

# Developments towards improving Paper Quality & efficiency for Mid Segment Paper Mills



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## SUMMARY

*Demand of paper quality is increasing from printing industry day by day either in Packaging segment or White segment. High speed printing in White paper and direct printing on the Packaging paper are the development in printing sector leads to push the quality standard of paper manufacturer towards increasing Paper making standard.*

*As, most of the sheet properties were decided by the forming section, the quality demands are pushed towards the forming fabric technology too. Forming fabric technology has changed drastically in the past few decades towards the improvement needed for Paper makers. A quick review of what was once considered state-of-the-art for a particular time period provides clear evidence that the advancements in this Paper Machine Clothing segment have paved the way for increased paper machine performance, sheet quality, and competitive manufacturing economics. As predicted, demands have continued to push for higher machine speeds and ever-improving sheet properties at a time with more challenging furnishes and operating costs.*

*Paper industry looking for continuous growth in competitive market with the constant care of sustainability on environmental regulations, it is the need of hour for making the paper with high end quality with reduced input cost on sustainable resources, energy and improved efficiency.*

*Innovations in Forming Fabric technology help paper makers to achieve higher performance goals through improved surface properties along with in reducing cost of fiber, chemical, improved dry content after forming, improved formation and other paper making quality parameters.*

*At Wires & Fabriks, we too have pushed the research and development engineering groups to meet these demands through continued innovation in forming fabric technology.*

*Paper machine clothing performance that helps keep the machine running efficiently adds to the bottom line. It should not only be engineered correctly for the application, but maintain its design properties over a sufficient lifetime to be cost effective and produce a high quality sheet.*

*This article will explain the innovation solution and the direction of ideas drive the paper machine clothing design for high performance of paper making for meeting high quality standards which is necessity for growth and sustainability of paper Industry. Improved mechanical retention for effective utilization of costly raw materials and improved Paper surface properties, high dry solids after forming section with less drive load and clear back water for improve runnability, efficiency and lesser ETP load. Some of the case studies explained the application impact of new innovative design in forming fabric which is the real-time solution for Indian paper industry for growth & sustainability in the competitive world.*

## Introduction

The Indian Print Industry has undergone a revolutionary change in the last 30 years. The average compound annual growth rate has been higher than 12% over the last 15 years. Indian packaging industry is currently growing at a rate of more than 16% a year. Post 1990, the trend has been to acquire the latest and the best equipment & machines. The progressive

printers of today are equipped with the latest computer controlled printing machines and flow lines for binding, while state of the art digital technologies are being used in pre-press. Leading print companies have optimized the use of information technology in each and every area of their business. These printers are today equipped at par with the best print production facilities in the world.

Today, India is fast becoming one of the major print producer & manufacture of printed paper products for the world markets. The quality standards have improved dramatically and immense production capacities have been created. The current annual turnover of all the components in the Indian printing industry are more than Rs.50,000 crores. With the growing printing industry, the need of the Quality standard of Paper also

increased dramatically. Hence the requirement passed toward Paper Industry also simultaneously.

Indian Paper Industry evolution:

In the year 1950-51, there were 17 mills with a total installed capacity of 1.37 lakh tonnes. With 70 years growth, at present there are about 800 mills with a total installed capacity of around 25 million tonnes and further growing with the CAGR of 7 to 8%. The production capacity ranges from 5 tpd to 800 tpd. The operating speed of paper machines increased from 100 mpm to 2000 mpm gradually and looking for further also.

The raw material consumption pattern has changed (as shown in Figure 1) drastically over the last four decades due to availability, cost and environmental factors. While on one side the cost of Virgin fiber has increased in India, there is an availability of agricultural residue with limitations of proper collection and handling. Various types of specialty chemicals and processes being used in paper making process to achieve required final properties of paper to meet the printing requirement. Also the machine configurations changed from Single Fourdrinier, Multi-Fourdrinier and Hybrid former with Top dewatering Unit, Gap former and so on.

