# Save Energy, Save Money With Total Clothing Solutions

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## ABSTRACT

Paper making in India is becoming increasingly challenging due to scarcity of resources such as fibers, water and of course, power. *AstenJohnson* undertook a portion of this challenge and have developed paper machine clothing products engineered to produce a superior sheet of paper or board using less power.
This paper will illustrate how we can reduce drag load in the forming section using the Float Forming™ principle of our CentraFlow forming fabrics. It will show how the multi-axial construction of our press fabrics increases sheet dryness entering the dryer section where the dewatering process is the most energy intensive. Finally, this paper, will explain how we can improve heat transfer in the dryer section with our well known MonoTier product family.


**Introduction**
High energy costs are putting intense pressure on the profitability of Indian paper makers.

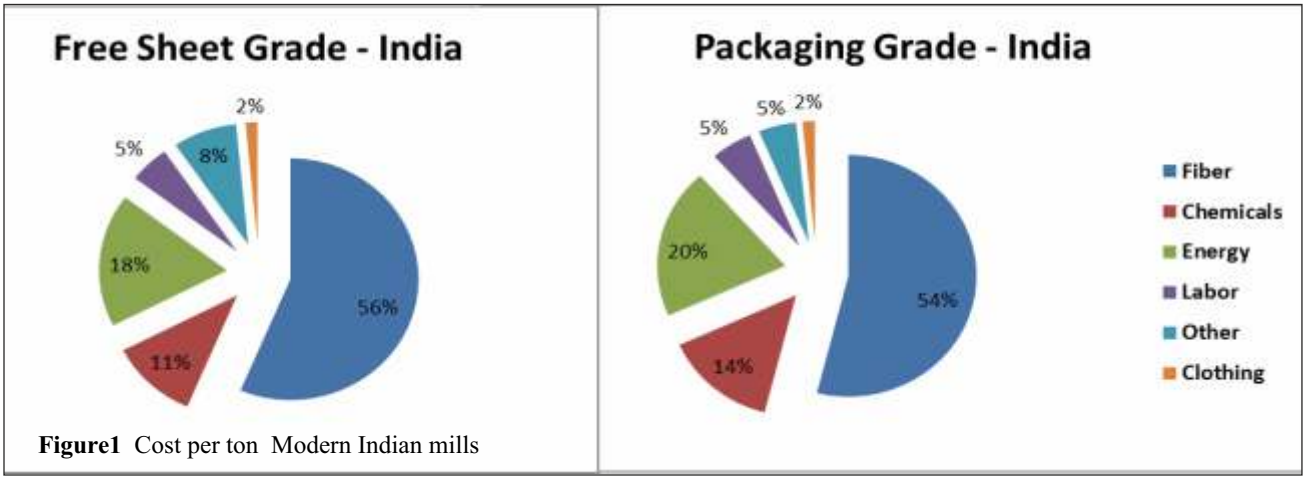



**Figure1** Cost per ton Modern Indian mills

Figure 1 shows the significance of energy costs for modern packaging and uncoated free sheet Indian paper mills. Eighteen to 20% of the manufacturing cost is spent on energy, whilst roughly 50% is spent on fibers and only 2% on paper machine clothing.

This energy is being consumed by various processes on the machines. More than half is being consumed in the dryer section [1]; therefore dryness entering the dryer section is a vital KPI *(Key Performance Indicator)* in managing energy cost on a paper machine. This paper will present new forming technology allowing paper makers to reduce drive load in the forming section, improve sheet formation yielding a more efficient pressing and increase off-couch dryness. We will discuss pressure uniformity of press fabrics and the beneficial impact on total press dewatering. We will also examine the contribution of contact heat transfer of dryer fabrics on the drying efficiency of the paper machine. Finally we will present best practices in machine operation yielding energy reductions.

| PROCESS | ENERGY CONSUMED |
|---|---|
| DRIVES | 24% |
| VACUUM | 21% |
| DRYING | 55% |

*ASTENJOHNSON (ASIA, SINGAPORE)*

## Forming Section

The lion's share of the energy consumed in the forming section is electrical. Nearly half of the electrical energy is used to drive the forming fabric. The other big energy consuming component is the vacuum used in the later part of the forming process.

AstenJohnson has developed 2 distinctive technologies to significantly reduce the energy required to form the sheet of paper. One resides in the distinctive weave construction of the CentraFlow family of forming fabrics which provides a gentler way of forming the sheet (trademarked Float Forming ™.) The other technology is the well-known yarn MonAlloy®.

The structure of different types of triple layer forming fabrics was investigated using X-Ray micro-tomography and 3D modeling. It was found [2] that traditional SSB fabrics and warp tied fabrics have a very open structure through the "Z" direction of the fabrics.

