# Fibres and polymers used in Textile Filtration Media

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October 2012

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**The most ingenious filter is useless without an adequate filter medium**

**So what is filter media?**

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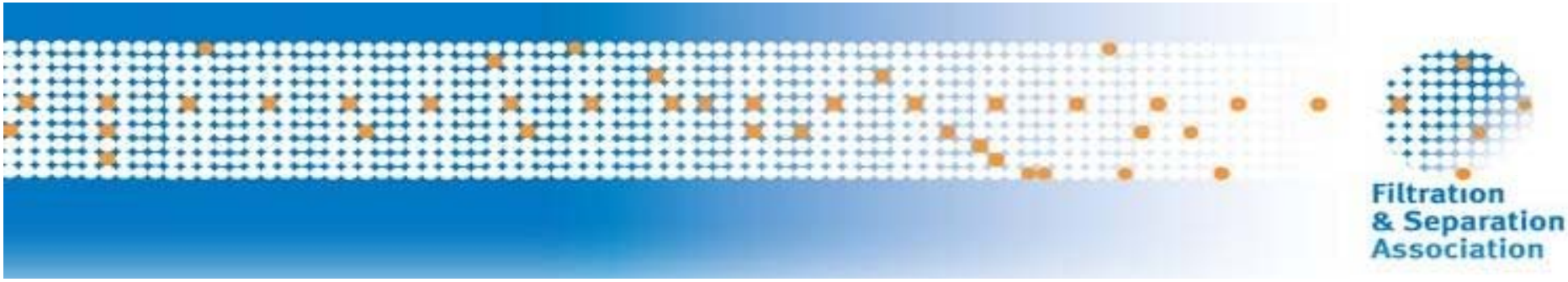


***A filter medium is any material that, under the operating conditions of the filter, is permeable to one or more components of a mixture, solution or suspension, and is impermeable to the remaining components***

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## Content

1. **Fibres and polymers used in filtration media**
2. **Yarns used in filtration media**
3. **Cloth construction used in filtration media.**

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# Fibres and Polymers used in Filtration Media

**Natural** - fibres from vegetable matter such as cotton, flax, jute, wood cellulose

- or fibres from animals such as silk, wool, fur, hair

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# Fibres from Vegetable matter





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# Fibres from animals





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# Fibres and Polymers used in Filtration Media

**Artificial - fibres from natural resources such as glass, ceramic, carbon, metal, reconstituted cellulose**

**synthetic – fibres derived from oil such as thermoplastic polymers**

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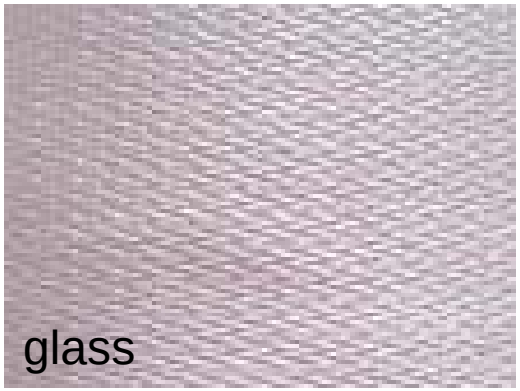
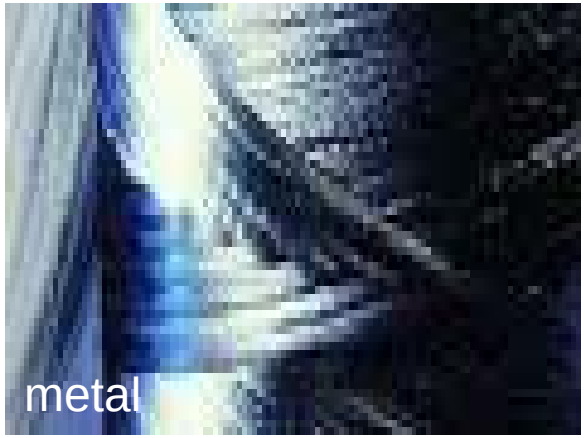
# Artificial fibres







