# Advancement In Press Felt Technology - A Paper Maker's Need

## Mathur P. K., Garg V., Arora M.K.

**ABSTRACT**

In the current globalization scenario new and improved, paper making technologies are emerging in the paper market and are being adopted. The demand of all paper makers is proper running of Press felts, with optimum drainage, and with required sheet properties. We being a complete Paper Machine clothing manufacturing company had understood the need and the requirement of paper makers, and have tried to translate them in our wet felt designs. Here we shall discuss, Press felt concept and design, new design developments with advantages, felt conditioning, and usefulness of felt diagnosis, for all Paper makers.

### Introduction

The paper machine clothing, and paper making industries have always been dependent upon one another. The earlier Paper making felt was made of wool , which was woven and then felted. The qualities of felts have always been important to the paper makers. The felt should be dimensionally stable, but supple and be able to quickly absorb moisture and should uniformally drain the water. The earlier woollen felts have been gradually replaced with 100% synthetic felts, because they are dimensionally stable, and this characteristic has made the synthetic felts desirable, particularly as faster and wider paper machines being developed. The paper machine has evolved into the modern and sophisticated technology like high speed, wider width, and totally automated machines. To keep abreast the latest devlopment the felt maker has spanned the entire range from conventional felt to Batt-on-Base(BOB) to Batt-on-Mesh (BOM) in single, multilayer and laminated qualities. The latest qualities of Spectra & Vector have opened a new chapter in the history of felt making.

### Press Felt Design Concept

The Paper Maker's requirements and general market demands are as under.

- To retain good dewatering properties, throughout its life
- Good sheet control and sheet release properties
- Suction press, in place of plain press
- BDR roll , in place of plain rolls
- Bi-nip, Tri-nip & Shoe presses
- Minimum re-wetting, with extended felt life.
- Quick start-up or pickup with better sheet properties
- Easier to clean fabrics
- Higher speed & higher press loads, with low energy consumptions
- High dryness inlet in dryers
- Good filler / fines distribution
- Reduction in sheet grammages
- Decreasing fiber length due to recycled pulp
- Improvements in fabric life

On the basis of the above, the market demand and Paper makers requirements, felt designers have modified their approach towards felt designing to incorporate the latest technology in following ways.

- Cable filament in m/c direction & Mono filament in cross direction.
- Double layer and Laminated designs in use.
- Wear resistant for improved life.
- Smooth and fine pressing surface.
- Excellent compaction resistance.
- Good and even sheet pick-up, with drop- off prevention.
- Prevention of shadow mark, wad burn and groove marks.
- Good dewatering by providing large void volume in base.
- No sheet stealing.

### Conventional Woolen Felts And Limitations

The conventional press felts were made using blend of wool and sythentic yarn. The warp yarns are required to stand the machine direction strength whereas the weft yarns being in cross-machine direction are softer and bulkier to give a good coverage and no marking. Proper weave pattern was chosen depending upon the end use. These felts compacted in short span of time thereby closing the drainage channels and restricting removal of water, resulting in sheet crushing and very low life.

### Batt-On-Base(BOB) Felts And Limitations

Batts on Base felts are an improvement over the conventional woolen felts. The BOB felt base fabric is made of yarn composed of wool and synthetic blends. These bases are very open in structure. The batt of fibers laid on the base cloth and neeedled. These felts had improved life then conventional felts and were successfully used in wider and medium speed machine. However with increasing machine speed and press loads 100% sythentic felts were developed.