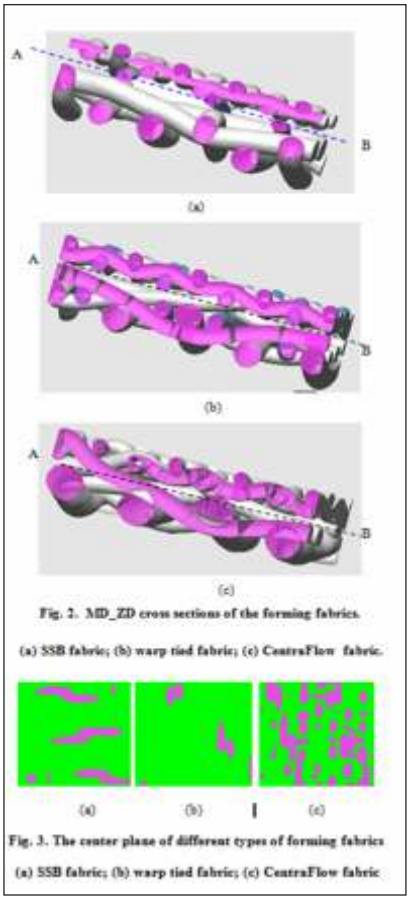



Fig. 2. MD_ZD cross sections of the forming fabrics.

(a) SSB fabric; (b) warp tied fabric; (c) CentraFlow fabric.




Fig. 3. The center plane of different types of forming fabrics

(a) SSB fabric; (b) warp tied fabric; (c) CentraFlow fabric

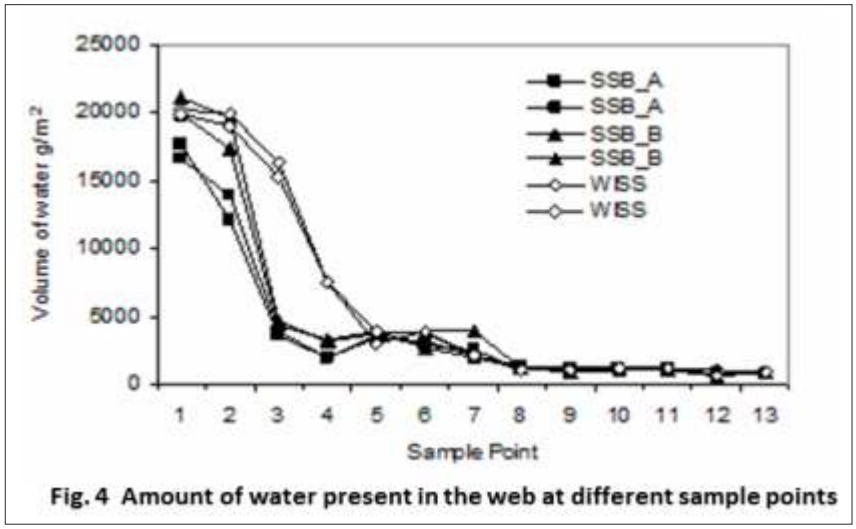



**Fig. 4 Amount of water present in the web at different sample points**

In the CentraFlow™ family of forming fabrics, all the tying MD yarns passes from the top layer to the bottom layer creating a distinctive center layer in the middle of the fabric. This layer creates a resistance to the very aggressive drainage early in the forming process which we refer to as Float Forming™ [3].

Figures 2 and 3 show the difference in the center plane of a SSB, a competitive warp tied fabric and our CentraFlow™ forming fabric. We can clearly see (Fig. 3, c) the path taken by all the machine direction yarns as they tie the top layer to the bottom layer of the fabric. This center layer creates a resistance to the high velocity fluid flow at the initial impingement thus reducing the tendency to plug the drainage holes with fibers, forming the sheet on top of the fabric instead of within the fabric (Float Forming™). *This is critical when dealing with furnish with short fibers (acacia, agro fibers, recycled furnish, etc…)*

We first tested this theory on laboratory drainage equipment followed by pilot machine validation. The pilot machine could replicate the very high peak drainage pressure of modern paper machines [4]. We compared our CentraFlow™ (coded WISS in Fig 4) with two commercial SSB fabrics having the same permeability.

We clearly see the fast initial drainage of the SSB fabric at the forming board (Fig. 4 - Point #1). At sample point #3, over 75% of the headbox water is drained. However, with the CentraFlow fabric, the initial water removal is more gentle and only 25% of the headbox water is drained at sample point #3.The drainage is shifted downstream on the forming table.

This gentle forming process creates a better *and dryer* sheet, *over the high vacuum elements, reducing drag significantly.*

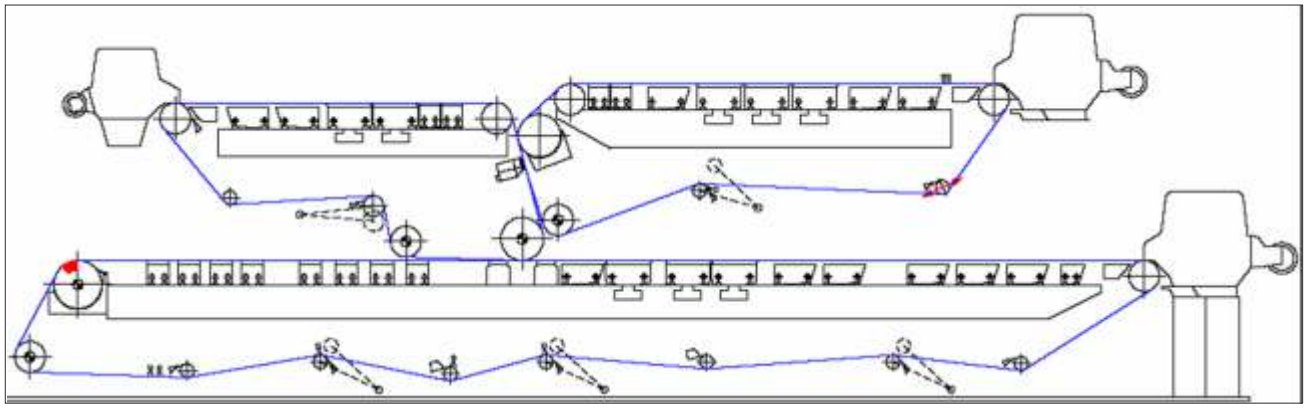
We have sold over 450 CentraFlow® fabrics worldwide since their development and documented several cases where Float Forming™ delivered:

- Reduced drive load
- Increased First Pass Retention
- Improved sheet release
- Improved sheet formation

We will illustrate 2 case studies below; one on a packaging grade machine the other on a free sheet machine.

The first case study documents the benefits obtained by placing two CentraFlow-HD® fabrics on each of the bottom and filler position of a 3-ply multi-wire Fourdrinier making 100% recycled paperboard at 800 mpm.

This customer was able to open the slice by 20% decreasing the headbox consistency thus improving sheet formation. A 15% drive load reduction is observed on the filler position and an



improvement of 16% of the 2 sigma BW profile was also observed. This translates into a $100,000 yearly saving in electricity alone!

The fabric design is not the only factor affecting drag load; the bottom yarn material is important as well. AstenJohnson developed a wear resistant yarn, branded MonAlloy® that prolong the fabric life by reducing friction on the static element of your paper machines. Figure 5 illustrates the wear resistance of different Nylons and MonAlloy versus polyester.

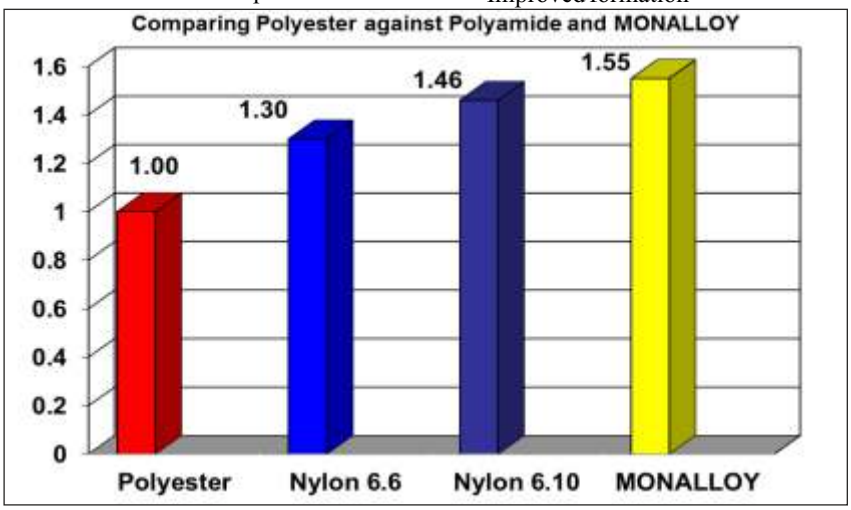



**Fig 5** Relative wear resistance of yarns

**Case Study #1 Forming**

M/C Data
Type : 2ply Fourdrinier
Paper Grade : packaging (180GSM)
M/C speed : < 800mpm

**Objectives**

- Improve fabric life!
- Increase Dewatering
- Lower Drag Load!
- Better formation(increase web strength)

**Results**

- Greater Energy Savings (131,000 USD/year)
- Improved formation
- Can increase M/C speed (Higher paper production)
- Increased retention reduced chemical cost (volume).
- Longer life

**Case Study #2 Forming**

***Application***

| | | |
|---|---|---|
| *Region* | : | *France* |
| *Machine* | : | *Fourdrinier* |
| *Position* | : | *Forming fabric* |
| *Grade* | : | *Speciality paper* |
| *Basis Wt.* | : | *40 - 180 g/m²* |
| *Speed* | : | *440 m/min* |
| *Pond width* | : | *340 cm* |
| *Furnish* | : | *Virgin fibers* |

**Product**
CentraFlow XL]

**Objectives**

- Improve retention
- Reduce drive power
- Live target 180 days

**Results**

- 300375 installed on 07/07/11, ran well for 49 days
- Removed due to an accident.

**Results**

- Good sheet formation in all grades
- Similar drainage to usual design
- Average drive load was 40 % lower with CentraFlow as standard supplier.
- That leads (from Customer's calculation) to a saving of 18.000 € on the annual power consumption.

