- Straight Through Drainage – not effective formation.
- Low Retention due to less Fiber support points

- More elongation
- Paper forming side and wearing side cannot be designed separately in a single layer fabric resulting in compromise.
- Bleeding issue

Hence the design changed towards double layer forming fabrics. The advantages of Multilayer forming fabrics are,

- These are High Warp Density Fabrics (Single Layer are low warp density nearly 55 to 60 % whereas Multilayer warp density > 100 % )
- Forming side and wearing side can be designed separately for paper quality & fabric life respectively.

The advantages of Multi layer fabrics over Single Layer fabrics have following advantages

- ♦ Dimensional stable on high speed and wide machines.
- ♦ Angular & gentle Drainage
- ♦ Higher Fiber Support points – high retention
- ♦ Reduced sheet release problem
- ♦ Less two sidedness
- ♦ Higher Life

These improvements were utilized by the cultural paper segment for making Writing and printing paper and specialty papers. The requirement of further increase in fiber support points with 2.5 Layer also well accepted by this

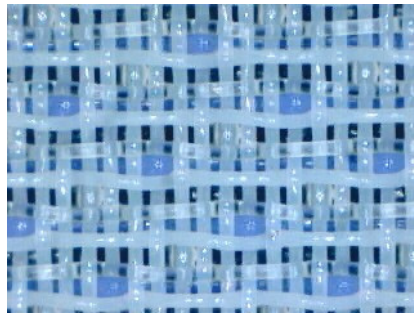
segment due to costly virgin furnish & improvement seen.

But to cater for packaging paper market, a new development came with Low Density

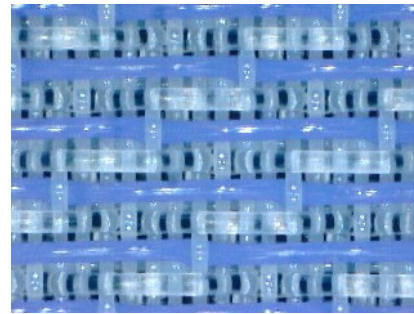
Double layer or 1.5 Layer. These fabrics are quite open hence remain clean with medium pressure shower. Generally used for making Kraft paper, finer variety of

these types of fabrics is used to make W&P paper but with wire mark. This LDDL helps to overcome the chronic bleeding problem encountered in a single layer fabric

**Figure 2: 10 Shaft LDDL (1.5 Layer) forming fabric**



**PAPER SIDE**



**MACHINE SIDE**

The advantages of LDDL or 1.5 Layer fabrics are,

- These are double layer fabrics so the wear side can be designed with higher diameter yarn to get higher life without sacrificing the paper formation.
- For the same diameter of the strands the FSI increases from 63 to 75+
- Increase in FSI results in improved retention and formation
- These fabrics eliminates the problem of bleeding, inherent in Single Layer Fabrics
- These fabrics are suitable for slow speed machines where Double Layer Fabrics cannot be used.
- These fabrics are relatively dimensional stable on high and wide machines.

Though Writing and Printing segment switched over to 2.5 Layer and so, Packaging segment rests at Single layer or 1.5 Layer due to drainage hurdles with the compromise on marking and life.