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# Synthetic fibres

thermoplastic yarns

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**In addition to some natural fibres, the increasingly wide range of synthetic polymer fibres would constitute the bulk of fibre types used in filter media.**

**Out of these fibres Polyester and Polypropylene would be the most widely used.**

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# Yarns used in Filtration Media

**There are three basic types of yarn widely used in filter media**

- ***Monofilament*** **- a single continuous filament.**
- ***Multifilament*** **– comprises of a bundle of identical single filaments (these may or may not be twisted)**
- ***Staple*****, made from spun and twisted short fibres, with synthetic fibre, this would necessitate cutting the continuous filaments into a specified length.**

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## Yarns used in Filtration Media

There is a fourth yarn, which is used much less commonly in filtration media, and that is yarn made from fibrillated (or split) film or tape.

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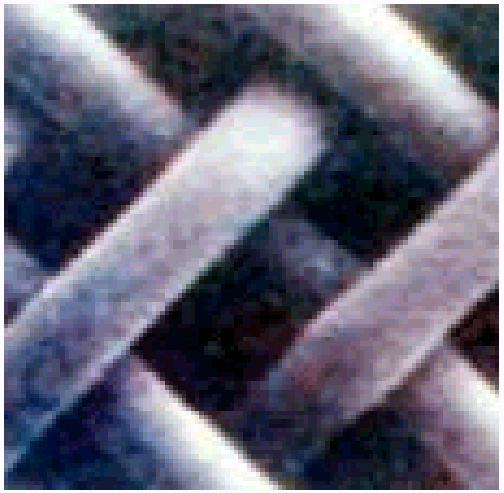
# Monofilament yarns



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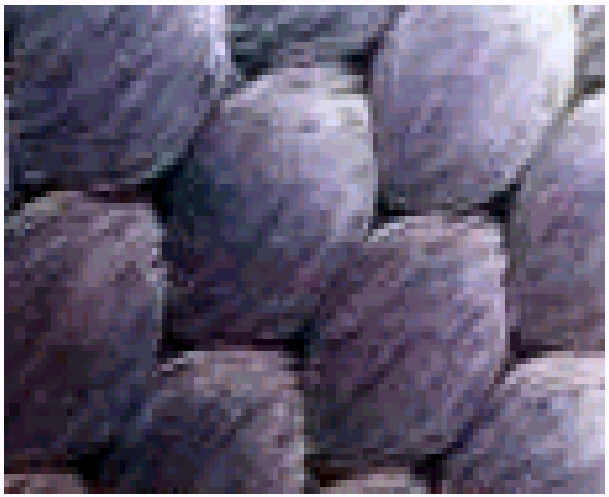
# Multifilament yarns



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# Staple yarns

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# Fibrillated yarns

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## Measurement of fibre, filament or yarn diameter

**Although several methods of measurement have been developed over the centuries, the most commonly recognised systems, in use today, are the denier and tex system.**

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## The Denier system

**The denier number is the weight in grams of 9000 mts. of filament or yarn, the smaller the denier number the finer the filament, for example :-**

**9000 mts. of 30 denier yarn would weigh 30 gms.**

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**The denier system is more commonly used when specifying filament size, but is not very convenient for use with staple yarns, due to the fact that these yarns are normally heavier, and would be difficult to determine, by measuring and weighing 9000 mts.**

**Therefore the more convenient Tex system would be used.**

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## The Tex system

**The Tex number is the weight in grams of 1000 mts of yarn, thus 1 Tex = 9 denier**

**In addition to this the term decitex or dtex may be used. This refers to the weight in grams of 10,000mts of yarn, therefore 1dtex = 10 tex.**

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**Monofilament yarns are often referred to as being of a specific diameter (eg. 0.2mm).**

**This can be calculated as follows :-**

$$D = 0.036 \; X \; [ \; (tex)/(density)]^{0.5}$$

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## Monofilament Yarns

**These yarns are made from a single continuous filament, made by extruding molten polymer through a specially engineered die (*spinneret).* Once through the spinneret the filament is drawn through a series of rollers to achieve the required tensile strength.**

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## Multifilament yarns

**Are made in much the same way as monofilament yarns, apart from the spinneret comprises of a series of finer holes, thus duplicating finer filaments. Strength is not as important in the single yarns (filaments), thus the bundles are compacted and twist added as required.**

