FILTRATION

A Survey of Filter Catridges:

Sorting Through the Choices and the Hype

By Jim Hunt |,

Summary: *There are literally hundreds of different filter cartridges on the market, leaving the water treatment professional to sort through the claims, counter-claims and various options presented. To help this sorting out process, this article will review the basic core technologies, discussing relative strengths and weaknesses.*

Cartridge filter manufacturers produce products for many industries and fluids. Their filters are used on water, gas, oil and beverages—every fluid used in industry. Each industry has its own differing requirements, making it difficult for manufacturers to adopt a uniform standard.

Absolute v. nominal

For example, when a cartridge is rated as 5-micron, you might think that's a definitive, empirical rating. It's not. There are a number of questions that must be asked to find out what "5-micron" really means. Is this a "nominal' rating or an "absolute" rating? What's the difference?

In some industries, a nominal rating means the cartridge must filter 60 percent of the particles at or above the micron rating. Other situations call for a 70 percent rejection, an 80 percent, or more. A truly useful rating is the efficiency rating. That is the percent rejection at the recommended flow rate for the stated micron rating. So you would expect a manufacturer to list his cartridges like this example: 5 micron— 85% efficient @ 6 gpm. The bottom line here is that a manufacturer's advertised micron rating by itself is absolutely meaningless.

Industry folklore has it that warehouses are full of cartridges and, when an order comes in, workers simply apply a micron label that matches the order. Whether this is factual or how widespread this practice might be is not as important as the issue of the need for industry standards and how advertisers pitching this industry are expected to use these standards.

The Water Quality Association (WQA) in its *Glossary of Terms* defines nominal to mean 85 percent rejection at the stated micron rating, at the recommended flow rate. Absolute is defined as 3-log or 99.9 percent rejection—as low as most users need, with the exception of the ultrapure water industry, which defines absolute as 4-log or 99.99 percent reduction or more. Third party validation would be an appropriate characteristic to look for in cartridge filters making this claim *(See Table 1).*

Table 1. General application guide based on micron ratings

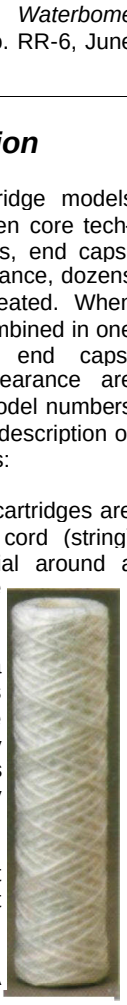
Micron rating	Application
Sub-micron	Viruses, bacteria, colloids, asbestos
1	*Cryptosporidium,* G/ard/a*, silt
5	Drinking water, pre-filter for 1 micron
10	Final sediment filter for utility water
20	Pre-filter, smallest discemable size to eye
50	Open loop heating and cooling systems

'Absolute rated. Centers tor Disease Control, *Assessing the Public Health Threat Associated with Waterbome Cryptosporidiois.* Vol.44. No. RR-6, June 16,1995.

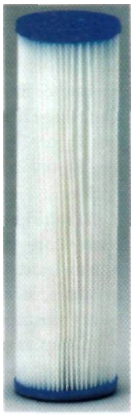
Cartridge construction

The hundreds of cartridge models can be boiled down to seven core technologies. By changing sizes, end caps, adapters, cores, and appearance, dozens of model numbers are created. When several technologies are combined in one cartridge and the size, end caps, adapters, cores and appearance are changed, hundreds more model numbers are created. Here is a brief description of the basic seven technologies:

String wound— These cartridges are constructed by winding a cord (string) made of most any material around a perforated center core. The cord is tightly wound next to the core and loosely wound on the surface, resulting in a depth filter. Large particles are removed near the surface and progressively smaller particles are removed as they progress through the filter. Early cartridges utilized cotton string but most current cartridges are built with polypropylene cord, which is compatible with most acids and alkalies. A disadvantage to string wound cartridges is they sometimes deform and dump sediment in high pressure or water hammer conditions—abrupt pressure changes often accompanied by a banging sound. These cartridges are ideal for low-pressure, non-critical applications; their low-tech manufacturing process makes them a cost-effective choice.


SMng wound

Pleated—These cartridges are built by laying flat stock accordion-style around a central core and dipping the ends into a molten plastic, which forms end seals and holds the cartridge together. The filter media varies from paper (cellulose) to polyester and polypropylene. The many pleats provide a large surface area for high holding capacity. The actual area differs from brand to brand, but generally a nominal 2.5-inch x 10-inch cartridge has between four and six square feet of surface area.


Pleated

Cellulose cartridges are less expensive than others but have a lower burst threshold (i.e., they rupture sooner), are susceptible to biological activity and should only be used on chlorinated water supplies. Polyester and polypropylene are progressively stronger and more resistant to biology, acids and alkalies. Pleated cartridges routinely handle higher flow rates than other construction methods; however, higher flow rates often cause some pleats to spread and others to bunch— a situation that reduces surface area. Some cartridges employ an external plastic net called a sheath or cage that holds pleats in place and improves overall efficiency.