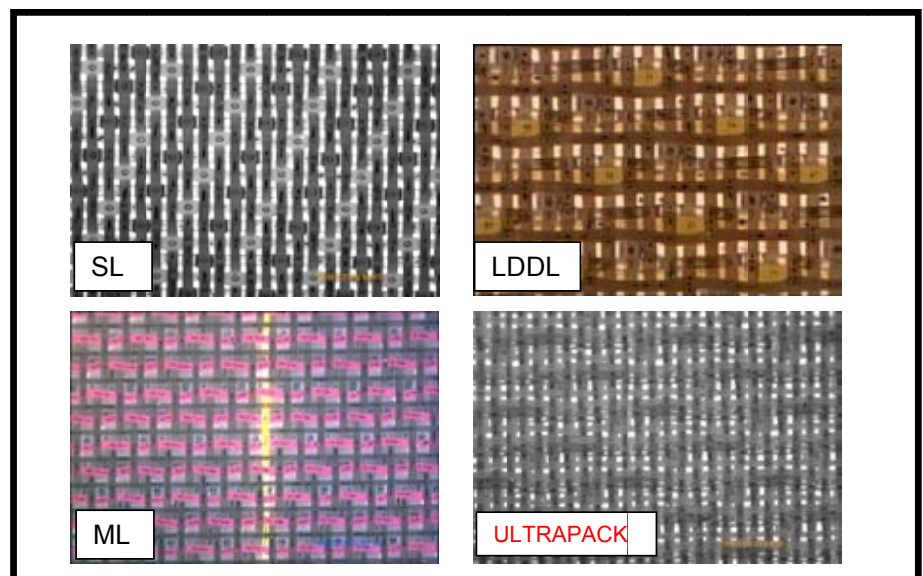
The limitations with the LDDL are,

Wire marking problem due to 5 shed CD float on Top surface. This will lead for uneven drainage holes causes drainage marking also. However, bleeding issue arrested but fabric gets dirty fast and reduced drainage. And customer faced edge curling problem due to design limitations

**Table 1: Specification comparison of Single & 1.5 Layer fabric**

	<b>5 Sh Single Layer</b>	<b>LDDL (1.5 Layer)</b>
Paper Side	21.40 X 16.50	30.50 X 23.00
Machine Side	21.40 X 16.50	30.50 X 23.00
Paper side MD yarn	0.27 PE	0.20 PE
Machine side MD yarn	0.27 PE	0.20 PE
Paper side CD yarn	0.40 PE, PA	0.20, 0.20 PE, PA
Machine side CD yarn		0.35, 0.35 PE, PA
Drainage Area %	31.10%	40.80 %
Fiber Support Index	59	99
Air Permeability, CFM	550	450
Wear Volume. cm3/m2	74	95

**Figure 3: Drainage holes & path comparison**





Hence, to overcome the issues, the new upgraded forming fabric needs for packaging paper to enhance the quality of paper with improved fiber support by higher retention and good formation, without sacrificing of surface marking, Life, etc.

Shute support Triple Layer for Packaging:

The new STL - Ultrapack fabric has high support points with high drainage capacity with improved life potential.

### *Expected benefits of Ultrapack over Single Layer & LDDL:*

The new forming fabrics have the advantages as below:

- Finer top surface to improve sheet release – no hills and valleys – to catch the fibers, hence no fines carry in return circuit – clean run and improved runnability of machine.
- Two warp design to reduce elongation problem on the machine.
- Fine top weft for good paper surface properties and robust bottom weft for potential for enhanced life.
- Well-known straight through drainage to handle more water on the wire table – more off-couch dryness leads for less Energy consumption in drying area.
- Improved Fiber support points for high mechanical retention hence improved formation – less solids to back water system, thus less effluent load to ETP.
- Plain Top weave will not leave surface marking to make near to uniform plane on surface.
- Due to very even in top surface, less prone for tar or stickies get settled on valleys. Even it sticks on surface; it is easy to clean with the showers from the surface of fabric.

### *ULTRAPACK forming fabrics - effect on Stickies:*

Stickies are so chemically diverse that removal by chemical means alone is very difficult. Stickles interfere with

**Table 2: Specification comparison of Single & 1.5 Layer fabric & ULTRAPACK**

	Single Layer	LDDL (1.5 Layer)	ULTRAPACK
Paper Side	21.40 X 16.50	30.50 X 23.00	22.50 X <b>23.40</b>
Machine Slide	21.40 X 16.50	30.50 X 23.00	22.50 X <b>11.70</b>
Paper side MD yarn	0.27 PE	0.20 PE	<b>0.18 PE</b>
Machine side MD yarn	0.27 PE	0.20 PE	0.27 PE
Paper side CD yarn	0.40 PE, PA	0.20, 0.20 PE, PA	0.20, 0.20 PE, PA
Machine side CD yarn		0.35, 0.35 PE, PA	<b>0.35 PE, PA</b>
Fabric Caliper, mm	0.77	0.80	1.30
Drainage Area %	31.10%	40.80 %	<b>38.50%</b>
Fiber Support Index	59	99	117
Air Permeability, CFM	550	450	<b>430</b>
Wear Volume. cm3/m2	74	95	131

paper production by fouling equipment and reducing the quality of the finished product. Stickies are generally considered to be the product of additions to the paper as contrasted with “pitch” which derives from naturally occurring resinous byproducts in the wood or inks which is used in printing and the glue material used in used Carton materials.

