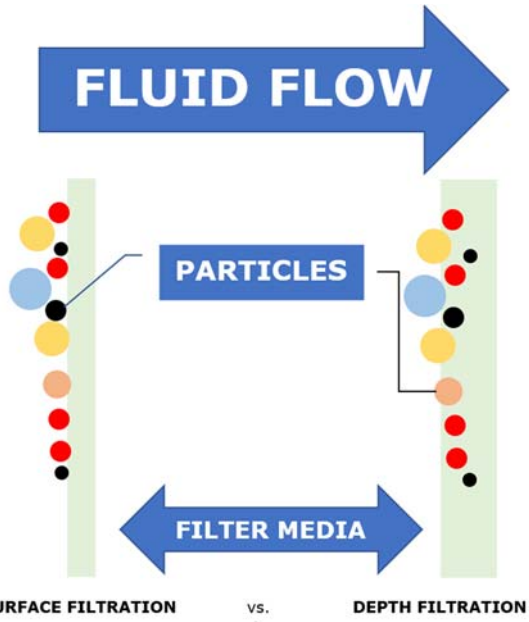
Surface vs. Depth Filtration

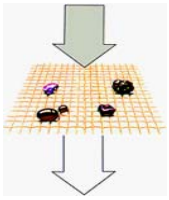
By: Chris Pasquali, CEO Factory Direct Pipeline Products, Inc.

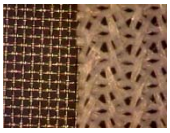
There are many types of filter cartridges and bags, if you are not sure of what you require, the first step is often determining if you require depth or surface filtration.

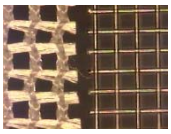


Surface Filtration implies that particles are retained mostly on the surface of the media, forming a layer of material that increases the efficiency or fineness of particles retained. Generally speaking, this type of filter media is referred to as having a "nominal retention"; perhaps initially being 60% to 70% efficient at retaining the targeted particle size and as the "cake layer" develops eventually becoming nearly 100% efficient. Nominally rated media is the most common and is less expensive than depth media. The amount of surface area directly correlates to the solids loading capability and related pressure drop.

Examples of surface filtration include perforated strainer baskets, mesh woven strainer baskets and both monofilament and multifilament style filter bags. The retention structure is designed to prevent particles larger than a certain size from passing through the media. Surface filtration works best when the particle percentage is <200 PPM and the particles themselves are non-deforming because gelatinous particles may extrude through the openings as the differential pressure increases. The volume of particles which can be retained corresponds directly to the total surface area of the filtration media. The efficiency of surface filtration media can be either nominal (applicable to woven filter bags) or absolute (applicable to more rigid media such as defined pore, perforation and mesh lined perforated designs).







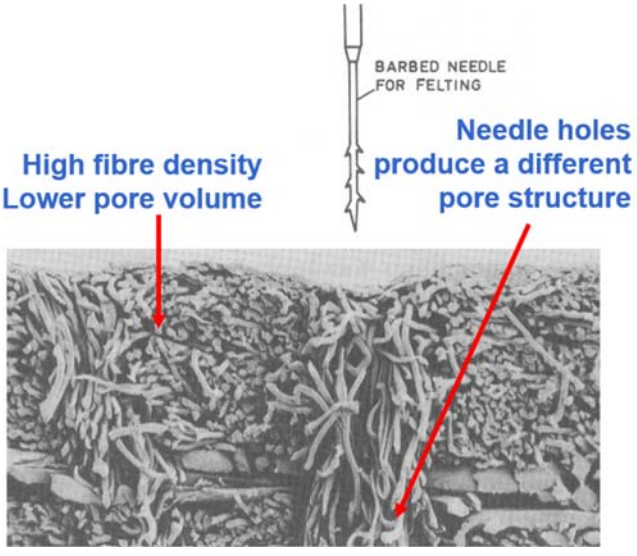
Depth Filtration refers to a thicker media or multiple layers of media, forming a torturous path to retain particles. This type of engineered media ideally retains larger particles towards the surface and progressively finer particles through the thickness or layers. Although there are nominally rated depth filtration media, the more complex designs are often rated at 95 to 99% efficiencies and therefore not reliant on a filter cake for their efficiency. The effect of surface area on rate of filtration is only part of the overall filtration efficiency, additional efficiency is gained by the density and number of media layers.

Depth filtration media can handle a higher concentration of particulates compared to surface filtration media across a specific span of time.