### Single Layer Batt-On-Mesh (BOM) Felts

It is an all monofilament plain weave mesh base, commonly known as single layer base. It comparises plied monofilament in warp and monfilament in weft. It has been particularly successful in providing a stable, easy and clean base. Selecting proper fiber for “Batt” and employing different needling technique felts could be made for various end users. The "plied monofilament" comprises of several strands of lower diameter monofilaments twisted together to form a round yet a hard but flexible cable. The bases made from "plied monofilament" in the warp and monofilament in the weft (**Fig.1 & 2,** )

*Voith Paper Fabrics India Limited,*
*113-114A Sector- 24,*
*Faridabad- 121005 (Haryanan)*

**Alpha A1- Single layer Batt-on -mesh**

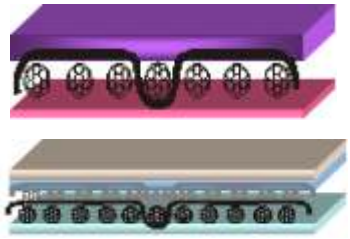


**Fig 1 & 2**

were strong, non-compressible (thus keeping openness till end of felt life) and yet flexible.

Felt made on these bases made a beginning of modern felts and brought about the high to very high nip pressure application at press and also the development of various presses to employ high nip loading.

## Double Layer Monofilament Base

It is a semi-duplex weave base. More commonly known as " Double Layer Base " **(Fig-3 & 4, )**. Its warp comprises plied-monofilament one over the other interlaced by single monofilament weft. This type of base gives greater void volume and load resistance. Selecting with proper "batt" and needling technique it could be used for a wide range of applications.

**Delta D2- Double layer Batt-on -Mesh felts**

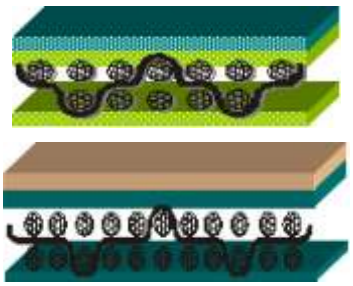


**Fig 3 & 4**

## Double Layer Monofilament Special Base

It is similar to a double layer or a semi-duplex base except that the underside warps are multifilament **( Fig-5 & 6, )**. This special structure ensures protection against abrasion. Batt is carefully chosen and needled over it depending on end-use.

## Application For Single And Double Layer

**Delta Plus D2P- Double layer Batt-on-Mesh**

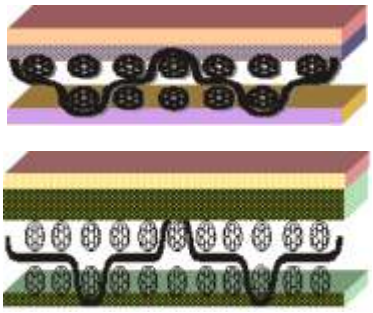


**Fig 5 & 6**

- High speed newsprint, fine paper and Kraft pick-up position.
- Bottom felt on multicylinder or former type board machine.
- Low load plain, suction, fabric, blind drilled or rubber grooved presses.
- Lick-up on single or two-felt Tissue machines.
- Bottom felt on two-felt tissue machine.
- Heavy duty plain presses on fine papers.

## Advantages

- Very stable base fabric
- Low flow resistance
- Good resistance to filling
- Minimal base mark
- Low water carrying capacity

## Laminated Base With Single Layer Components

This base comprises of two components **( Fig-7 & 8, )**. First component is a top layer base of single layer weave (it can be made of any weave pattern) and bottom layer is second component of the single layer. These two components are put one over the other and needled by selecting proper "batt" over it. In this combination base, the weft could be monofilament or plied monofilament.

**Omega 2 O2**

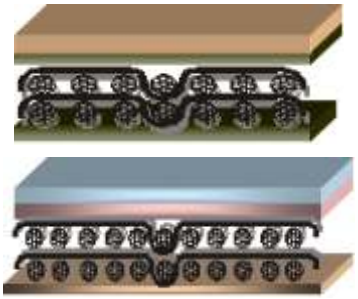


**Fig 7 & 8**

## Laminated Base With Single Layer And Double Layer Components

This base comprises two components **( Fig-9 & 10, ).** First component is a top layer base of single layer weave (it can be made of any weave pattern) and bottom layer is second component of the double layer. These two components are put one over the other and needled by selecting proper "batt" over it. In this combination base, the weft could be monofilament or plied monofilament.