**Case Study #3 Forming**

***Application***

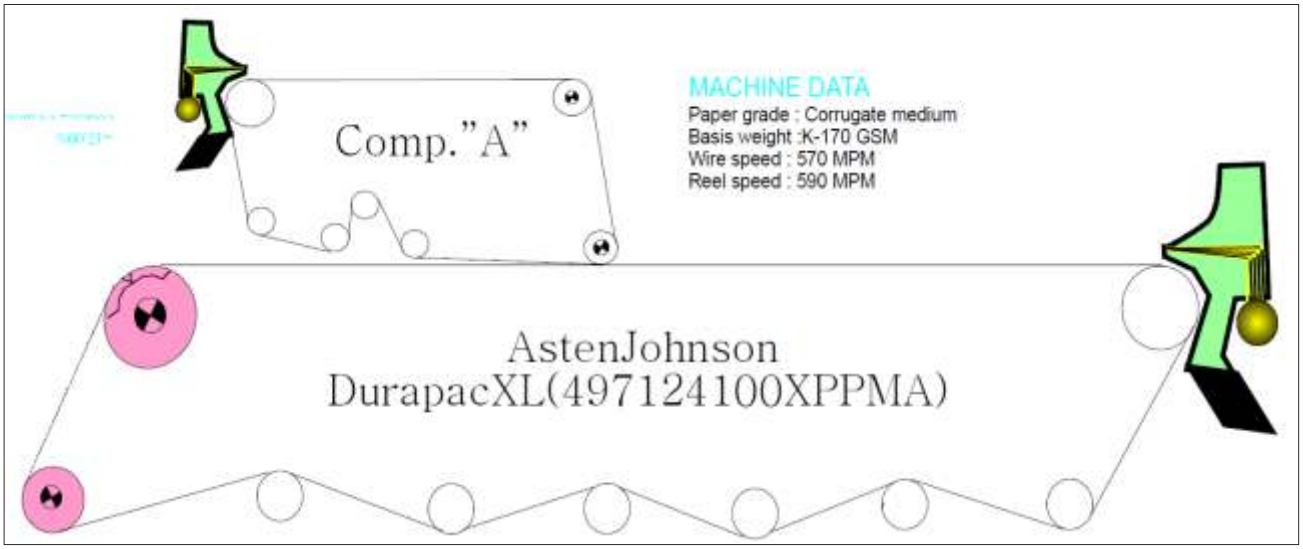
| | | |
|---|---|---|
| *Region* | : | *Asia* |
| *Machine* | : | *Multi-wire Fourdrinier w/ Bel Bond* |
| *Position* | : | *Top* |
| *Grade* | : | *Kraft Linerboard* |
| *Basis Wt.* | : | *120 gsm* |
| *Speed* | : | *965 mpm* |