Stickies accumulate in white water recycle systems resulting mostly in deposits on paper forming fabrics, on felt and on wet end equipment. Consequently, quality problems such as pinholes, increased down time due to frequent break down and clean ups, additional costs for cleaning and prevention, inherent damages to fabric and drying equipment are commonly encountered in the production and use of secondary or recycled fiber furnish.

Larger sized (>0.42mm) stickies generally can be easily removed by mechanical screening and sieving processes and are not a significant problem. Medium sized stickies (0.075-0.42 mm) cannot be effectively removed by mechanical means. They may be pliable making them difficult to remove by screening. Small size stickies are not a problem as

long as they remain stable in the furnish. However, once they become unstable, they accumulate, agglomerate, and stick onto surfaces of the papermaking equipment. They eventually grow larger and are subsequently released into the pulp resulting in pinholes, breakages in the sheet, and poor paper quality.

The ULTRAPACK forming fabric will carry the micro-stickies along with the paper while it is in unstable stage due to high mechanical retention. Otherwise, the micro-stickies will circulate in the backwater system and accumulate, agglomerate and grow larger and larger. Then it releases in to system and causes poor runnability and quality of Paper.

### *Laboratory analysis:*

The hand sheet former used to measure the drainage time taken for different design of forming fabrics which is used for Packaging grade paper. 100 gsm sheet made with same consistency for measuring the time taken in seconds for different designs.

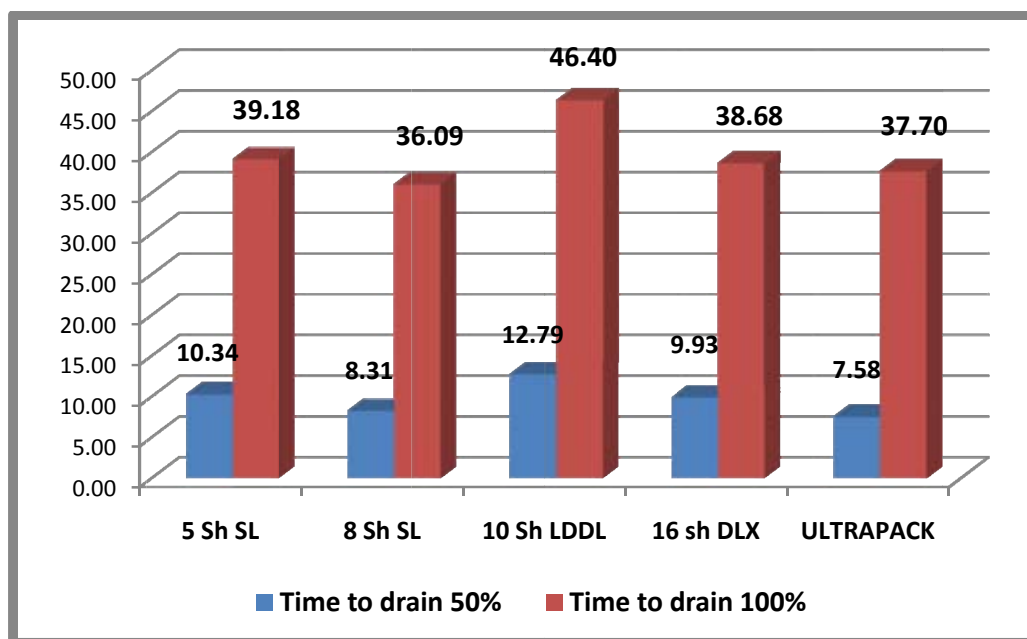
The following table (table 3) shows the drainage time taken (in sec) for different type of forming fabric which is used for producing Packaging Kraft papers