Different Styles of Filter Bags Providing Depth Filtration

Needlefelt and meltblown manufacturing processes are used to manufacture modern filter bags. Both methods consist of a layer of fibers to provide a three-dimensional filtration capacity, with finer particles caught deeper in the material and larger ones closer to the surface. Overall depth filtration style filter bags can retain 300 to 500% more particles compared to surface filtration style filter bags.

Needlefelt style filter bags begin with a mixture of different size polyester or polypropylene fibers which are compressed into rolls of high-density sheets without any direct pathway through the media. This material is then punctured across its surface with barbed needles, producing a pore structure. The barbed needles and fiber composition result in pores that have tangles of fibers providing a non-direct “torturous path” for fluid and particles to navigate.



Fluid entrained with particles follow the path of least resistance with finer particles caught deeper in the pores and larger particles closer to the surface. As the pores become clogged, the denser areas of the media retain both fine and large particles until the system differential reaches the maximum recommended (typically 20 – 30 PSI). The retention

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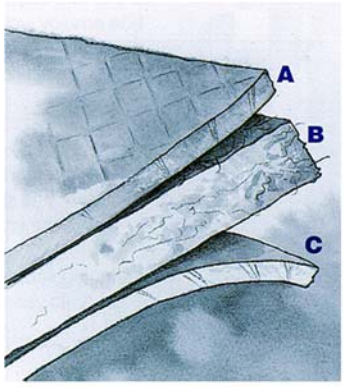
of needle felt bags is nominal due to the non-specific nature of the fiber layer and perforation method used for pore creation.

Meltblown depth filtration filter bags are similar in that they consist of fibers; however, the fibers are manufactured by atomizing raw polymers with hot air and thus the resulting fibers can be engineered for size and density by controlling the ratio of the polymers flow rate and pressure along with the corresponding flow, pressure and temperature of the atomizing air. The retention characteristics can be further controlled by the density and thickness produced.

Nominally rated meltblown filter bags provide depth filtration related to density and thickness (length and complexity of torturous path). Absolute rated depth filtration filter bags are created from multiple meltblown layers to form an ever-increasing density, allowing for stratification of retained particles throughout the thickness of the filter bag. Some designs appear to be a single layer but under a microscope you can see the layers and their respective densities. The most efficient depth filtration filter bags have as many as 7 distinct layers of density.

Fiber Migration

This refers to the potential for the fibers which make-up the filter bag to break-loose and go downstream of the filter housing. This is certainly possible with needlefelt filter bags and less likely with woven (surface filtration) and meltblown (depth filtration) designs. Metal perforations, wire meshes and woven monofilaments are examples of “one-piece media” whereas the needlefelt process results in random fiber lengths. To prevent fiber migration of needle felt material the external surface is typically “singed” – heated to bond the fibers together. The meltblown process by its very manufacturing technique bonds the fibers together and such downstream fiber migration is negligible. Applications requiring very fine “absolute” efficiencies will undoubtedly consist of multiple layers of meltblown material with an outer mesh layer designed to mitigate any fiber migration.



Comparing Filter Bag Designs

The cost differences of various filter bags and cartridges are often a reflection of the thickness and design of the media, ultimately related to its efficiency. Thus, nominally rated needlefelt designs are the least expensive and provide a minimal amount of depth filtration. Meltblown filter media will cost more due to the complexity of its multiple layers of density and thickness enabling it to hold more particles.

It is interesting to note that there isn't a "universal" or industry standard for "nominally" rated filter media. Each manufacturer selects or manufactures the core material based upon their specifications and definitions of "nominal" and therefore if you are comparing pricing and one filter bag is considerably more expensive than another there is a good chance that it is a reflection of the material's thickness and complexity. Depth filtration media will usually last longer than surface filtration media, although it also costs more, so your return-on-investment calculation must also include the applicable incoming freight costs, disposal costs and labor costs associated with filter cartridge and bag changes.

It is easier to compare filter media which has an absolute rated efficiency, which means that the efficiency for retaining a certain particle size has been tested and specifically stated; this is typically expressed as a BETA Ratio. In-depth analysis of filter media efficiency and BETA Ratios is provided in our article Filter Bag Design. The next time you have a filtration application reach out to us using one of our special web based inquiry forms, send an email or call our office; we will put our experience to work for you!

Visit us at https://fd-filterbags.com/ and let us know how we can assist you with your pumping application!

Chris Pasquali has provided sales and engineering support for Hayward/Eaton since 2001