PERFORMANCE ENHANCEMENT IN AGRI-RESIDUE PAPER MAKING BY NEW GENERATION FORMING FABRIC – CASE STUDIES

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SUMMARY

The Indian paper industry plays a significant role in the nation's economy with a turnover of more than 50,000 crores of Rupees. It ranks sixth among the energy intensive industries and occupies 16th position among the top global paper producers. Acute shortage of raw materials and issues concerning environment and high cost of basic inputs has resulted in lowering of the operational capacities.

Our paper industry has a highly fragmented structure consisting of small, medium and large sized papers mills having capacities range from 10 to 1500 tpd processing wood, agro residues and recycled waste paper as major raw materials.

Theoretically, any fibrous plant can be pulped to provide cellulosic fibers for paper manufacture, but technical and, more often, economic constraints limit the number of species of usable plants. The most important agricultural residues used in the paper industry are straw and bagasse. The raw material consumption pattern has changed drastically over the last four decades due to availability, cost and environmental factors. While on one side the cost of wood and waste paper has increased in India, there is an availability of agricultural residue with limitations of proper collection and handling. The agri residue had favorable low lignin content driving better formation, but also has challenges of lesser strength due to short fiber, more fluffing/linting due to less retention and presence of abrasive silica/ash.

The innovation in forming fabric design has helped in addressing this opportunity and deliver improvements in quality and performance. In this paper, through a few case studies we would share the performance enhancement achieved in Agri-residue Papermaking through New Generation Forming Fabric.

LITERATURE

Indian Paper Industry – Agro-residue papermaking

The per capita paper consumption in India at a little over 13 kg, is way behind the global average of 58 kg. India is the fastest growing market for paper globally and it presents an exciting scenario; paper consumption is poised for a big leap forward in sync with the economic growth. The futuristic view is that growth in paper consumption would be in multiples of GDP and hence an increase in consumption by one kg per capita would lead to an increase in demand of 1 million tonnes.

Non-wood based paper mills, contributing over 70% to total country's production, manufacturing an Eco friendly paper from agro residues such as Wheat straw, Rice straw, Bagasse, Sarkanda etc. otherwise waste, and waste paper, as such converting Waste into Wealth and conserving forest resources to an extent to 20 million trees per year. Non-wood based paper mills, which pre-dominantly set up in rural areas, provide large-scale employment and lively hoods directly and indirectly to almost 40 lakhs people, majority are from lower income group of society i.e. marginal farmers, skilled and semi skilled workers.

This industry ensures remunerative prices for various agro residues otherwise waste was burnt in the fields. India being an Agrarian economy, the growth of agro-based industry can only solve economy and employment related issues.

The combined expenditure by both Central and State governments on education sector has gone up to the tune of 12 times in the last 20 years. Even private sector expenditure in education has increased by 15 times in the last decade.

India's paper consumption is expected to ride its economic growth. As per an economic estimate, India's GDP is likely to grow @ 7-8 per cent, which is expected to accelerate the consumption of paper and paperboard.

Challenges with Agri-residue for Paper making

India is one of the major sugar producing countries in the world, but in terms of pulping of bagasse for paper making has reduced substantially, even-though it is available in plenty, but it is diverted for power generation by sugar units for captive power generation etc. Due to incentives and other financial support from various government agencies for power generation through co-generation in the sugar mills, this precious fibrous material is not available for paper making. The sugar mills may gain financially if fibers are supplied to the paper mills rather than power generation or using as a fuel, which is much low in thermal efficiency. There is a need to propagate the concept of paper making from straw and discourage burning in the field.

Apart from the availability the challenges lies in storing and processing of agricultural residues to use in paper making throughout the year.

Forming of Paper with Agricultural residue:

Though with less lignin content in agri-residue, which is easy pulp-able, the drainage, retention and life of the forming fabric is the challenges for PMC suppliers. The requirement of forming fabric is till now managed mostly with Single layer forming fabrics. The new generation SSB forming fabrics can combine the drainability characteristics of single layer with the benefits in retention and life potential which can be achieved with multi layer/triple payer to extend multiple benefits for paper makers.