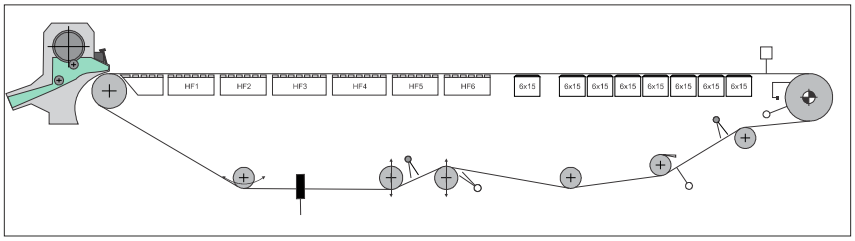
**Objectives**

- Increase fabric life
- Increase dewatering

**Results**

- Increased fabric life: 48% (from 37days to 55days) (saving 3 forming

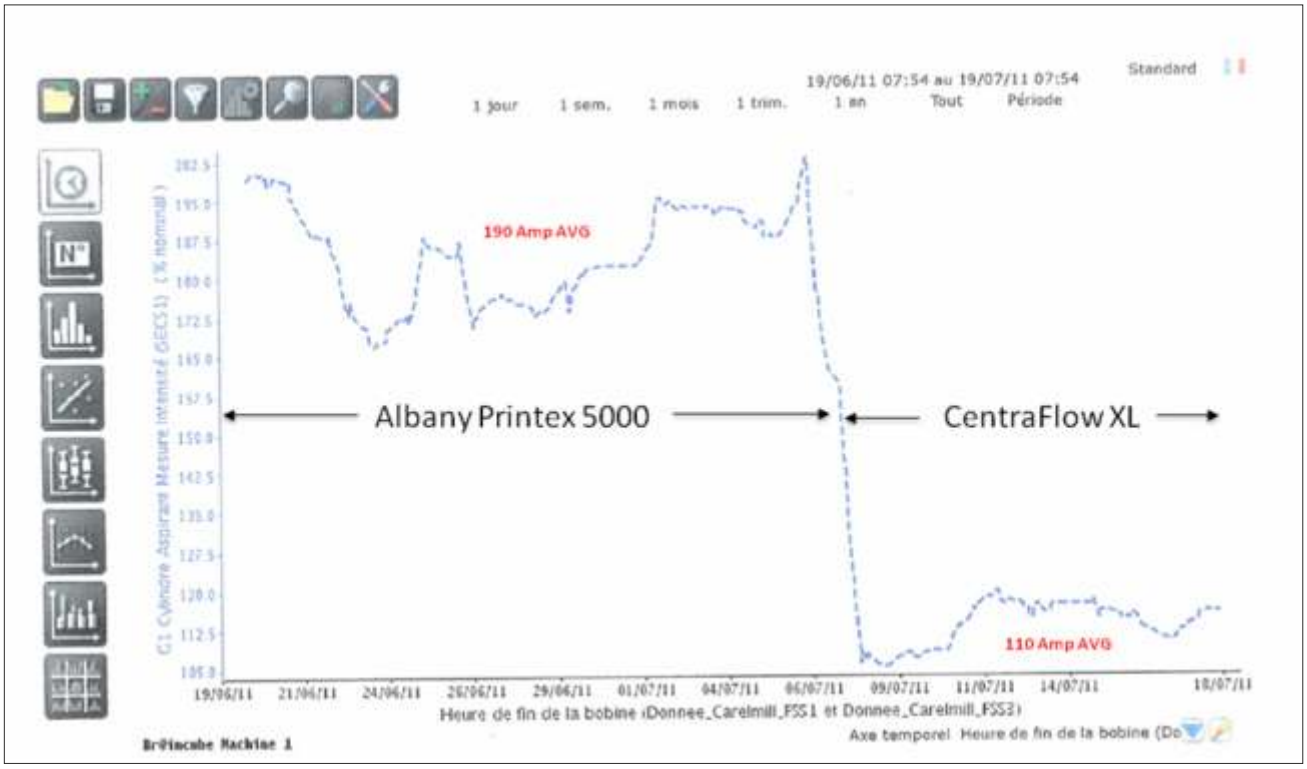


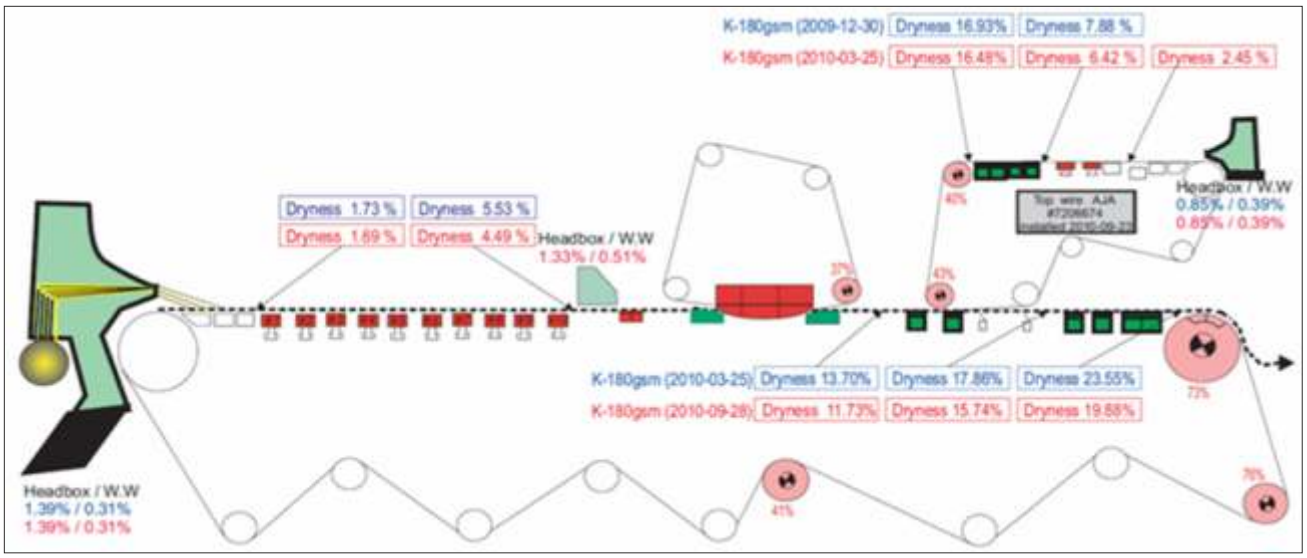


€.

**Press Section**

As previously stated, the dryness of the sheet after the press section is critical in minimizing the total energy used in the paper making process. We have seen many developments in the press section design (geometry, longer nips) that




fabrics per year)

