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Manufacturers of

LOEFFLER FILTRATION

GAF Filter

# Application Report:
## Bag Filters vs. Cartridge Filters: Comparing Cost and Performance

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May 2003

Bag filters and cartridge filters often compete for use in the same applications but it is often a point of confusion which type of filter is the best choice. In this report, cartridge filters are compared with bag filters and some of the advantages of bag filters are explained.

**Comparison- Filter Construction**

There are three basic types of depth cartridge construction: Resin bonded, thermally bonded micro-fiber, and string wound. Resin bonded filters typically are made by curing resin-impregnated acrylic, glass, or cellulose fibers into a rigid structure. Thermally bonded micro-fiber cartridges are made by depositing multiple layers of extruded fibers, most commonly polypropylene, around a center core. String wound cartridges are typically made out of cotton or polypropylene yarn wound around a center core.

All three types work in a similar fashion—liquid under pressure is forced through the cartridge and exits through one end (figure 1). Since the fluid moves from outside to in, debris is collected mostly on the *outside* surface of the cartridge. Because of this, care must be taken during change-out so that dirt does not flake off and contaminate the downstream flow. And since cartridges usually have outlet connections on the bottom, dirt and debris tends to collect next to the seal – making this downstream contamination even more likely.

Bags filters, on the other hand, catch all dirt *inside* the bag where it is completely removed from the filter vessel during change-out, and their seals are located near the top of vessel, making it less likely for dirt to collect near the seal.

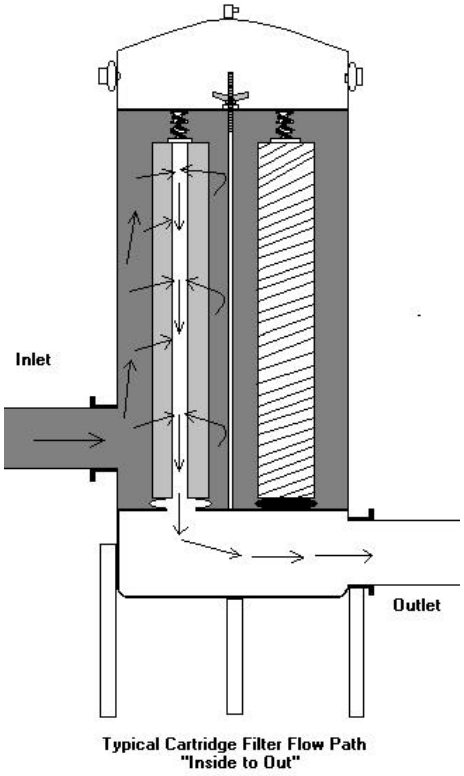


Figure 1

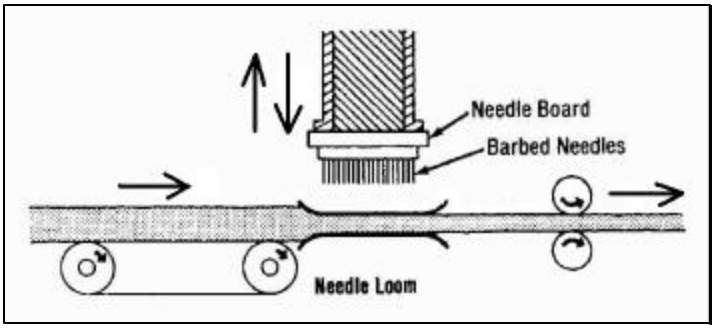


Figure 2

Bag filters are generally made of three types of media: mesh, melt-blown, or needled felt. Mesh bags generally use either monofilament or multi-filament fiber woven into a consistent mesh pattern and then heat-set to fix the pore size in place. Bags made with melt-blown material have multiple layers of melt-blown fabric. This fabric is composed of extremely thin extruded fibers laid down and fused together to form a material with an exact and consistent pore structure. Mesh and melt-blown bags use a precise surface capture rather than a depth

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matrix of fibers to achieve their results and are not part of this comparison.

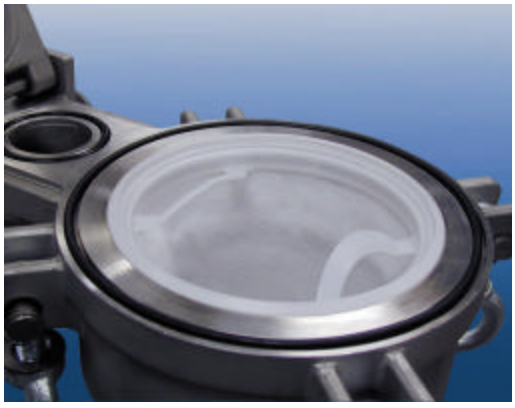
We will focus on needled felt, which is made on a needle loom. A layer of tufted fibers called a batt is fed through the loom while a needle board with thousands of barbed needles repeatedly punches and withdraws through the batt, leaving the fibers entangled (figure 2). By varying the denier of the fiber, the advance rate and weight of the batt, the strokes per minute, and the penetration of the needles, a wide range of felt densities can be made.

Better manufacturers of needled felt filter bags closely monitor various material parameters, including denier of fiber, weight per square yard, thickness, air permeability and burst strength so that repeatable results can be obtained. Modern needled felt manufacturing techniques can now produce felt filter media that will provide overall filtration performance, that is, micron efficiency, pressure drop, ease of use, and cost of ownership that is demonstrably superior to most depth filter cartridges in a wide range of applications.