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**Twist adds strength, as well as reducing the effects of abrasion, both during manufacture of the media , and it's subsequent usage.**

**Twist is also important as it can affect the filtration performance of the end product. The tighter the twist the less flow will be affected.**

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## Staple Yarns

**These yarns were (obviously) the first yarns used in the manufacture of Filter fabrics, made from Natural fibres, long before synthetic fibres were developed.**

**Compared to the manufacture of Mono and Multi filament yarns the manufacture of staple yarns is somewhat labourious :-**

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**The clean fibre is first carded, through a series of spiked rollers the fibres laid parallel and a uniform sheet is formed, this is then drawn together to form the roving or sliver. In some instances a secondary process (combing) may be incorporated after carding to remove short fibre, giving a smoother sliver. These slivers are then passed through the spinning machines to produce a yarn, which in turn may either be twisted as a single yarn or twisted with other yarns to make a folded or ply yarn. These twisted yarns often require steaming to allow the yarn to be easily processed**

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## Fibrillated yarns

**Usually these yarns are made from Polypropylene, as the long polymer chains can be easily processed for fibrillation effects. A film is embossed (as in the gravure printing process). This film is then heated and stretched causing the embossed indentations to rupture.**

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## Woven Filter Media

**Although there are many weaves types available, there are three main types used in Filtration products.**

**Plain weave**

**Twill weaves**

**Satin weaves**

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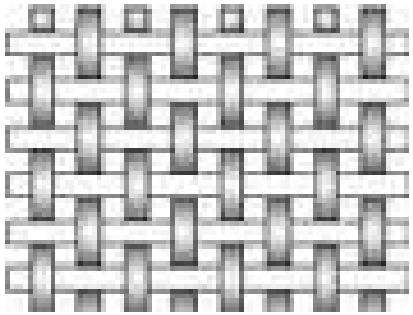
## Plain Weave



**This weave type can produce the tightest media, and give the highest filtration efficiency.**

**It can also produce the most rigid media, which can be beneficial, or otherwise depending on the end use  filtration process**

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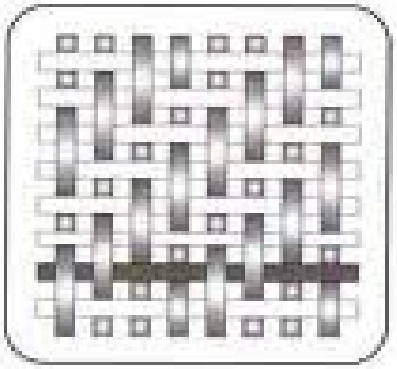
## Twill Weaves



**These weaves can be recognized by their strong diagonal pattern. More weft (filler) threads can be packed into these weaves, allowing the production of a more bulky fabric than a Plain weave will allow (with the same yarns). It would also be less rigid, making for an easier fit into the filter.**

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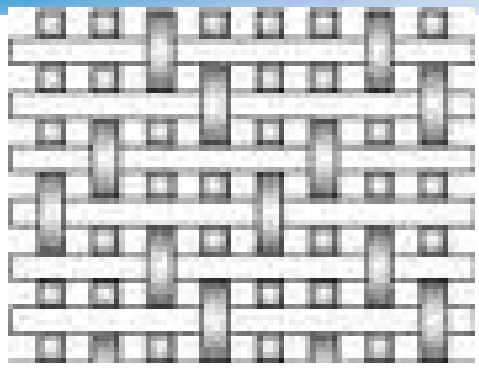
## Satin weaves



**These weaves have longer floats, caused by greater spacing between the interlacing. Satin Weaves lend themselves to producing much smoother face surfaces, a big advantage for cake release, resistance to flow and less moisture in the cake. But due to the construction, poorer filtration clarity and a shorter life can be expected.**

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## Double Layer Weaves

**In recent years there has been an increased use in double layer weaves, these cloths give a good surface for both cake formation and release properties, whilst giving go flows with the looser integrated backing cloth.**