- Dewatering: increased off-couch dryness with max. Operating speed

**Case Study #4 Forming**

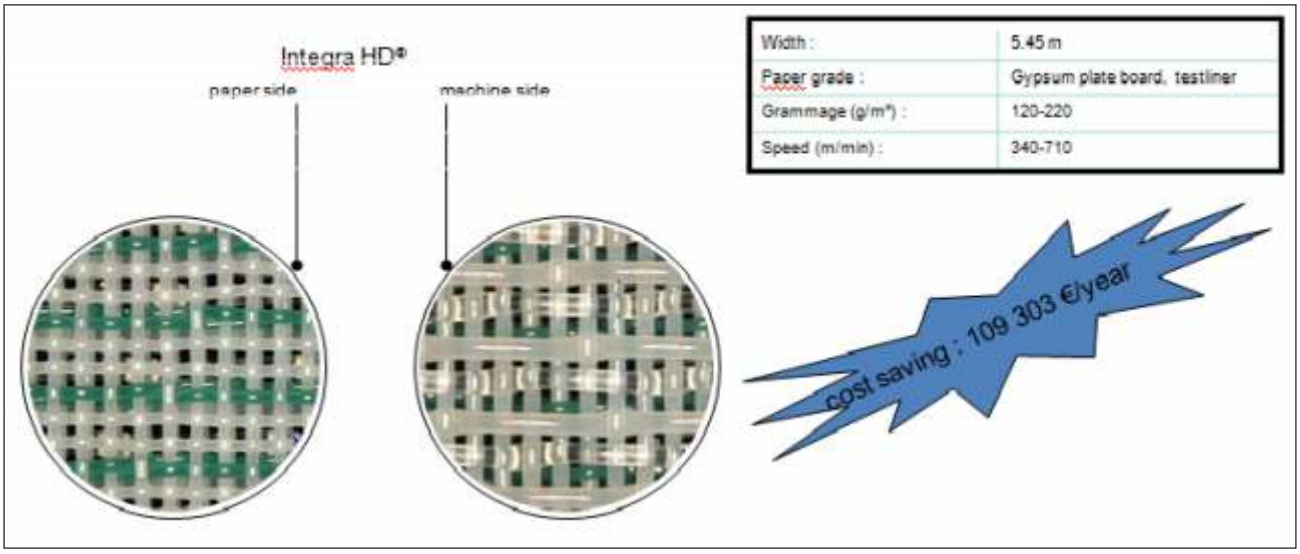
**Reduced Drive Load**

By using Monalloy on the wear side of the bottom wire, the energy consumption in the wire section could be reduced significantly.

The annual savings compared to a competitive SSB fabric with alternating PET/PA weft yarns amounts to 109 303

enable the papermaker to reach dryness in excess of 50%. However given a certain press section configuration we can maximize the after-press dryness with the proper press fabric design.

Pressure uniformity is a critical




parameter [5] in water removal in the press section. The sheet is always in close contact, and sometimes sandwiched, between press fabrics; therefore press fabric uniformity is equally critical to water removal [6]. AstenJohnson developed a NEW method to measure press fabric uniformity [7] taking into account the full structure of the felt (base and batt) and which avoids focusing only on the felt surface.

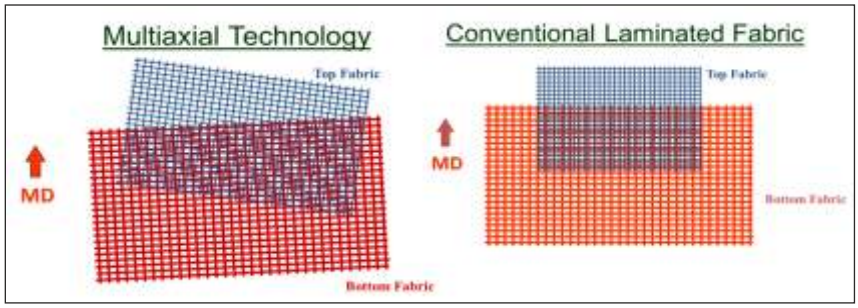



**Fig. 7** Comparison of Multiaxial to Conventional Fabrics

The challenge when developing a press fabric is to balance the fineness of the weave and the yarns with the openness needed to channel the water through the felts for the duration of its operational life. AstenJohnson's multi-axial base construction allows us to meet this challenge.

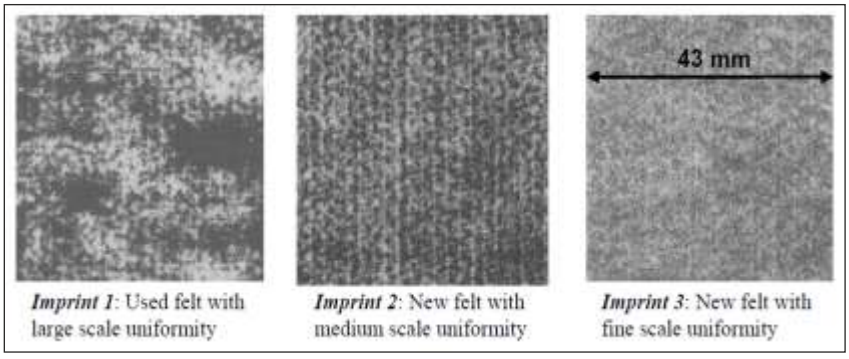



**Fig. 6** Typical images of pressure sensitive film on 3 felts

By angling the base layers we prevent them from collapsing within each other thus enabling us to use smaller yarns and a tighter weave without hampering water removal through the press fabric.

The batt layer anchored in this base is critical as well. Factors like life often runs opposite of optimum water removal. Smaller denier yarns will wear faster than larger denier yarn…like anything in papermaking, it is a compromise.

The batt preparation process (carding, cross-lapping) dictates the macro- and micro-uniformity of the batt layer. Many sensors are used to measure and control the batt making process.

The needling process is also extremely important and can destroy a perfectly laid batt. AstenJohnson uses elliptical needling machines to maximize batt anchorage and thus increase felt life while reducing needle tracking for low marking and improved water removal.