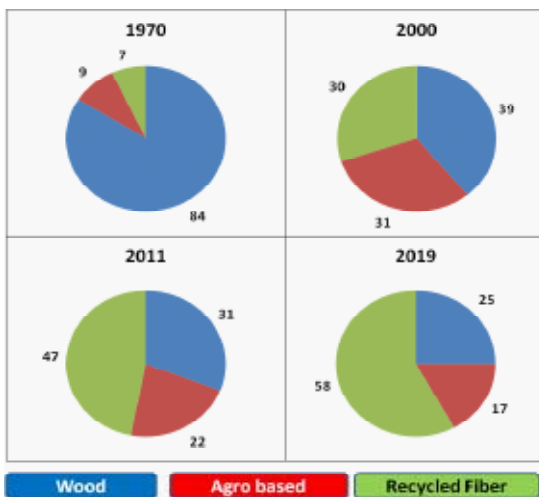


Fig 1: Indian Paper mills raw material scenario

With the available infrastructures, paper mills upgraded the machine with modifying the rolls and accessories, includes size presses, changing the process parameters. For improved efficiency, the cleaning system also improved by lubricating showers and high pressure showers. Paper mills meet the requirements by improving quality of product and efficiency without much capital investments. But now-a-days, the demand is in increasing trend to compete the international market. Hence, it is required to move ahead further to sustain in Industry.

The changes in Paper machine configuration and the demand of printer's needs shifted to Forming fabric suppliers also, as the "Wet end is the heart of Paper machine" and the "Forming section is the heart of Wet end".

Indian Paper machine clothing evolution:

Generally, 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.

Single layer came into existence in the 1950. In the beginning there was plain weave which exists even today. Soon it was discovered that Plain weave was not suitable for paper making because of low life of a Forming Fabric and elongation in general.

A 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 (as shown in Figure 2)

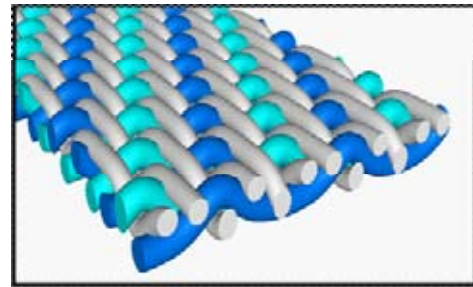


Fig 2:5 Shaft Single Layer fabric

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
- Poor surface quality of Paper while increasing yarn dimensions for Life.

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.
- Reduced sheet release problem
- Less two sidedness
- Improved surface quality
- Higher retention
- 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 furnish & improvement seen.

But to cater for packaging paper market, a new development came with Low density Double layer or 1.5 Layer (figure 3) as the Liner Kraft being printed directly. For better print reproductiveness, Kraft paper also in the need of good surface properties. 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 LDDDL helps to overcome the chronic bleeding problem encountered in a single layer fabric.

The advantages of LDDDL 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 surface marking and life.

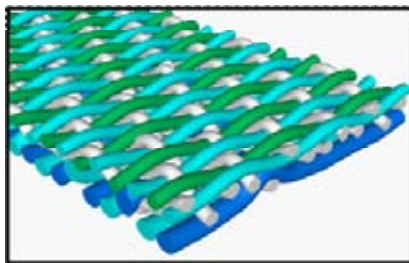


Fig 3:1.5 Layer forming fabric

The limitations with the LDDDL are,

Wire marking problem due to 4 or 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.

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 with good drainage capacity like Single Layer, without sacrificing for marking, Life, etc.

In the same way, for White segment, the transition time for changing from Single layer to multilayer and to new generation forming fabrics needs much more time. Moreover, this requires more changes in the machine parameters to get the benefits.

**Shute support Triple Layer for Packaging:**

The new Shute support Triple Layer (Figure 4) fabric has high support points with high drainage capacity with improved life potential.

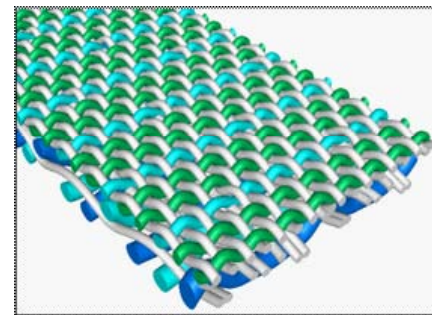


Fig 4: NEW GENERATION DESIGN

The below-said Figure 5 shows the improvements with the new innovative design over Single layer fabric for Packaging Kraft. With better fiber retention and drainage characters, the inherent problem of bleeding issue will be reduced with potential for improved life.