Resin-bonded

Resin-bonded—These cartridges are produced from cellulose, fiberglass strands or fibers coated with resin. This process produces a depth filter of superior strength and collapse points higher than most wound or pleated products. This strength is particularly

useful with high viscosity fluids like ink and paint. Some manufacturers build these cartridges in graded density, which trap larger particles near the surface and smaller particles deeper in the media. Cartridges are available grooved for greater surface area or smooth for greater strength. A variety of inner cores are available including no core, polypropylene, stainless steel and tin-plated steel. Resin-bonded cartridges are suitable for high temperatures, up to 250°F.

Spun polypropylene—Also known as "melt-blown" cartridges, these are the products of molten polypropylene injected into a high velocity air stream. The result is a highly porous materialthat's controllable for a graded density. The car-tridges are very strong and withstand high differential pressure even though they're without a solid core. Polypropylene is used without binders so there's no lost filtration area and no leachables. The manufacturing process lends itself to mass production, resulting in a low-cost high performance cartridge.


Spun

Carbon-pleated— These are simply pleated celluloseor polyester cartridges that have been impregnated with powdered activated carbon. This configuration provides sediment filtration and chlorine, taste and odor reduction at modest flow rates.

Granular GAC— These cartridges are essentially a canister containing granular activated carbon (GAC), a compression pad and a post filter. The compression (or expansion) pad limits channeling and the post-filter reduces carbon fines and other suspended matter. The water enters one end and travels the length of the carbon bed exiting the other end. This configuration allows for maximum contact time and good taste and odor reduction. Low flow rates are recommended.


Carbon Pleated

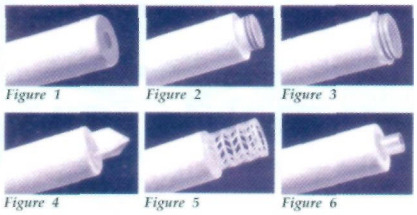


Figure 1 Figure 2 Figure 3 Figure 4 Figure 5 Figure 6

Carbon block— These cartridges are either molded or extruded. In both manufacturing methods, granular or powdered activated carbon and binders are mixed. The mixture is poured into a mold or pushed through a tube (extruded) and heated until the binders are melted. When cooled, the m ixture retains the shape of the mold or tube. Specialty cartridges are then produced by adding resin and other materials. Often an outer wrap is applied as a sediment filter. End caps and cores are added to complete the product. The process can be controlled to produce various micron ratings.


Granular GAC

Water enters the side of the cartridge and migrates to the center core. Some cartridges are configured to remove volatile organic compounds (VOCs) and pesticides in addition to chlorine and other tastes and odors.


Carbon block

Ends, connectors and cores

Basic cartridges will either be open on one end, called a Single Open End (SOE), or on two ends, known as Double Open End (DOE). Open cartridges (see *Figure 1)* will seal into the housing in several ways. They may have a gasket that compresses against the housing or a pliable end cap that's compressed against the housing; or they may depend on a knife-edge of the housing to penetrate the cartridge for a good seal. Cartridges for critical applications have special end adapters including polypropylene fittings with double O-rings (see *Figure* 2), or adapters with locking tabs (see *Figure* 3), bayonet or fin adapters to assure alignment (see *Figure* 4), springs for tight fit (see *Figure 5)* and/or extended cores (see *Figure 6)* as additional common options.

Cartridges may or may not have a center core, depending on construction method, fluid being filtered, temperature, differential pressure and purity requirements.

Couplers are used to join 10-inch cartridges to make 20- and 30-inch cartridges. It's very difficult to make and use a coupler that does not allow fluid by-pass. As the differential pressure builds (as the sediment builds up), there's an ever increasing probability of sediment by-pass. Use couplers in non-critical applications only.

The variety of ends, connectors and cores allows one the ability to configure a system precisely to the job requirements. However, understand that manufacturers also use a baffling array of adapters simply to create a proprietary product. There's also the question of just how compatible a cartridge is with a particular housing. An excellent cartridge and an excellent housing may not be a good match. In critical situations, the test should be performed on a cartridge-housing integrated unit.

Conclusion

The varieties of filter cartridges on the market today offer many choices but also tend to confuse the user. Without stifling invention or breaking the spirit of the entrepreneur, rating cartridges to a common standard would go a long way in reducing confusion. There has been discussion in joint meetings with NSF *International* and WQAthatWQA'sdefinition of "nominal" and "absolute" be incorporated in NSF/ANSI Standards 42 and 53— or a more accurate definition developed that can be adhered to uniformly.

Provisions should also be made for assuring the compatibility of a cartridge with a particular housing. It has been suggested that standards be established for the architecture of filter housings. These standards have yet to be adopted, but the knowledgeable dealer is already asking his supplier these questions. Water treatment dealers realize that no one cartridge is the answer to every application. This knowledge of product is yet another reason why the end user gets more value for his money when buying from a professional dealer.

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