Figure 1: Requirement of forming fabric

Single layer forming fabrics suffered from Fiber bleeding problem and poor sheet surface due to straight through drainage with more permeability. To improve life, the increased yarn diameter leads to poor surface on end product.

In Multilayer,

- Maximizing fiber support can severely retard drainage by closing the "holes" at high mesh counts.
- Non-uniform drainage hole sizes and relationships in double-layer designs can mark the sheet, retard sheet release, and cause fiber carry (run dirty).
- Relatively unstable weaves can contribute to unsatisfactory CMD profile, especially on long unsupported runs.
- Relatively low stiffness factors can cause excessive deflection into drainage elements, thereby increasing drag loads.

Now in Paper industry, the following are the requirements of paper makers to produce the paper at economically and efficiently.

- Market emphasis on improvement of paper quality
- Improved paper surface due to modern printing technologies on all paper grades
  Efficient usage of less cost short fibers
- More filler addition to reduce input cost and improve paper properties.
- Lower basis weight and faster the machine speed

Hence to overcome the above-said issues, the solutions lie in New Generation SSB forming fabric but for agricultural residue it needs new modifications to attain the requirements.

Accordingly, the STL product which is well proven on wood and recycled furnish , has now been redesigned for Agri-residue paper making aptly supported through small process adjustments in paper machine by paper makers.

Forming fabric Application & Relationships:

Table 1: Forming fabric application & relationships

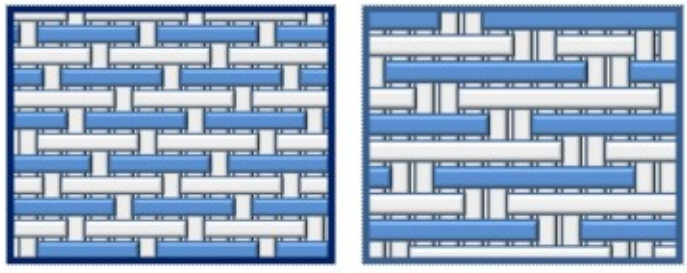
Fabric Property	Effect on Operation	Effect on Sheet quality
Drainage (Air Permeability, Drainage Index, Surface Open area)	Power consumption & Drives	Formation Off-couch dryness Speed of the machine
Fiber Support Index	Cleanliness in return run	Wire mark Sheet release Porosity
Maximum Frame length	First Pass Retention Clear back water system Clean run of machine	Improved two sidedness Less fluff/linting Improved total retention Less ETP load on drained fines and fillers

Challenges with existing STL and need of modification:

The standard 5 shed bottom float and 6 shed bottom float have the limitations of more stitching points in square unit area which is hindrance in the free drainage path. Whereas with the modified 10 shed float there is a reduction of the stitch points, hence free drainage increased which is required for agricultural residue. Along with the increased drainage, the high burial provides extra life in the fabric. By increasing the burial, the caliper increase is compensated with the optimizing bottom and top weft yarn diameters.

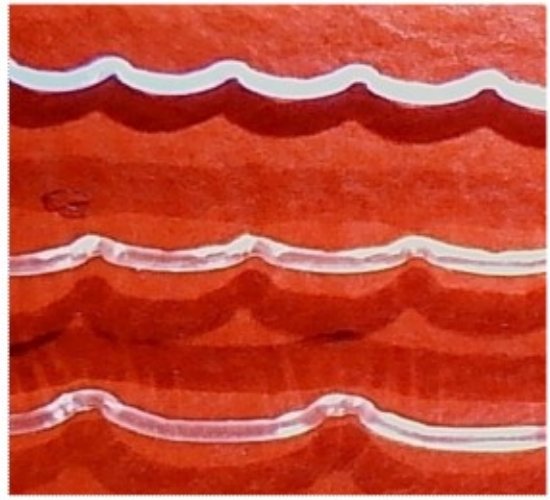
The 5 shed bottom float and 10 shed bottom float shown as block diagram shown in Figure-2

Figure 2: 5 Shed bottom float and 10 Shed bottom float STL



By changing the weft ratio, the high FSI with higher number of bottom weft were possible to improve first pass retention and life potential of the fabric without losing air permeability. The high burial and stitch point explained as in Figure 3.