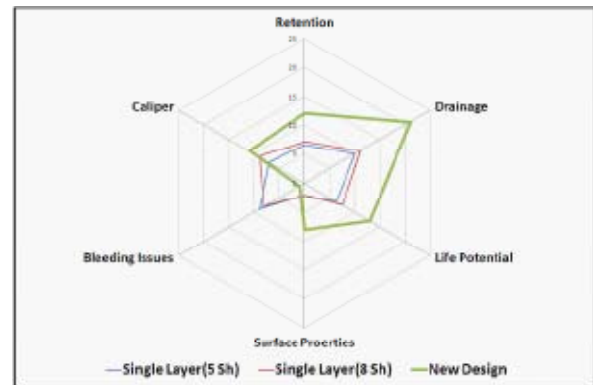


Fig 5: Comparison of Single Layer Vs New design

New ULTRAPACK (Figure 6) with plain top weave and improved surface will helps in achieving the improved sheet quality for better printability in the Kraft liner.

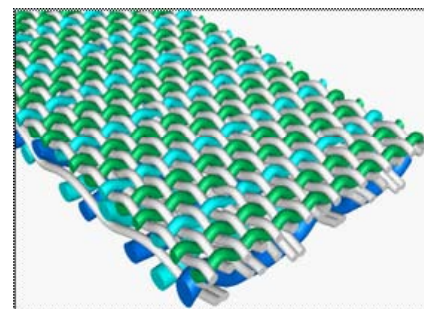


Fig 6: ULTRAPACK

The below-said Figure 7, shows the improvements achieved in ULTRAPACK from 1.5 Layer.

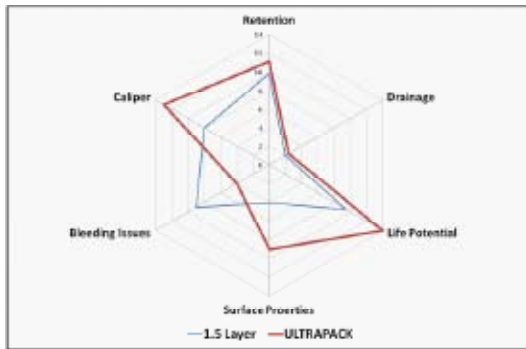


Fig 7: Comparison of 1.5 Layer Vs ULTRAPACK

**New Generation STL for Writing & Printing Segment:**

Due to high capital investment cost, most of the mid segment Paper mills, could not upgrade the Paper machines like, vacuum capacity, stretcher availability. But the quality demand from end user threatens the competitors' entry. With the existing machine configuration, by converting the forming fabric design, the benefits of New STL (Figure 8) can be achieved with few machine process changes.

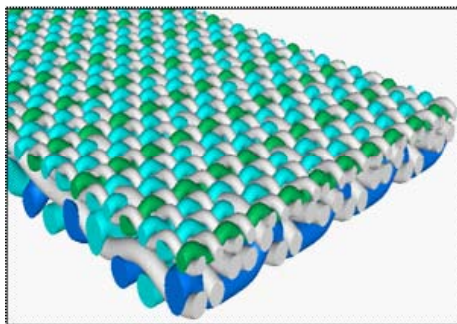


Fig 8: AQUAFLEX

New generation forming fabric AQUAFLEX shows impressive improvements in application with the following benefits.(as shown in Figure 9)

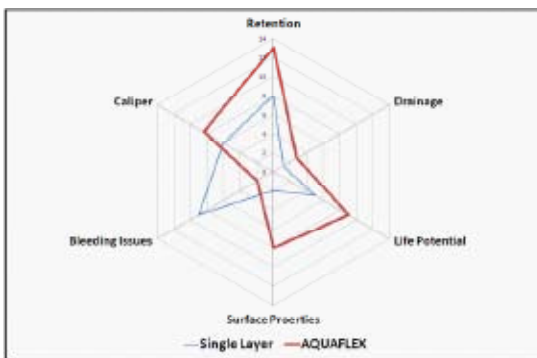


Fig 9: Comparison of Single Layer Vs AQUAFLEX

**Expected benefits of AQUA or ULTRA series 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 issue 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 as like Single Layer 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 load to ETP.
- Plain Top weave will not leave surface marking to make near to uniform plane on surface for better printability.