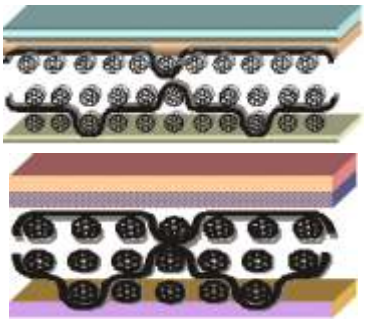


**Fig 09 & 10**

## Laminated Monofilament Base With Different Weave

This base also comprises of two components **(Fig-11,)**. First component is similar to "Combination Base" but the bottom layer is the second component of "Triplex base". They are placed one over the other under tension and needled by selecting proper "batt" over it. In this base the weft could be monofilament or plied monofilament.

**Omega 2 Plus O2P**

**Fig 11**

## Application For Laminated Bases:

Extended nip press on linerboard machines, suction pick-up on newsprint and fine paper machines. Suction or drilled presses on fine paper and Kraft machines with low load uses Laminated base with single layer component while in case of high specific load laminated base with double layer component are used.

## Advantages For Laminated Base Felts

**Resistance to shadow mark**: High base thickness and resistance to compaction prevent shadow mark and extend the useful life of the felt.

**Hydraulic pressure**: Large and void volume in the structure reduces hydraulic pressure, maintaining more uniform flow.

**Resistance to base mark**: The double base construction enables a fine topside base to be used, thereby reducing the risk of mark.

**Resistance to filling**: Treatment may be applied to give additional resistance to contamination by waste finishes.

**Smooth felt surface**: Carefully selected batt fibers and needling techniques provide a smooth surface for uniform sheet pick up.

## Futher Development Of Modern Felts

Presses like "Bi-Nip", "Tri-Nip", "High-Nip", "Extended-Nip" etc. have been developed where very high nip load is employed demanding higher strength, higher porosity under compression, compaction-resistance and extended life from the felt. Compaction is one of the major factors in these high speed wider machines, therefore, the designers are all the time in pursuit of developing a most suitable type of base which can meet the requirements. The latest Spectra & Vector inventions open a new chapter in the history of felt making as per **Fig.12 & 13**.

**Spectra & Vector**

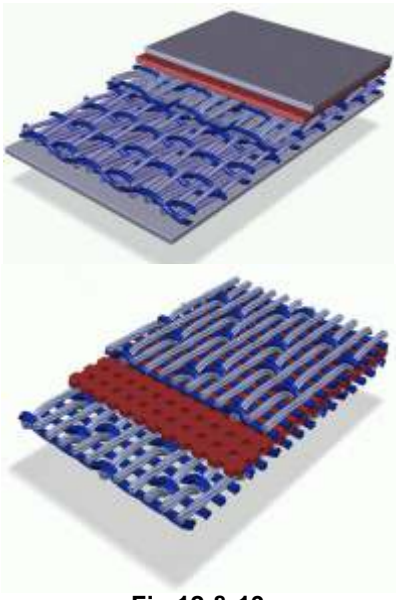


**Fig 12 & 13**

## MERITS OF MODERN FELTS OVER CONVENTIONAL FELTS

| | Conventonal Felts | Batt on Base Felts | Modern Felts |
|---|---|---|---|
| 1. Compaction | Fast | Gradually | Negligible |
| 2. Stability (Dim.) | Nil | Good | Excellent |
| 3. Felt Chocking | Complete | Gradual | Very slow |
| 4. Void Vol. Loss | Complete | Slow | Late stage |
| 5. Dewatering | Poor | Good | Excellent |

## Felt Related Problems

Following felt releated problems are commonly faced by Paper makers.