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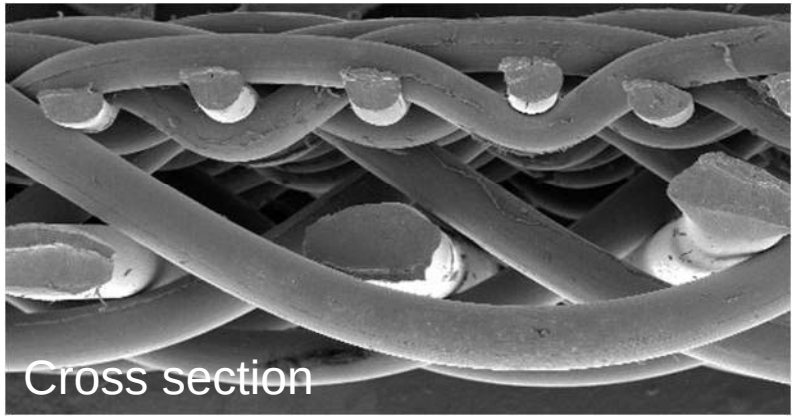
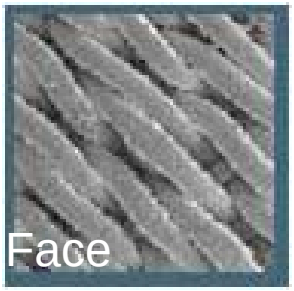
# Example of double layer weave





## DualTex™ from Clear Edge P/L

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# How weaves affect the performance of filter fabrics

| Performance Characteristics | 1 | 2 | 3 |
|---|---|---|---|
| Maximum filtration clarity | Plain | Twill | Satin |
| Minimum resistance to flow | Satin | Twill | Plain |
| Minimum moisture in cake | Satin | Twill | Plain |
| Easiest cake discharge | Satin | Twill | Plain |
| Maximum fabric life | Twill | Plain | Satin |
| Least tendency to blind | Satin | Twill | Plain |

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**Some of the reasons woven fabrics are used as filtration media, are their regular structure and relative strength over other types of construction.**

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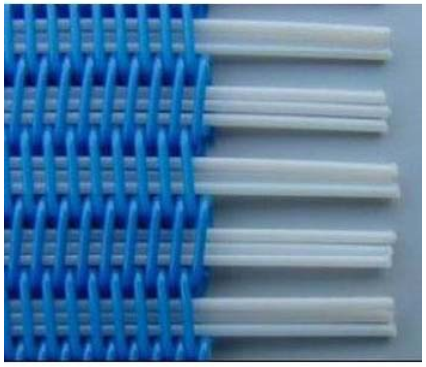
## Spiral Link Fabrics



**Initially developed for clothing papermaking machines, these fabrics are made from preformed monofilament spirals enmeshed in the length, and joined with a series of straight monofilaments across the width.**

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**This construction results in exceptional stability in the width, giving the media superior resistance to bowing and distortion. These fabrics are usually heavier thus being suitable for larger belts.**

**Due to their robust characteristics these cloths are ideal when separating larger particles.**

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## Surface Coatings

**Are now regarded as an important aspect of the filtration media industry. Coatings are added is several different ways, (a separate module will deal with these at a later date). They were used to primarily modify the surface permeability, but have developed in recent years to enhance many aspects of the characteristics of filter media products.**

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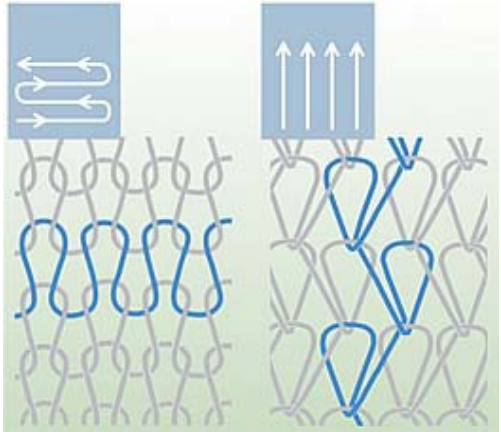
## Knitted fabrics



**Knitted fabrics are usually more open and less stable and as such are rarely used in filtration, although in some applications knits can be effectively employed.**

