



String Wound Filters – The Best Pre-Filters?

On some levels, string wound filters might be considered to be of unsophisticated technology, but they are often the most intelligent choice. Experienced plant personnel and new-system designers select string wound filters because these filters have proven effective, because advances in the manufacture of string wound filters have continued to advance filter performance, and because this filter design continues to provide value (favorable price/performance ratio).

String wound filters are used for pre-filtration in a myriad of applications, ranging from protecting potable water systems using RO desalination membranes in large municipal water facilities to protecting under-sink RO units in home water systems; from cleaning up amine for gas sweetening in petrochemical plants to chemical filtration in a “tank farm” at pharmaceutical API (active pharmaceutical ingredient) plants; from ensuring circuit board quality in plating solution bath recirculation systems to protecting geological formations via water filtration in a geothermal plant. The engineers and maintenance technicians who select these filters know their facilities backwards and forwards and strive daily to maximize the performance of their plants, and as a result they have tried a variety of filter types and migrated to what has proven to work and has provided the best value. In many cases, this is a string wound filter. This is a type of Darwinian “survival of the fittest” testament to the effectiveness of the string wound filter type for many applications.

One challenge for those who would seek to displace a string wound filter from an application in which the filter user has decades of success, is that string wound filters are generally very competitively priced – oftentimes the lowest price, and provide very competitive performance. The risk of taking out a string wound filter that works and potentially trying something that doesn’t work can be high. In addition, new plants continue to be built with string wound filters specified and used as the filter-of-choice because of this experience.

One question that is frequently asked is “what is the best type of pre-filter” - and the answer can only be determined on a case-by-case basis. One critical matter to resolve is the definition of “best” and this will itself vary, depending on the application, the specific process design, capital budget for installing new filter housings and many other factors. The chart below explores just a few of the many possible definitions of “best pre-filter”. In real situations, a combination of factors are weighed before making a final determination, and it is based on this consideration of multiple factors that prudent people have often selected string wound filters as the best choice.

Examples of Some Considerations in Selecting “The Best” Pre-filter*

		Examples of Some Possible Pre-Filter Performance Metrics			
		Provides Longest Life	Lowers overall Filtration Costs by Protecting Downstream Filters	Lowers maintenance costs	Provides incremental improvement in effluent quality
Examples of Some Possible Situations Upon Which the Definition of “Best Pre-Filter” Might Depend	Premature stoppage of flow is catastrophic	✓			
	Management seeks to minimize costs		✓		
	Maintenance of downstream equipment can require costly downtime and capital outlay			✓	
	The filter, although of a “pre-filter” type, is actually the only filter or is the final filter and has an impact on process yield				✓

*A checkmark indicates the performance factor that might receive the most consideration, or receive the highest weight in deciding upon a filter for a given situation. While one performance metric might be deemed the most important for a specific situation, this metric will usually not receive exclusive consideration, and in actual operations plant personnel will consider multiple factors. String wound filters are often selected based on a balanced consideration of multiple factors. This is not a comprehensive list, but is shown for illustrative purposes.

Some other examples of technical considerations for filter selection are particle-size-distribution, type of contaminant, percent solids concentration, chemical compatibility, temperature, and sensitivity of the process to different types and sizes of contamination – and this is a very partial list. Generally, the best way of confirming a filter selection remains an actual trial (for example, a side-stream trial or other small-scale simulation) followed by a carefully-monitored on-stream, full-scale trial. We at Delta Pure suggest that it is on this basis, the actual full scale-trial and actual long term experience with the filter in the actual process, that the string wound filter has proved itself as superior in many settings.