Table 3: Drainage time taken for different design of fabric

Product	T1	T2	T3	T4
5 Sh SL	3.02	10.34	25.82	39.18
8 Sh SL	2.62	8.31	25.17	36.09
10 Sh LDDL	3.26	12.79	30.36	46.40
16 Sh DLX	2.97	9.93	25.78	38.68
ULTRAPACK	2.82	7.58	27.30	37.70

The drainage behavior of ULTRAPACK is same like Single layer fabric compared to LDDL or Multilayer forming fabric which is used for making packaging grade

Figure 4: Drainage time taken in Seconds



The measurements were taken at different intervals to ensure the behavior of drainage. The following curve shows that the drainage pattern is same as Single layer forming fabric which is the need for new modified design.

The ULTRAPACK for packaging paper will have better drainage character with improved mechanical retention and potential for improved life as shown below

Figure 5: Drainage pattern comparison (drainage in sec).

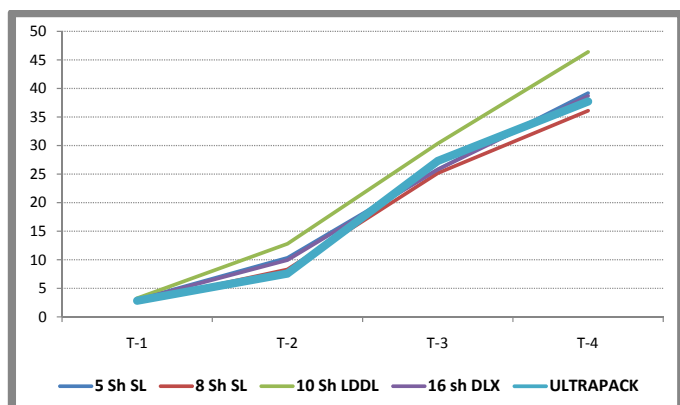
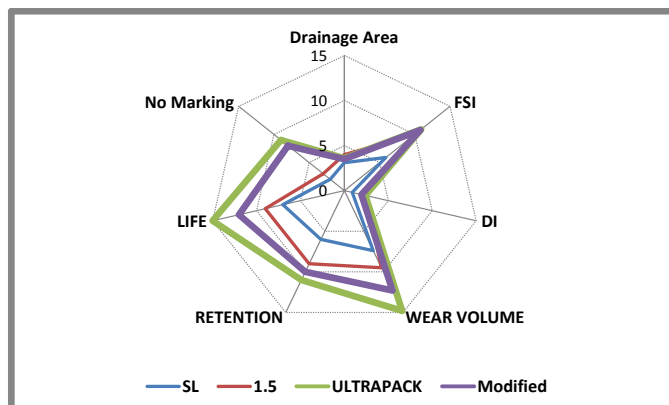


Figure 6: Comparison of parameters with existing & modified fabric



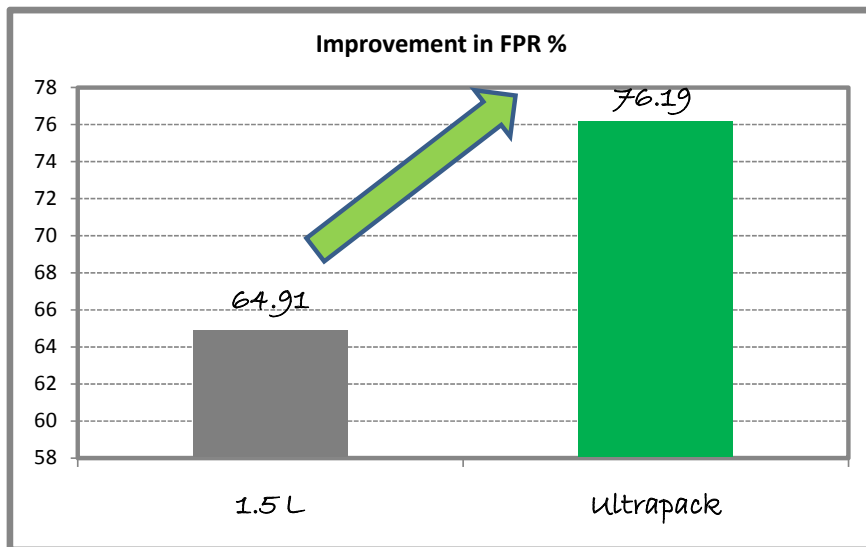
## Case studies:

### Customer A:

Multilayer Kraft machine making 140 to 230 GSM with 340 m/min speed with 100% recycled furnish.

Objective: To improve First pass retention

Figure 7: Improvement in FPR%



### Result:

- Higher First Pass Retention from 64.91 % to 76.61%.
  - Higher FPR yields less cost of fibre, high couch solids and thus less steam consumption.
  - Improvement in FPR with same dosage of Retention aid chemicals.
- Drag load reduction by 4%.

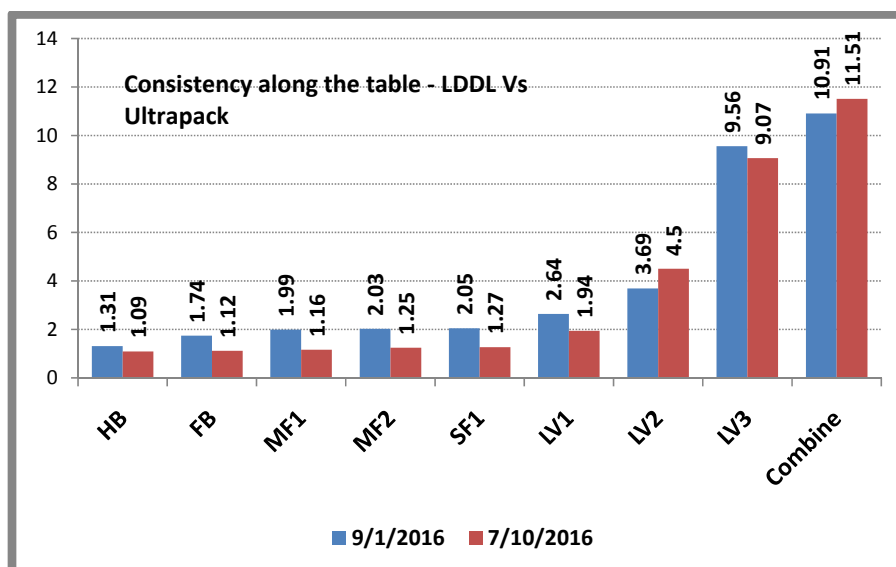
### Customer B:

Multilayer Kraft machine making 140 to 230 GSM with 345 m/min speed with 100% recycled furnish.

**Objective :** To improve First Pass retention, Off-couch dryness & reduce Solid Lost.

The following graph shows the improvement of Off-couch dryness in the Top layer.

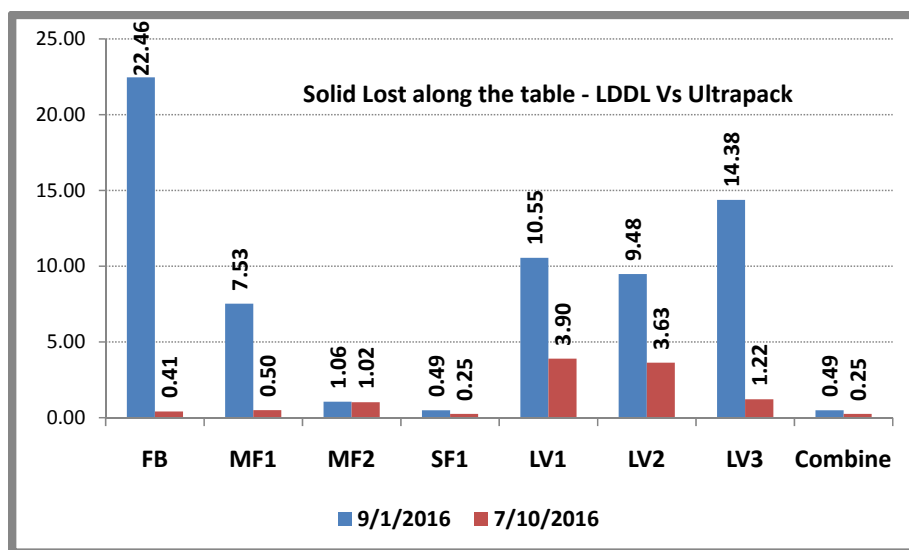
Figure 8: Improvement in Off-couch dryness