Figure 3: Burial of 5, 6 & 10 shed float



Potential benefits of STL on Agricultural residue paper making

By providing STL in agri-residue furnish the expected benefits are

- ✓ Improved retention helps in efficient use of fibers,
- ✓ Increased off-couch dryness thus machine runnability improved,
- ✓ Clean run due to less plugging by improved mechanical retention,
- ✓ Good sheet release due to fine surface of STL,
- ✓ High drainage capacity with short forming available time (with increased speed),
- ✓ Rugged bottom side for improved fabric life with less abrasion by drained and carrying of fillers,
- ✓ Reduced solid lost thus reducing ETP load with better sheet properties.

Based on these potential benefits some of our experiences are shared below:

Case 1: Improved retention and higher life of forming fabric.

A Fourdrinier machine producing Writing & Printing grade of 56 to 90 GSM with 93% agricultural residue and 7 % Wood pulp, 525 mpm speed was previously using Double layer fabric. The objective of the trial was to improve retention and increase the life potential.

Modified New Generation STL was implemented and following benefits were observed:

- ✓ First pass retention improved from 4 to 8% for 56 to 70 GSM respectively
- ✓ Retention dosage reduced by 28% from 360 gms/t to 260 gms/t.
- ✓ Fabric's run life improved almost 50% from 41 days with Double layer fabric to 60 days with STL.