**Trouble shooting solutions - Case studies:**

The ultimate valid criteria for the economic production of Pulp and Paper Industries are: Quality, Efficiency and the Cost. In this, efficiency is the link between Quality and the Cost. Now in India, we are in the need of urge in Improving the Quality by less Cost and improve our efficiency in the productivity. The cost and efficiency is directly related to Energy consumed in the Paper machines. The following chart shows the energy saving potential through optimized Doctor Blade usage.

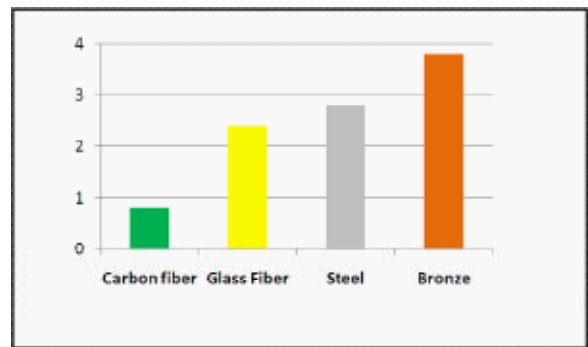


Fig 10: Energy saving potential through Doctor blade in Paper machine

The above graph (Figure 10), shows the relative power consumption of doctor blade materials. This graph generated based on laboratory test in simulated paper machine environment.

The optimized showering system helped in reducing Fresh water consumption in the Paper making process, which is the need of the hour for sustainability of the paper making.

By introducing the Gang filter between Save-all to showers, water quality improved from 80 to 120 ppm to 50 ppm, which helps in reducing the time required for cleaning the showers and reduced the fresh water consumption by 35% by utilizing the back water in place of Fresh water in the LP Showers and Sheet knock off showers in PMC. (Figure 11)

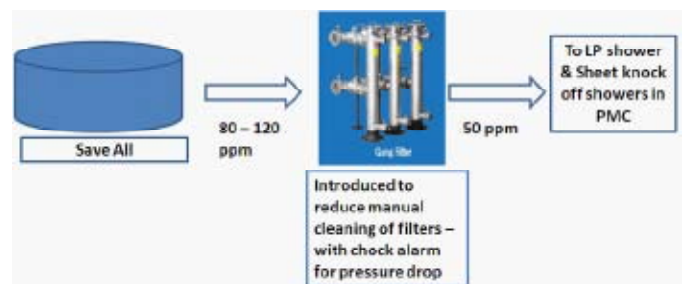


Fig 11: Optimizing usage of back water through proper filter

The automated oscillating high pressure shower will give the uniform cleaning process to maintain uniform CD profile & longer fabric life and increased production. Controlled cleaning for fabrics and rolls covering every point of the surface and in parallel lines whose pitch per fabric revolution is equal to the diameter of the cleaning jet due to its synchronized speed with Paper machine, and with instantaneous reversing action, there is no standstill at the switchover points with zero dwell time mechanism. The auto water shut off mechanism when oscillator mechanism malfunction will help in avoiding the damage of the fabric. Whenever, machine speed increases, the shower oscillation needs to be synchronized to match the stroke of the oscillation to keep the fabric proper cleaned.

A high speed Paper machine has problem of Poor formation and lines observed in the paper. While analyzing the used fabric (Figure 12), Uniform line observed in forming fabric due to poor cleaning and non-synchronized shower oscillation system. And it is observed, poor cleaning by High pressure shower due to improper oscillation. The speed of oscillation is not synchronized hence the lines developed in the end of the strokes of every oscillation turns.