Filters that appear to be simple cylinders and that are made using melt blown fibers are called melt blown depth filters or sometimes simply “melt blows”. These filters generally have a graded pore density and take aim at solutions with a relatively wide distribution of contaminant sizes. The filter designer may envision a filter with four zones, and use, for example, a gradient from outside to inside of 70 > 40 > 20 > 10 microns (these numbers were selected for illustrative purposes only and are not meant to represent any specific filter), and this type of graded-density melt blown filter is often optimized for performance with a standard solution, and using a standard type of contaminant with a standard type of contaminant size range. (One common type of test contaminant is called AC Fine Test Dust.) In reality, each process has contaminants of a different particle size distribution which may or may not lend itself to the design of a given melt blown filter. In some situations where a filter might have been improperly selected (or where the process has changed), only the inner annular portion of a melt blown filter may be substantially used, meaning that most of the depth has not been utilized; in other situations, the outer annular section may be substantially plugged, again meaning the depth of the filter has not come into play. Polypropylene is the most common material used for melt blown filters, and this polymer has very wide but not universal chemical and temperature compatibility. One “red flag” for potential (but not automatic) incompatibility with polypropylene is the presence of halogenated organic chemicals. Another difficulty for polypropylene can be elevated temperature. One situation where melt blown filters shine, is when they are compatible with the process and are carefully selected so that their pore gradient closely matches the actual particle size distribution and contaminant loading for a unique fluid and process; in those situations, the entire depth of the filter is used, and the innermost “tightest” layer can provide assurance of the final effluent quality without plugging. Another situation where melt blown filters have met success is with deformable or gelatinous contaminants – normal differential pressures are often not sufficient to push these contaminants through the depth of a melt blown filter, and in other situations the depth filter is able to break up a gelatinous contaminant into small bits that are more easily tolerated downstream. At the same time, melt blown depth filters tend to be more resistant to blinding and plugging with gels.

Pleated nonwoven filters can provide a high surface area and a more targeted micron removal efficiency that can help assure a specified level of product cleanliness with long life in a polishing step. These filters tend to be considerably more expensive, and they have less depth than a melt blown filter. These filters are often used with relatively clean solutions whose contaminants possess a narrower particle size distribution – perhaps because the fluid has been pre-filtered upstream by string wound or melt blown filters prior to the polishing step. Note that these pleated filters can use a “melt blown” medium which, instead of being formed into a cylindrical log like the “melt blows”, is formed into long sheets and pleated. Pleated filters with multiple layers of thick melt blown sheet material often bridge the gap

between traditional pleated filters and cylindrical non-pleated melt blown types – but generally at a price premium and with sacrifice of filter area.

String wound filters are available with a wide range of yarn media and core materials for extensive compatibility with a range of chemicals and process temperatures. In addition to chemical filtration, string wound filters are also available in food-grade materials and are used for potable water, food, beverage and numerous critical and regulated applications. String wound filters are depth filters, and are also made in graded pore-density configurations in two ways. One way is to use more than one type of yarn in two or more stages, so that the outer layers are coarser and act as pre-filtration for the innermost section. Another approach is to vary the tension on the yarn during the winding process. String wound filters have also evolved over the years, to avoid old, solved issues such as foaming and media migration. While string wound filters provide the benefits of depth filtration, they also have an interesting, textured surface that increases the capacity (relative to melt blown cylinders that have a smooth surface) for particulates that might be arrested on the surface. These two characteristics- depth and surface area – combine to provide competitive life in many situations.

The manner of making the string wound filter allows for flexibility and speed. The ability to obtain a filter with the material-of-choice at a great price and short lead time can be extremely important from an operations point-of-view.

One important filtration concept is “fixed pore structure.” A fixed-pore-structure filter is one in which the filter, under design conditions, will not allow previously trapped contaminant particles to escape due to movement of a filter medium’s fibers. Meltblown and pleated nonwoven filters generally use fixed pore structure materials. For example the polypropylene fibers in a melt blown structure stick to each other and do not separate as differential pressure builds. Investments in improved yarns and more sophisticated winding techniques have enabled filter manufacturers such as Delta Pure to produce string wound cartridges with improved pore structures and reliable, consistent entrapment of particulates.

Delta Pure provides a variety of filter types, including string wound, pleated nonwoven, melt blown, activated carbon, and other filters, of a variety of materials, micron ratings and configurations. Our filtration specialists are available to help you select the right filter for your application. We don’t automatically advocate one filter type over another, but will work with you on a consultative basis to help you arrive at the best choice.

At Delta Pure Filtration, we continue to see a rising demand for all filter types, including string wound filters. The increasing demand for water globally is one strong driver for our business, as more challenging sources of water are harnessed to nourish and supply the world’s population to increasing standards with the most cost effective methods. This is especially critical in areas of the world where the price per liter (or gallon) of water can be more costly than petroleum. Production and supply of affordable energy is another global challenge requiring filtration-intensive processes. String wound filters are continually used for these and other applications based on the value they prove to provide every day.

To select the right pre-filtration products to optimize your process, solve a filtration problem, or obtain application assistance, [contact us](#) at Delta Pure. Todd Furbee, tfurbee@deltapure.com