Figure 4: First Pass Retention Improvement

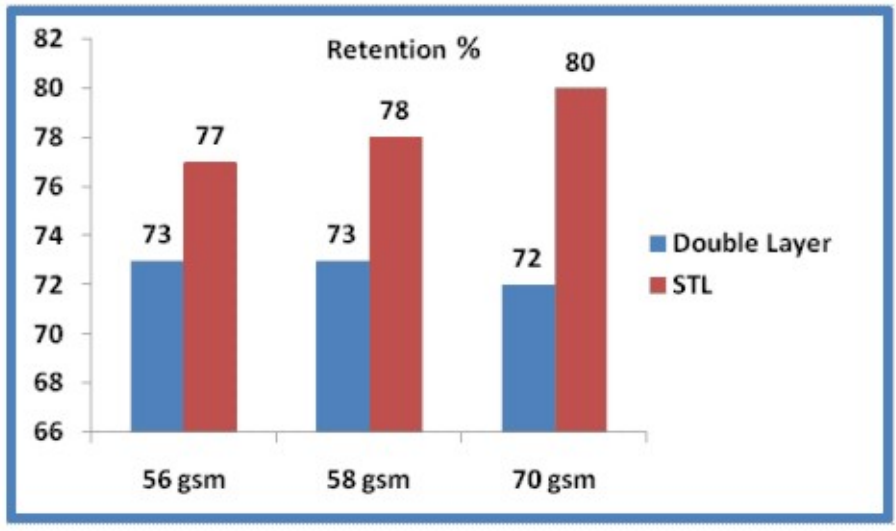


Figure 5 : Reduction of Retention Aid Dosage

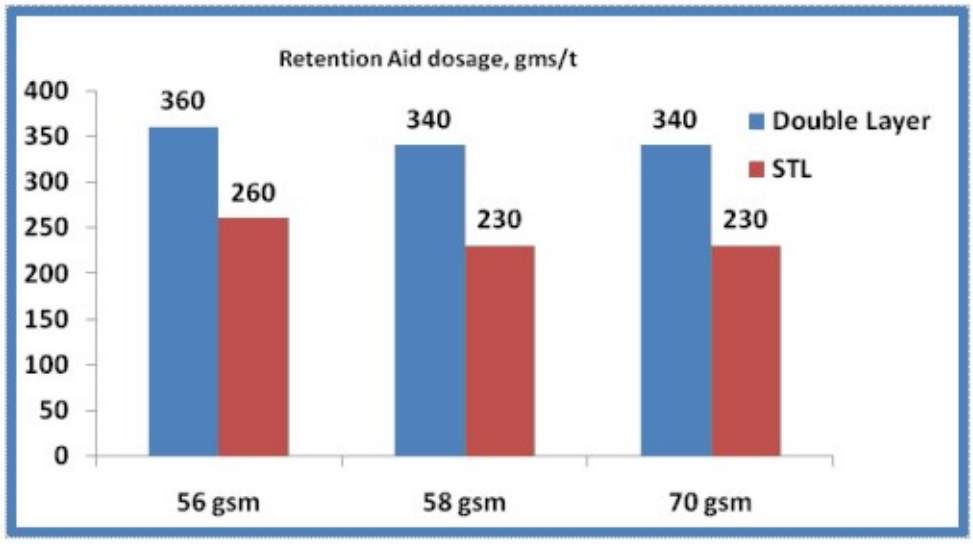
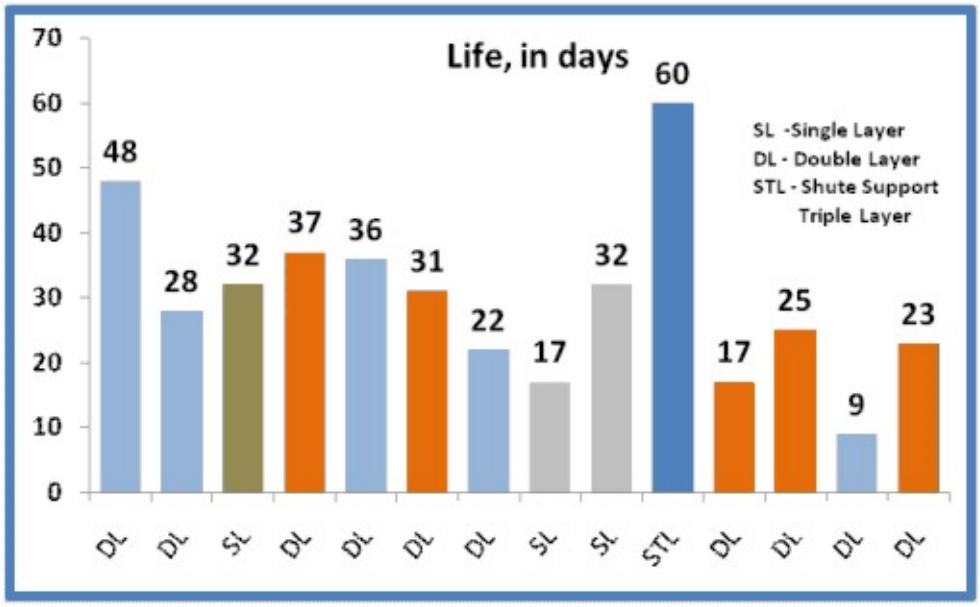


Figure 6: Life in running days



Apart from the above measurable gains, the other benefits of clean back water system, lesser two sidedness, better sheet surface properties, improved machine runnability were also observed by the mill.