The following graph shows the reduction of Solid lost overall. The reduced initial solid loss by the controlled drainage at forming board and helped for good

The following graph shows the reduction of Solid lost overall. The reduced initial solid loss by the controlled drainage at forming board and helped for good formation and high FPR.

Figure 9: Reduced initial Solid lost & overall Solid lost



### Result:

- Controlled initial drainage and high drainage on vacuum zones leads improved off-couch solids
- Less solid lost on forming section
- Less drag load

Customer C:

Multilayer Kraft machine making 100 to 250

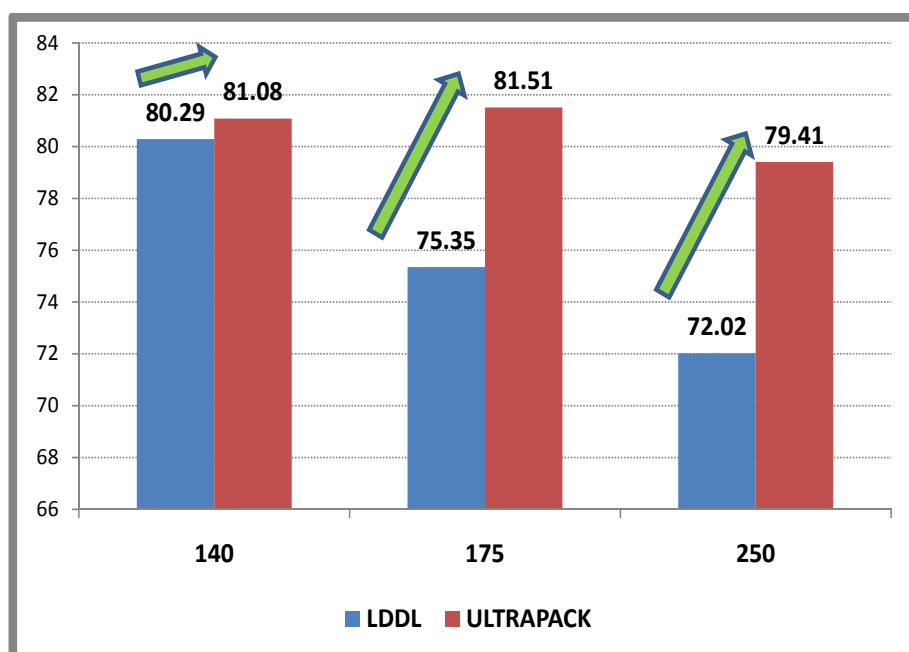
GSM with 300 m/min speed with 100% Recycled furnish.

