Wet Felt Development

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During the last decade the development and improvement of Paper making machinery has been tremendous, and this has been particularly so of the press parts. At the same time felts, and all types of clothing for paper machines have been keeping pace with developments, as for instance the introduction of newer techniques of manufacturing and design and the use of all the new modern man made fibres as replacements, or supplementary to, the natural fibres which had hitherto been used.

The design and making of felt was always carried out by Textile manufacturers, but nowadays felt making has become so highly skilled and technical, and of such a complex nature that it is also necessary for the technologist to have a wide experience of paper making. So that, with a regular flow of correct information and constructive criticism from the paper makers he is able to design the best felts for a given set of conditions for any paper machine.

Most readers will be aware that the functions of the wet felt are as follows :

1. a) The felts primary function is to carry the weak web of paper through the presses.

   b) The felt must have good dimensional stability in both machine and cross machine directions so that it runs within the limits of machine width and deckle of paper, and that the amount of available stretch is sufficient, even on older machines, which is often inadequate.

   c) The felt must be sufficiently permeable as to allow the passage of water expressed from the web.

   d) The felt must act as a cushion for the web of paper as it passes through the nip of the presses and must be sufficiently resilient as to be able to recover its thickness immediately afterwards.

   e) The felt must befree from imperfections which may be transmitted to the sheet of paper. Nor must the construction of the felt cause any defect or mark on the sheet.

   f) The felt must be strong and tough enough to withstand the mechanical wear caused by the paper machine.

Wool has always been the most suitable of all the natural fibres to meet these requirements. It has been possible however, with the advent of man made synthetic fibres to improve upon some of the requirements.

2. At present there are five types of wet felt being manufactured.

   i) Conventional
   ii) Batt-on-Base.
   iii) Batt-on-Mesh.
   iv) Weftless
   v) Baseless.

After No. (i) Conventional, the others nowadays are termed 'sophisticated' types, and more so as one progresses down the list.

There are three factors which govern the suitable design of a felt.

   i) Strength.
   ii) Openness.
   iii) Finish

With conventional felts it is difficult to improve one of these factors without reducing the effectiveness of at least one of the other two. But by the introduction of synthetic fibres the felt designer has much more scope, especially when he couples with the use of synthetic fibre the manufacturing technique of needling. He can by these means improve upon all the requirements listed from (a) to (f).

As already stated, wool was, before man made synthetic fibres were discovered, the most useful natural fibre available for the making of felts.

The felts were made in the conventional manner of weaving the thread lengthways and crossways and afterwards shrinking the felt by the milling process in order to give stability to the cloth.

Synthetic fibres were later introduced into the wool blends, varying between 10% and 35% and so a stronger conventional felt was produced.

The Batt-on-Base was a further development of the conventional

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felt, and consists of a woven structure known as a base cloth, made from wool and synthetic yarns, onto which a web of wool and synthetic fibres called a Batt is attached by means of a process known as needling or fibre locking. The attachment of batt to base cloth is achieved by numerous triangular needles the sides of which have tiny barbs. As the needle descends into the batt, fibres are hooked by the barbs and pushed into the base cloth where they become attached to the yarns.

The use of synthetic fibres and needling enables the felt maker to produce a much more open base cloth of greater strength than a conventional felt. By reducing the number of machine and cross machine threads that are used in conventional felts by some 30% a more open felt is produced, and, as the weight of the felt is thus reduced it is replaced by batt which is needled to the surface of the base.

The ratio of base cloth to batt varies with the position on the machine on which the felt has to run, but is usually about 70% base to 30% batt and 40% base to 60% batt. Thus one can have a coarse suction press felt where mark is of no importance or a fine base cloth with batt on both sides when the best possible sheet finish is needed.

Originally only 35% synthetic fibre was used as an addition to the blends of wool, but as needling techniques improved more synthetic has been added, until today using very sophisticated needling methods and highly technical equipment 100% synthetic felts are being produced.

Economics, however mnst play a large part in deciding the quantity of synthetic to be used. With levies and duties imposed in various countries on synthetic fibres and yarns it is not always possible to exceed 50% synthetic content as there after the advantages are lost due to the higher costs which ultimately result in increased costs per ton of paper to the papermaker.