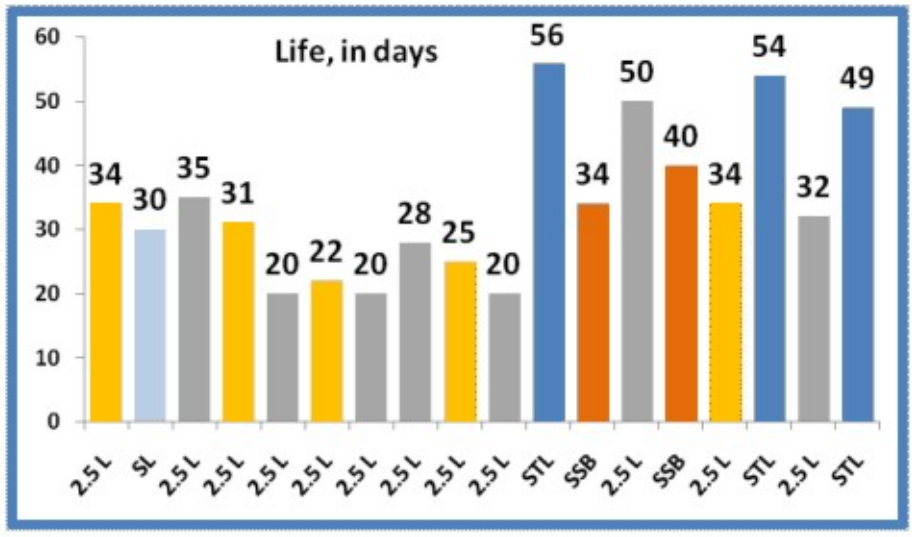
Case 2: Improved life of forming fabric and other paper properties.

A Paper machine of Fourdrinier with TDU producing Writing & Printing grade of 50 to 110 GSM with 90% agricultural residue and 10 % Wood pulp, 600 mpm speed was using 2.5 layer fabric. Modified New Generation STL was proposed with the objective is to increased life of forming fabric.

The benefits derived from this case are as under:

- Fabric's running life improved by 70% from average of 31 days with 2.5 layer fabric to 53 days with STL. The effort was well supported by increased machine lubrication on machine.
- Apart from life, machine runnability and paper properties improvement also achieved.

Figure 7: Fabric life in days on machine



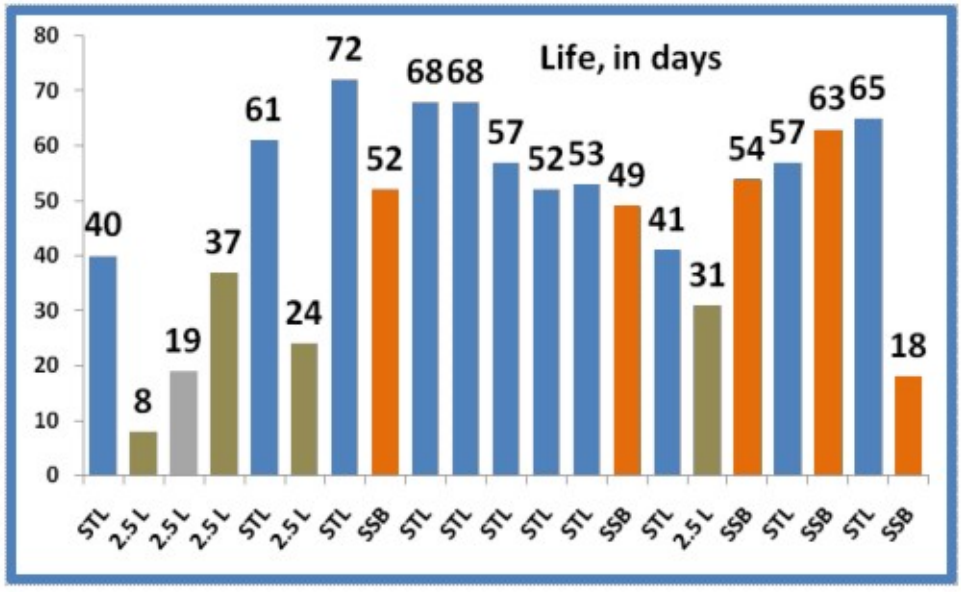
Case 3: Improved life of forming fabric and other paper properties.