After changing the shower unit with the automized speed synchronization, the line in paper issue eliminated and the sheet formation improved.

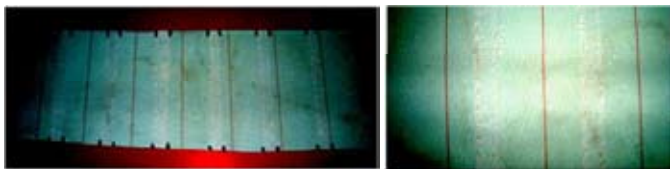


Fig 12: Analysis of used forming fabric

**CASE STUDY # 1**

A Fourdrinier machine making white paper with Recycled furnish at 410 mpm. The objective of the project is improve paper surface and improve fabric life considerably. Customer being used Single Layer fabric for long time. AQUAFLEX was mounted on the machine, the formation improvement observed, Wire mark eliminated. Formation index improved (Figure 13) in all basis weight of paper made on the machine.



Paper surface with Single Layer

Paper surface with AQUAFLEX

Fig 13: Formation improvement & Wire mark elimination by AQUAFLEX

Along the with the improvement on the surface of paper, the formation index of different basis weight are improved by 5 to 6 points than the Single Layer as shown in Figure 14.

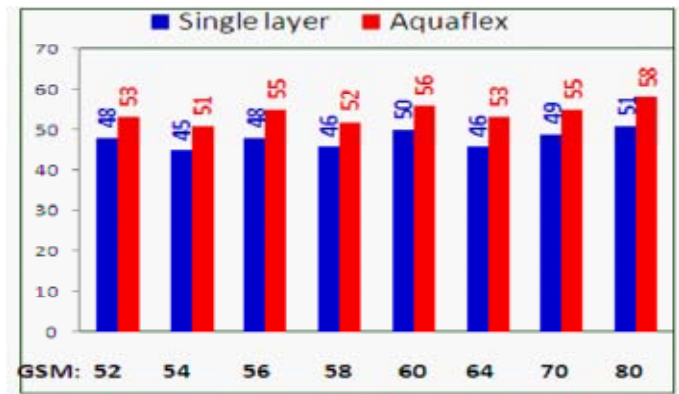


Fig 14: Formation index improvement in AQUAFLEX

**CASE STUDY # 2**

A multi-Fourdrinier machine making Liner Kraft with recycled furnish at 370 to 400 mpm speed. With the objective of increase off-couch dryness, our ULTRAPACK supplied and mounted on the machine. Customer using 1.5 Layer previously. With the small adjustments in the machine parameters, the off-couch dryness improved by 2.75% from 21.78% to 24.55% (Figure 15) along with the First pass retention improvement of around 3 to 7 %. Drag load was same as previous 1.5 Layer. No slippage problem and machine runnability improved.

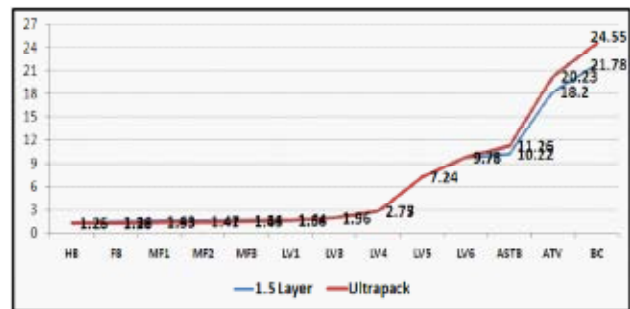


Fig 14: Off-couch dryness improvement in ULTRAPACK

**Conclusion:**

Paper makers can improve efficiency and Quality in the final paper with the help of improvement in technology. The new generation forming fabric and technology will help in

1. high mechanical retention for improve paper finish and reduce the fiber cost
2. Reduce Energy cost by steam cost by increasing off-couch solids
3. Improvement in machine runnability to improve productivity
4. Reduce solid lost in forming section to reduce ETP load and clean back water system
5. Necessity has come to improve quality and reduce cost of operation for success in competitive way to fulfill the demand of growth of end users.

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