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## Non-woven Filter media

**There are basically two types of non woven products:-**

**Felts, either using the basic characteristics of the fibre, or mechanical processing to produce a fabric.**

**Bonded fabrics, using either some additional adhesive material, or the thermoplastic nature of the polymers used to produce a fabric.**

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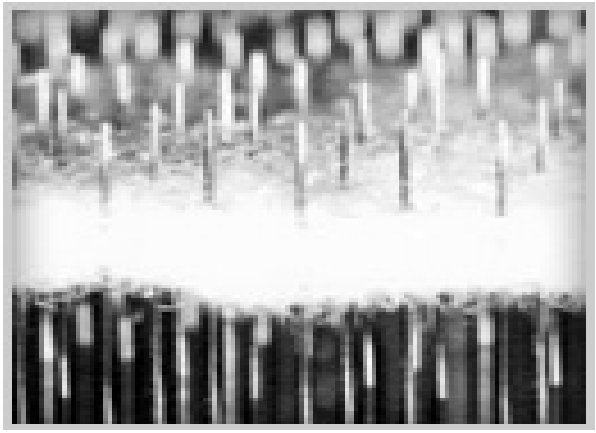
# Needlefelts



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**Needlefelts originated in the 1880s, but the 1970s saw the “explosion” in needlefelting, this coincided with the increasing use of synthetic fibres**

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**Assemble a lofty “batt” of several layers of carded material, this is then compressed together by needling, using a mass of specially barbed needles (as many as 100 penetrations per square centimeter), this gives the required thickness.**

**Punching (needling) can be from both sides of the web, which can improve the uniformity of the felt.**

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**Often a scrim is inserted during the process, giving a stronger product. Also the shape of the cross section of the fibre has a significant effect on the strength of a needledfelt. Whereas the fineness of the fibre has an impact on Filtration efficiency.**

**Nowadays other techniques are used to create felts, such as air entanglement or hydroentanglement (using air or water to replace the needles)**

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**Needlefelts would seem to be ideal for filtration, unfortunately manufacture has not yet reached the desired effects, but is quickly catching up to wovens, and we see today several traditionally woven applications turning to the cheaper needlefelts.**

**Having said this it must be stated that thermally bonded spun polymeric media is replacing needlefelts in the more traditional “dry” filtration areas, they are generally more effective in finer filtration applications.**

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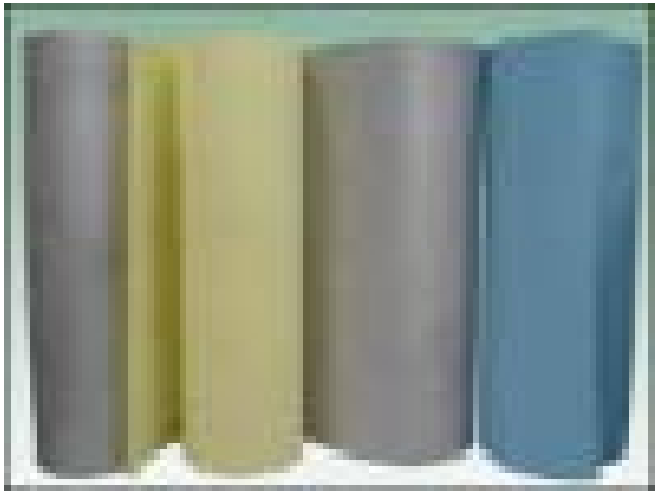
# Bonded Filter Media



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## Bonded Filter Media

**These products can be categorized as follows :-**

**Resin Bonded media**

**Thermally Bonded media**

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## Resin Bonded Media

**The web of fibres is formed as felts (by carding and layering), but then a quantity of resin (usually in liquid form) is added to the web followed by a curing process to set the resin and produce the necessary permeability and material strength.**

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## Thermally Bonded media

**If the web is produced from Thermoplastic polymer (and is not too thick) the fibre can be bonded by passing the web through a series of paired heated rollers, which have a dimpled surface, which created a “point sealed” media, often used in industrial liquid filtration.**