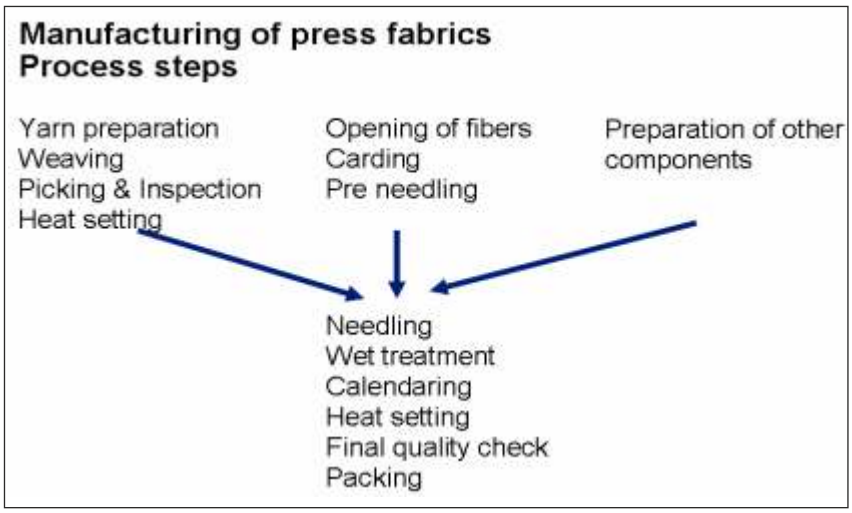
1. Compaction
2. Choking
3. Water carrying
4. Re-Wetting
5. Vibration
6. Guiding
7. Elongation
8. Crushing
9. Shadow Marking
10. Fiber Shedding
11. Batt Peeling Off
12. Wad Burning
13. Bleeding
14. Shrinkage
15. Vacuum not building up
16. Sheet Stealing
17. Creasing
18. Dimensional Stability
19. Low life
20. Blowing
21. Base mark

## Press Felt Conditioning

Press felts have the potential to play a crucial role in increasing overall press performance and in reducing energy / steam consumption, so the aim of the Paper Makers is to keep the production cost low, with higher m/c efficiency, and this can be achieved if optimum m/c conditions prevail throughout the life of the felt. The efficiency of press section and runnability of the m/c can be improved with "well conditioned felt". Modern press clothing has the potential to increase overall performance, but this potential can not be achieved unless an effective cleaning & conditioning system becomes an integral part of the press configuration.

The introduction of high synthetic content needled felts into the paper industry has greatly contributed towards improvement in resistance to get damaged & abrasion. The effect of this has been that only few felts are removed due to complete wear out. The majority of felts are taken off because they have become filled up with contamination material of the Paper

## PRESS FELT MANUFACTURING PROCESS



sheet or the compaction by mechanical Press load. There are mainly three cleaning forces used i.e. water, vacuum and physical contact with an aim to remove material from felt to maintain the resilience and caliper of the felt. Felt cleaning is essential due to increasing use of secondary fiber, and to maintain high bulk and openness. The most effective physical cleaning available is to have full width oscillating high pressure showers, followed by lubricating showers, and one or more suction boxes depending upon the application.

Practical experience shows that it is preferable to select a higher diameter nozzle directed inside the felt, and smaller nozzle diameter where shower is outside of felt i.e. on paper side to avoid the excessive wear of the batt.

A high pressure jet is stable for certain distance after leaving the nozzle but then gradually begins to disintegrate as shown in the **Fig. no.14 & 15**. This length of stability depends on the size of the nozzles and the fluid flow design principles and water pressure. Nozzles with a diameter of 1.0 mm should be

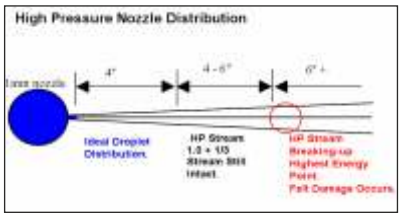



**Fig no. 14**

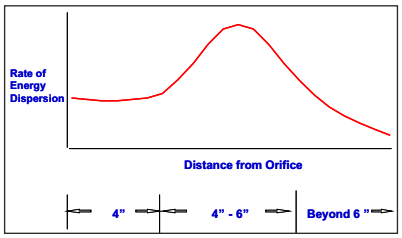



**Fig no. 15**

placed at distance of 100-150 mm (4"-6") from felt as jet begins to disintegrate after this point. The position of high pressure shower depends on the quality of felt being used along with speed of the machine. The loading agents, the fibers and dirt particles have a tendency to adhere more firmly to the batt layer of the felt, so the effect of the high pressure shower can be improved if it is directed towards the paper side. The risk involved in directing the jet towards the paper side is more in pick-up felts, and mark sensitive paper. A beneficial effect with regards to both cleaning &