A Fourdrinier machine producing Writing & Printing grade of 50 to 100 GSM with 70% agricultural residue and 30 % Wood pulp, 550 mpm speed, was using 2.5 layer fabric. The STL trial was made with the objective of increasing life of forming fabric.

Modified New Generation STL delivered following benefits:

- Fabric's running life improved by double the life from average of 28 days with 2.5 layer fabric to 57 days with the help of increasing machine lubrication and adjusting machine parameters like jet landing and vacuum level by the paper makers.
- This repeatability of benefits were rechecked with re- mounting of 2.5 layer, which proved the benefits of STL towards life potential.
- Apart from life, machine runnability and paper properties improvement also achieved.

Figure 8: Fabric life in running days



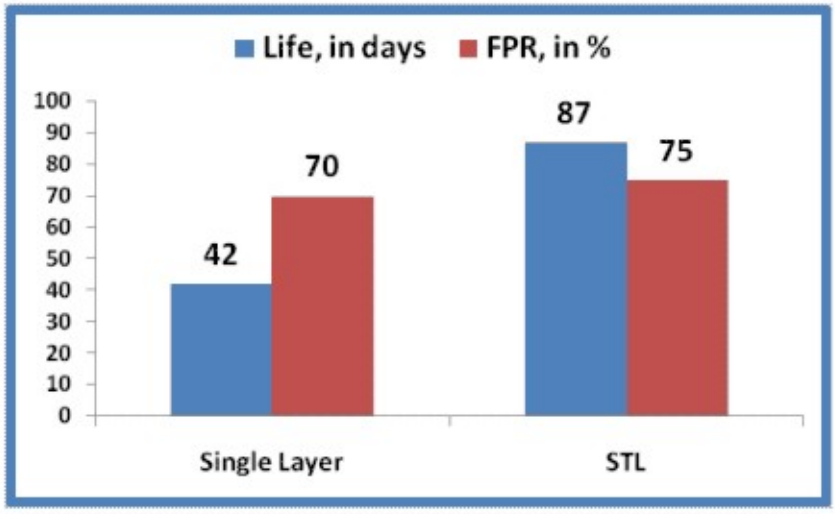
Case 4: Improved life of forming fabric and increased FPR.

A Fourdrinier paper machine producing Writing & Printing grade of 54 to 180 GSM with 75% agricultural residue and 25 % Recycled furnish 280 mpm speed was using Single layer fabric. Modified New Generation STL was applied here with the objective of improving forming fabric life and FPR.

The benefits experienced are as under:

- Fabric's running life improved by 20% from the benchmark of Single layer i.e., from benchmark of 50 days with Single layer fabric to 61 days with the help of increasing machine lubrication and adjusting machine parameters like jet landing and vacuum level by the paper makers.
- First pass retention increased by 5% from 70% to 75%. Thus retention aid chemical consumption reduced.
- In some grades, off-couch dryness got reduced, hence speed reduced by 10 mpm occasionally to maintain the dryness.
- Fabric fine tuned and target achieved.

Figure 9: Life and First Pass Retention improvement



Apart from the targeted objective, sheet formation improvement noticed and two-sidedness reduced considerably.

Conclusion

Though the advantages of STL / SSB forming fabrics have been experienced on wood based furnish over a long time, through continuous improvements in design from PMC standpoint and also with the process improvements on the machine, jointly providing best solution for efficient and economical production. This literature primarily covers the experience of machines in writing and printing grades producing paper. Similarly, we continue to develop and fine tune our STL solutions for the packaging segment as well.

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Literature reference

1. www.ipma.co.in 2. www.iarpma.org 3. Study on Socio-economic Impact of agro residue mills – by N H Consulting Pvt ltd for IARPMA. 4. Non-wood fiber for paper making - Michiel Adriaanse, Harry Morsink 5. INPAPER International – October-December 2015. 6. Technology and R&D documents of M/s Wires & Fabriks (S.A.) Limited.