### Objective :

- To Improve First pass retention
- Reduce drive load & improve Life

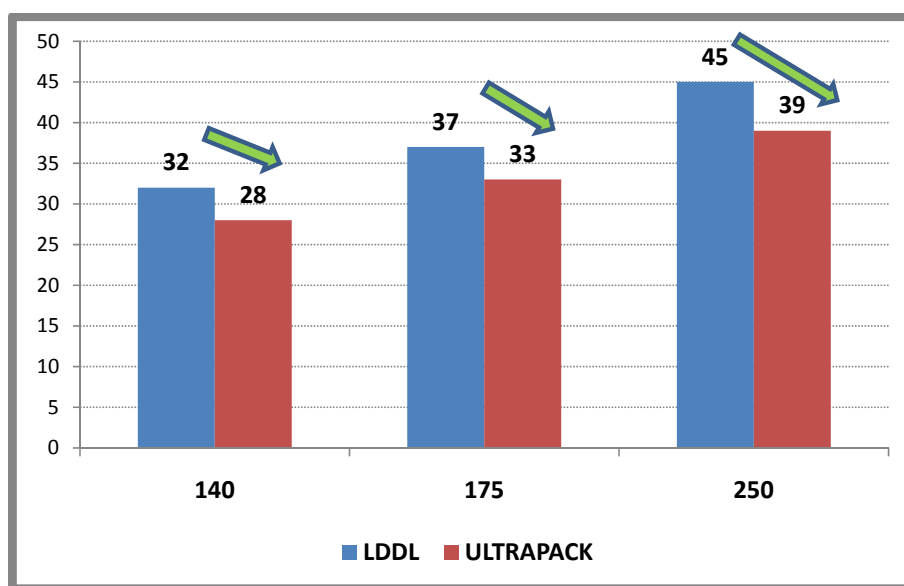
The following graph shows the improvement in First Pass retention in different basis weight made on the machine.

Figure 10: First Pass Retention Improvement



The drag load has come down in the wire part due to good drainage and no sheet sealing in the initial stage, thus vacuum in the wire part used in effective way.

Figure 11: Wire part Drive load reduction



### Result:

- Higher First Pass Retention 2.0 % to 6.0 % in all basis weight range.
- Higher FPR yields less cost of fibre, high couch solids and thus less steam consumption.
- Improvement in FPR with same dosage of Retention aid chemicals.
- Drive load reduction by 10 to 12% in 140, 175 & 250 GSM

### Conclusion :

Paper makers can reduce cost of Operation and Quality improvement in the final paper with the help of improvement in technology through 3 E's – Efficiency, Environment and Energy. The ULTRAPACK will help in

- high mechanical retention for improve paper finish and reduce the fiber cost
- Reduce Energy cost by reduced drive load & steam cost by increasing off-couch solids
- Improvement in machine runnability by reduced stickies with required drainage capacity to match with Single Layer or LDDL forming fabric
- Reduce solid lost in forming section to reduce ETP load and clean back water system

- Necessity has come to improve quality and reduce cost of operation for success in competitive way to fulfill the demand of growth of Quality Packaging paper in India.

### Acknowledgement:

The authors are grateful to the management of Wires & Fabriks (S.A) Limited for the full co-operation and guidance extended for publishing this technical paper. We would also like thank the technical committee of IPPTA for accepting this paper.

### Literature reference :

1. <http://www.mckinsey.com> - Pulp, paper, and packaging in the next decade: Transformational change
2. <http://www.smitherspira.com> – Global packaging Industry – Market report
3. <http://www.indiapack.org/> - India Pack 2015 – Indian packaging industry: Growth potential
4. <http://www.packplus.in/Industry>
5. <http://www.google.co.in/patents/US5540814>
6. [www.busniessstandard.com](http://www.busniessstandard.com)
7. [www.packwebasia.com](http://www.packwebasia.com) – Packaging market data trends
8. [www.all4pack.com](http://www.all4pack.com) – Packaging – Market & Challenges 2016
9. [www.crisilresearch.com](http://www.crisilresearch.com) – CRISIL research - Packaging
10. [www.poyry.com](http://www.poyry.com) – WFO – up to – 2030 & Future outlook for the Forest Industry
11. [www.risiinfo.com](http://www.risiinfo.com) – Annual review of Global Pulp & Paper Statistics
12. [www.worldpackaging.org](http://www.worldpackaging.org) – Market Statistics & Future trends in Global packaging – World Packaging Organization
13. [www.ficci.in](http://www.ficci.in) – knowledge paper.cdr
14. Technology and R&D documents of M/s Wires & Fabriks (S.A.) Limited.