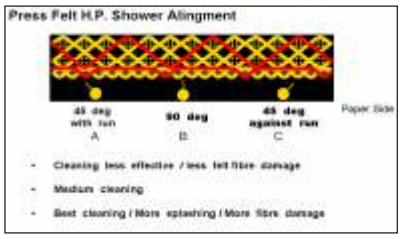



**Fig no. 16**

retaining the bulk of the felt can be obtained by setting the jet at an angle to the direction of the movement of the felt and angle should be 45 degree as per **figure no.16**. It is best to set the pressure range for high pressure showers from 7-28 kg/cm2 with out risk, of damaging the felt and the water pressure on the out side of the felt should be lower side, to avoid the damages to the felt. The showering time depends upon water pressure, type of felt, and speed of machine therefore paper makers efforts should be effective combination of pressure, and time without taking risk **(Fig no.17, ).**

L.P. showers (fan jet type) with 2-4 kg/cm2 should be put on face side of the felt, prior to vacuum box preferably directed between felt and roll to reduce friction on the top of the box and to form a vacuum seal. Low pressure further helps to release fillers as it

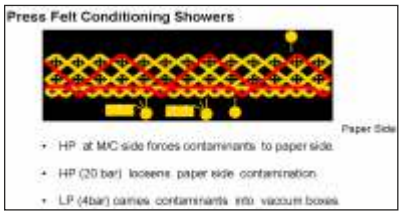



**Fig no. 17**

increases flow within the felt being a continuous and stationary operation. Low pressure shower should not be placed either too near or too far to Uhle box because in both cases the box lubrication will be low with reduced vacuum efficiency as shown in **Fig. no. 18**. The correct position of LP showers should be 1-2" in front of Uhle box as shown in **Fig. no. 19.** to improve vacuum efficiency and to reduce felt and box wear.

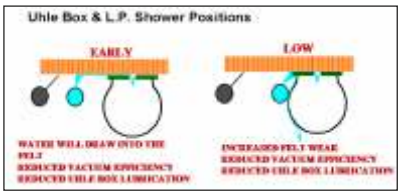



**Fig no. 18**

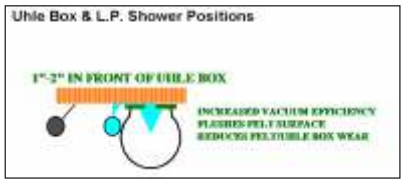



**Fig no. 19**

vacuum box. The slots used are usually of 10-12.5 mm wide, as any thing narrower will prove to become blocked. Test has shown that a greater dewatering of the felt is achieved with two narrow slots as compared with one slot of equivalent width; this is due to the doctoring action of the extra slot edge. For effective felt dewatering an air flow 10-12 m/sec is ideal. It has been observed that for maintaining an air flow of 3-4 m/sec throughout the felt life to ensure trouble free run of the felt. Felt makers have recommended different air flows for different type of felts which are as under.

Vacuum requirement for felt conditioning can be calculated as per the formula given.

Vacuum requirement = Slot width (cm) x No. of slots x Slot length (cm) x Air flow ($m^3/hr/cm^2$) $= 1.2 \times 2 \times 470 \times 5 = 5640\ m^3/hr = 94\ m3/min$.

Chemical cleaning of felts and its advantages are as under.