Obviously the economics plays a vital part in deciding which type of felt and what amount of synthetic content should be used wherever felt life, paper production, and felt cost are to be considered.

The needling process has a stabilizing effect on felts. By either increasing or decreasing the amount of needling, so the thickness of the felt is altered, as also are some of the other properties, particularly the permeability and chances of fibre shedding. If needling is excessive then a very stable but impermeable felt is the result. If too little needling then the felt will be unstable and fibre shedding will occur.

From the fabric press which was clothed with an open mesh fabric covered by a felt, evolved the idea of combining the mesh fabric with the felt into a single composite unit.

Like the Batt on Base felt, the Batt-on-Mesh felt is of two component parts, a base a batt, but in the case of the Batt-on-Mesh felt, the base is woven from 100% synthetic yarns which can either be monofilament or multifilament with a small amount of spun yarn on the face side of the fabric. The weave of this base fabric is in fact in two layers. The batt which is layered and needled onto the base is also 100% synthetic the needling causing the batt to become attached to the spun yarn on the face side of the base, thus leaving the back as an open mesh and clear of fibre. Due to the construction and the principle of combining the under fabric to the top felt a Batt-on-Mesh felt is usually heavier than its Batt-on-Base or Conventional counterpart on the same press position.

Having established the technique of eliminating a portion of machine and cross machine threads in the base of Batt-on-Base felts in order to obtain better permeability the next obvious step was to try to eliminate more or even all the threads in order to obtain even greater permeability. By the elimination of all the cross machine threads the Weftless felt was produced.

There are various techniques adopted by felt manufacturers to produce a Weftless felt. But whatever method is used, the object is to have a base of only machine direction threads and the complete or very nearly complete elimination of cross machine threads. It is sometimes found that a few cross machine threads add to the stability of a felt but even so the number of threads is so minimal as to still make the felt virtually weftless. The ratio of base to batt can be 20% to 80%. A characteristic of this type of felt is that the batt is alwrys needled to both sides of the base in order to maintain stability and are never of less than 50% synthetic content and some weftless felts are even 100% synthetic.

The felt without any base known as a Baseless felt, is manufactured with 100% synthetic, as

only with the heat setting of the synthetic can stability be achieved. Wool is not suitable for this type of felt as the temperatures required to heat set the synthetic is too high.

3. Conclusion :–The conventional felts which were originally all wool were raised or napped on either one or both sides to reduce weave impression and to increase bulk. Or they were singed for coarser types of paper where weave impression was of less importance than permeability. The introduction of synthetic enabled felts to be made which were more resistant to machine wear, but at the same time other characteristics did not always remain the same. The surface finish was sometimes affected as also was the drainage. The result was that felts tended to dirty or blind more quickly and better cleaning methods were required.

Batt–on–Base felts were developed to give improved drainage and the elimination of weave impression. The felts also, even with the inclusion of synthetic, have stability and resilience as good as conventional felts.

Batt–on–Mesh felts provide a very high degree of stability in machine and cross machine directions, a characteristic which is not always present in other types of needled felts. Due to the construction of the base a greater degree of water removal is obtained, but often additional equipment is required to remove the water on the return run. The weftless felt is particularly suited to high grades of Paper as the paper finish from this type of felt is particularly good. Weave impression is eliminated. Water removal is increased and resistance to backward flow of water is reduced.

The Baseless felt is the ultimate stage of progression so far achieved as far as non–marking and water removal is concerned.

The changes which have taken place in paper machine design has made it necessary for felts to be developed larger in size, and more open for water removal. At the same time retaining stability and resistance to machine wear, to withstand the increased speeds of modern paper machines, and have resilience and cushion and good surface finish as not to leave felt impressions upon the paper. Felts must be more versatile, and suitable for a great many uses which the papermaker may require.

It cannot be predicted with any certainty what form future developments will take, but it is certain that a variety of types of felts from conventional to highly sophisticated, from low synthetic content to 100% will be required for a long time. It connot be envisaged that one single type of felt will ever be developed to serv e all the needs of modern paper making. There will ever be the need for a variety of types of felts for particular uses and to this end, Porritts & Spencer (Asia) Limited a member of the Scapa Group, U.K. are now established in Faridabad to cater to the diverse needs of the paper industry in India.