**Case Study #5 Press**

***Application***

| | | |
|---|---|---|
| Region | : | Asia |
| Machine | : | Tri Vent + 4P |
| Position | : | 3rd Press |
| Grade | : | Copy & Base Paper |
| Basis Wt. | : | 70 100 gsm |
| Speed | : | 1250 mpm |
| Trim | : | 7M |
| Furnish | : | Virgin fiber |

**Product**

Press AXiom XF 3

**Objectives**

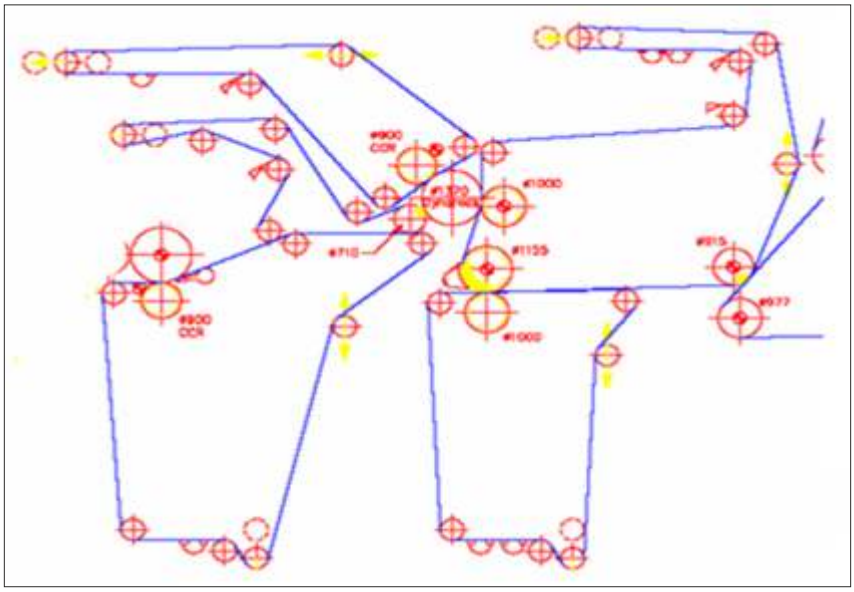
- Shift the dewatering from 4th Press more to 3rd press

**Results**

- Ran well on the machine for 40 days.
- Stable dewatering performance from uhle box to nip.

## Dryer Section

The bulk of the heat utilized in the dryer section is from the condensing steam in the dryer can. The contact heat transfer



between the sheet and the dryer cylinder is improved by increasing the pressure of the dryer fabric on the sheet. Some degree of convection heat transfer occurs when the surrounding air is hotter than the sheet [8].

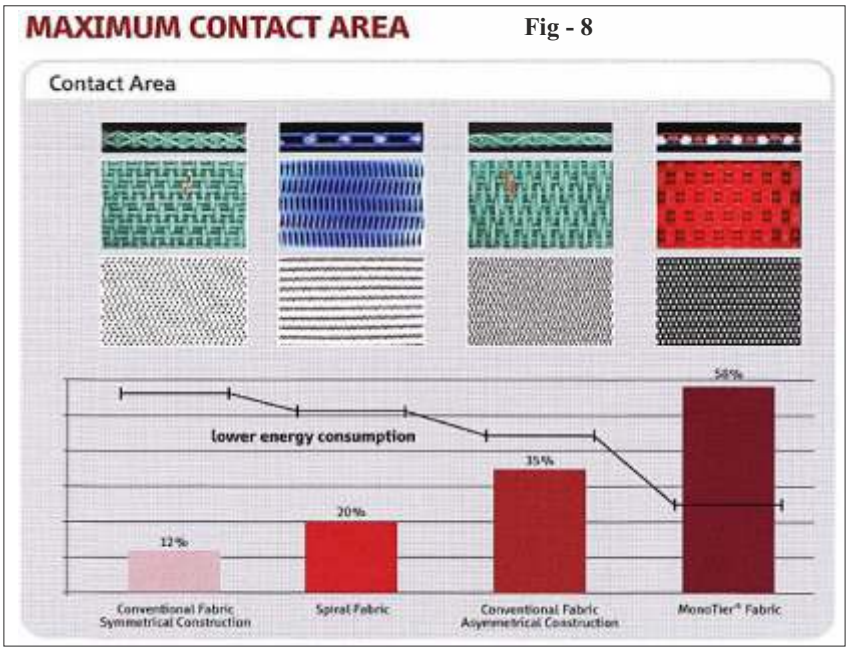



Fig - 8

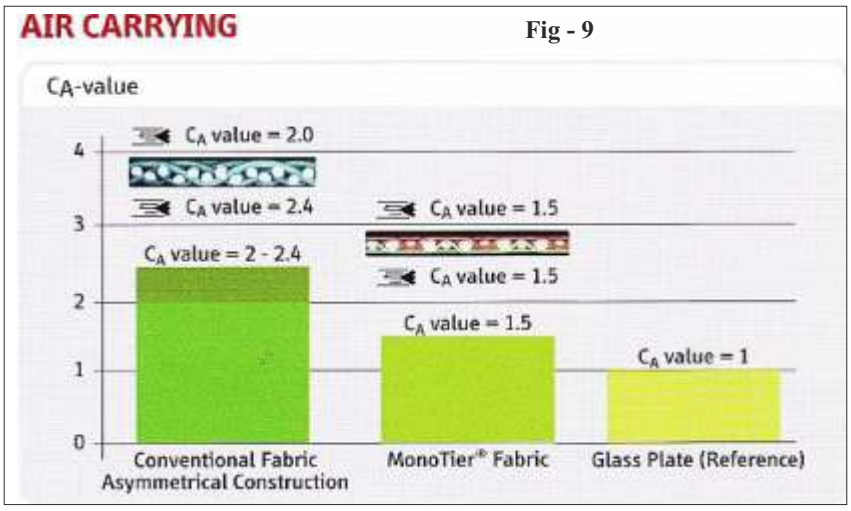



Fig - 9

Dryer fabric permeability plays a significant role in the convection heat transfer. One would want to install the most open dryer fabric possible that will not cause sheet handling problems. Increased air permeability of dryer fabrics increases heat transfer up to 400 cfm [9, 10, 11].