- Improved sheet quality due to more uniform pressing
- Increased production due to reduced breaks
- Increased production due to elimination of sheet spots / cracked edges and crushing.
- Increased profits through reduction in steam consumption.

| Type of felt | Air flow proposed |
|---|---|
| Single layer Felt | 4.5 $m^3$ / hr / $cm^2$ |
| Multi layer Felt | 5.0 $m^3$ / hr / $cm^2$ |

Vacuum boxes with square edged slots are most frequently used and preferred because square edge at the trailing side doctors water from the inside of the felt and this action is important where large amounts of water are removed at

## The importance of wet felt diagnosis and its advantages

In order to monitor felt and press performance, it is recommended the moisture in the felt at various points to be checked at regular intervals. Modern


**Fig no. 20**

equipment like Scanpro Press Tuner and Air - Flow measuring instruments as shown in **Fig. no 20**, greatly help the paper maker in monitoring the felt performance and in working out cleaning and washing schedule of the felts. The air flow through the felts is measured through with the help of air flow meters. This instrument provides the idle solution to the problem of measuring the air flow in to the suction boxes. The air flow reading should be compared with recommended air velocity and also with vacuum gauge reading.

- If air flow is high and gauge reading is low then it shows that felt is open.
- If air flow and gauge reading are low, it indicates that vacuum capacity is low.
- If air is low and gauge is high then it indicates that felt is plugged.

The following conditioning checks are normally carried out on a press by Technical Services team as per **Fig. no 21.**

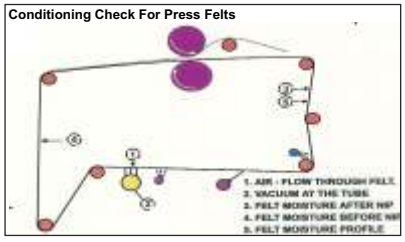



**Fig no. 21**

- Air flow through the felt.
- Vacuum at the tube.
- Felt moisture before the nip.
- Felt moisture after the nip.
- CD moisture profile of the felt.

Felt moisture profile taken after the nip across the full width of the felt help in diagnosing press and felt related problem, which are normally difficult to detect and are identified by scanpro moisture profiler. Paper makers can diagnose the problem of wet felts in following order.

- Felt wear out
- Crushing at press nips
- Press vibration
- Plugged felt conditioning shower
- Uneven felt filling
- Uneven moisture profile
- Blocked suction holes for press rolls
- Poor sheet dewatering
- Misaligned press roll
- Uneven roll cambering
- Uneven loading at edges
- Conditioning System
- Oscillating shower performance
- Uneven moisture profile of the parent roll
- Uneven and damaged press roll cover

## Case Study

A uniform felt moisture profile before and after Uhle Box is shown as a case study in **Fig. no. 22, Annex. 5**, where CD moisture profile before uhle box is straight and is carrying 604 gsm water,

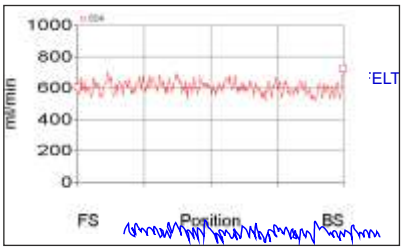



**Fig no. 22**

while CD moisture profile after uhle box is also straight and is carrying 400 gsm of water thus a dewatering of 204 gsm which is ok for 1300 gsm felt.

## Conclusion

The future of Indian Paper Industry is bright as industry is utilizing the renewable raw material as recycle fibers, apart from this there is a rise in literacy rate and consumption , along with rise in running cost, so paper maker should focus more on optimizing the wet felt technology and advancements to increase the profitability. Depending on this specific advance application, Paper Makers can achieve a uniform moisture profile with additional dryness which will result in low steam consumption in dryer section with better machine runnability.

## Acknowledgement

The authors would like to thank the Board of Management at Voith Paper Fabrics India Ltd, Faridabad for their willingness to prepare this paper and to participate in IPPTA workshop.

## References

1. Hand Book - Paper Testing & Process Optimization Catalog - 1995
2. L&W Scanpro Press Tuner Operation instruction
3. Consideration for cleaning felts with high pressure shower, TAPPI 1973, No. 7
4. Paper Trade Journals, April 1977
5. Product Information - Voith Fabrics, Blackburn (UK)
6. Voith group of companies and its internal literature