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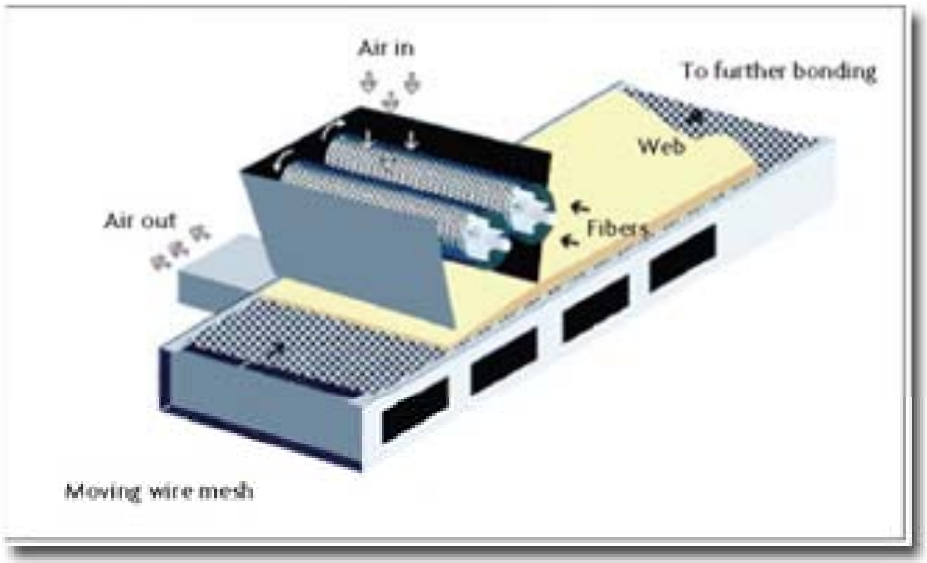
# Dry Laid Spun media

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## Dry Laid Spun Media

**A molten polymer is extruded through a series of spinnerets onto a moving belt. These are then bonded by a various combinations of heat, pressure and chemical activation.**

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**Nowadays even dry laid media can be mainly categories as Spunbonded or Meltblown Media.**

**Although both manufacturing processes are similar there is a difference in the air streams are used giving different characteristics, Meltblown Media is usually more effective in finer filtration.**

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## Wet Laid Media

**It appears that variety is the norm in today's world of Filter Media, and as well as Dry Laid media we must mention Wet Laid media.**

**This method of production is based on the traditional papermaking process, and usually applies to cellulosic fibres. Much of the commercially used filter papers are produced using this method.**

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# Composite non-wovens

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**Non-wovens of all types are used as components in composite materials, with the various layers being chosen to give the desired filtration performance and material strength characteristics.**

**Cross utilization of various materials either woven needlefelts and non-wovens are frequently used in composites to produce the desired filtration and strength properties of the final media.**

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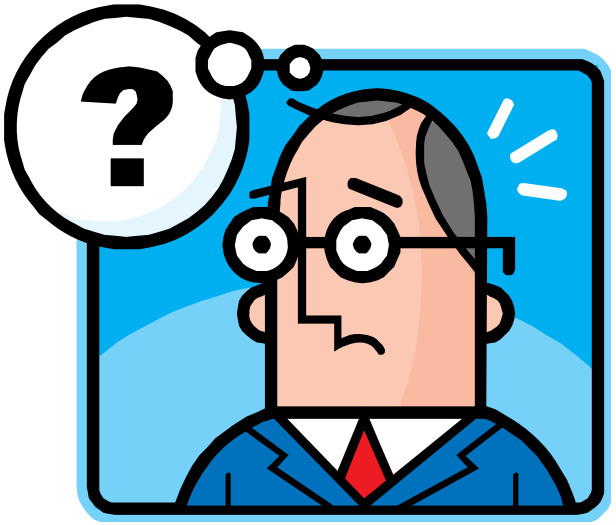
# Questions

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**Acknowledgements -**

**Handbook of Filter Media**

**- Derek B Purchas and Ken Sutherland**

**Filtration Society (UK)**

**- Professor Richard Wakeman**

**Clear Edge Filtration**

**- Professor Richard Lydon**