AstenJohnson MonoTier dryer fabrics are well known for their very high contact area. This increases the contact between the sheet and the dryer can improving heat transfer.

The very low air carrying coefficient of our MontoTier fabric allows us to use a higher air permeability fabric than would be possible with other woven designs without any sheet handling issues.

Of course, keeping the dryer fabric open through its life is key. Periodic measurement of the fabrics is essential to schedule either cleaning of replacement of the fabric. AstenJohnson has developed a new type of dryer fabric, branded MicroTec® and CleanTec™ which are woven using our patented grooved yarns which facilitate the cleaning of the dryer fabrics, *conserving their original permeability through their operating life.*

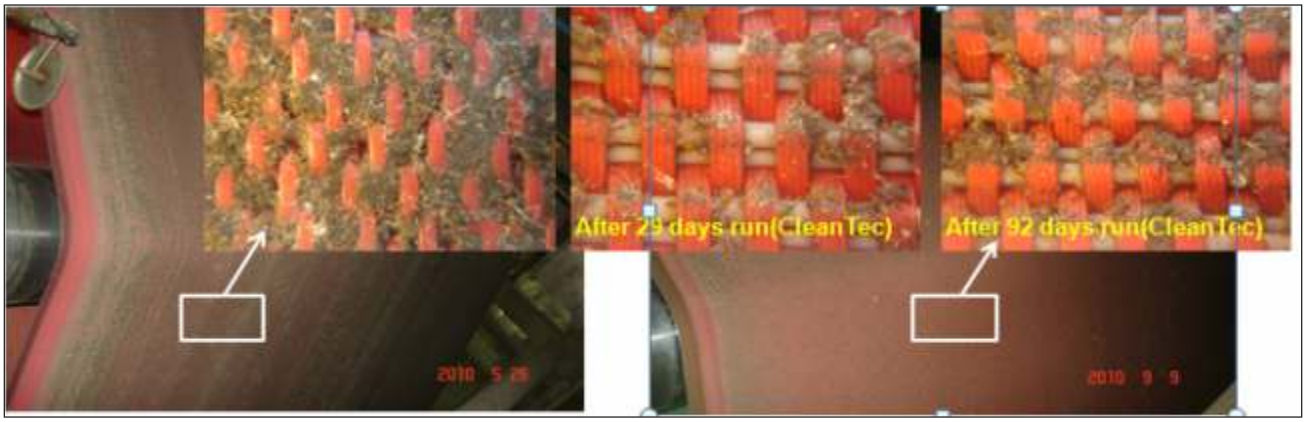
**Case Study #6 Dryers**
**Record Lifetime And Better Contamination Management**

Our MicroTec 400 fabric reached a record lifetime of 444 days in the 6th bottom. The longest lifetime of competition was 283 days.
The customer is very satisfied with the combination MicroTec/cleaning device. The cleanliness and the performance of the cleaning device is significantly better with MicroTec than with spiral fabrics. In combination with spiral fabrics, the cleaner caused humid stripes in the paper. Furthermore the MicroTec shows a better stability than the so far used spiral fabrics.

**Case Study #7 Dryers**
***Application***

Region : Asia
Position : 1G Dryer
Grade : Corrugated Medium
Basis Wt. : 120 ~ 180 g/m²
Speed : 800 m/min

- CleanTec ran well for 277days (Competitor 1G fabric was removed after 106 days due to severe


After 26 days run(Dongil, 150cfm) Removed and HP water gun cleaning: every month

After 92 days run (Clean Tec, 150cfm) Removed and HP water gun cleaning: every 3 month

contamination)
- CleanTec 's contamination rate was much slower and cleans easier than competitor.

**Operational Considerations**

Paper machine clothing manufacturers have developed fabrics which give significantly more operating life to the papermakers. However, it is important to note that clothing cost is insignificant when compared to energy cost. One can be "penny rich and dollar poor" by stretching the life of fabrics beyond their useful life!

Many operational best practices can be shared to help the paper maker reduce energy. We are listing a few here…

- Survey your high vacuum equipment for gradual scheduling.
- Check all rolls for defective bearings
- Check the lubrication water to your couch roll(s) strips
- Increase the forming fabric tension
- Optimize your forming fabric cleaning system
- Monitor regularly your after-press solids; plan felt changes accordingly
- Increase the dryer fabric tension [12]
- Contact your AstenJohnson representative for fabric recommendations!

**Conclusions**

Energy is a big part of papermaking cost. This cost can be substantially reduced by a proper selection of paper machine clothing. By far the key to reduce your energy bill is to maximize dryness after the press section. Extending press fabrics beyond their useful life can translate into increased energy cost in the dryer section.

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