**Comparison: Performance Characteristics**

A big advantage to bag filtration is that per unit they have a much larger inside diameter and many times the surface area as a comparable depth cartridge. As seen in Figure 3, bag filters provide a wide-open flow path in comparison with cartridge filters. A more open flow path generally means less flow friction and its

Figure 3



Typical bag filter's inside diameter is 7 inches

Cartridge filters typically have 1 inch inside diameters

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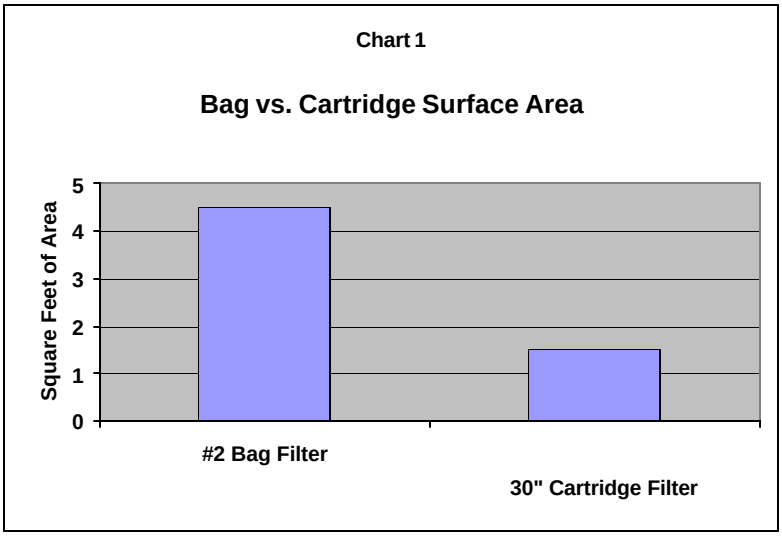
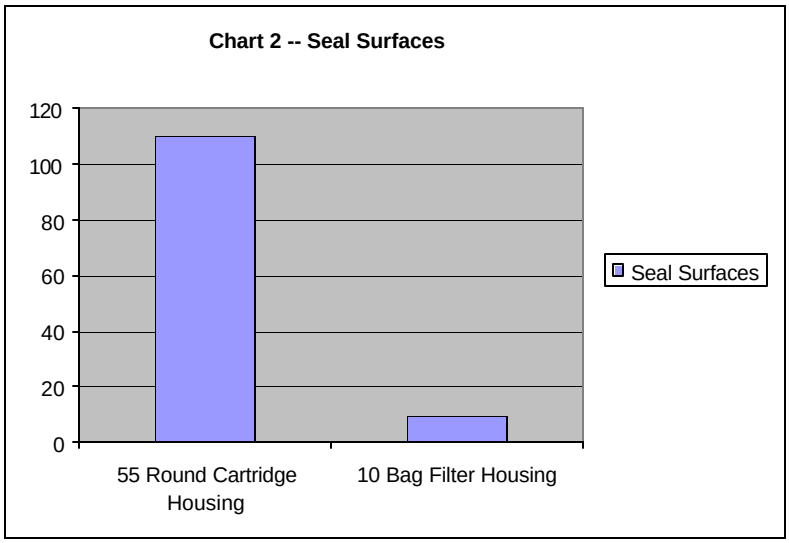
accompanying loss of pressure. Bag filters overall have lower start-up Differential Pressure (ΔP) and so can provide longer run times and a fuller use of available filter surface area.

But available surface area is always the most critical factor affecting filter performance. Having more surface area lowers a filter's start-up ΔP and provides for more dirt holding capacity. To equal the surface area of just one #2 size (7"x32") bag filter you would need *three* 30 inch depth cartridges. In a typical cooling water application of 90 gpm, you would need at least *five* 30 inch cartridges to equal the same flow as one double length filter bag—see Chart 1.




All things being equal, fewer seals per filter means less chance of dirt by-pass. Commonly used DOE (double open end) style depth cartridges have two sealing surfaces per cartridge. This means you have 110 seals on a cartridge filter handling the same flow as a bag filter with only 10 sealing surfaces (Chart 2). With bag collars like the patented Sentinel® ring, a seal good enough for even 1 micron absolute rated filters can be achieved.




**Comparison- Cost of Ownership**

There are many factors to be considered when comparing the relative benefits of using bag filters over depth cartridge filters. Unit cost, the most obvious factor, is decidedly in the bag filter's favor. In that same 90 gpm cooling water application, it can take as many as five 30 inch cartridges to handle the same flow as one #2 size bag filter. Five 30" string-wound or spun polypropylene depth cartridges would run you about $30.00 to $45.00 list per change out. A good quality bag filter that would handle the

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same load would list out at about $5.00-- quite a difference in unit cost.

How about disposal? In an application where the filters must be treated as hazardous waste this can be an important consideration. Generally the filters are put into a 55 gallon drum and hauled away for burial in a land-fill. Since bag filters are much more compressible than cartridges, you will be able to pack many more per drum. Add to this the fact that you use fewer bags per application than cartridges, and it is easy to see that you will reduce your hazardous waste disposal costs by at least a factor of 10.

Storage space can be an important cost factor to look at, especially when the customer's storage space is at a premium—as in urban areas where per square foot costs are high. Since they will use fewer bag filters than cartridges, and because bags take up much less space than bags you will reduce necessary storage space by the same factor as disposal cost. Shipping costs, a good percentage of the total delivered cost of cartridge filters, will be reduced by at least 30% by changing to bag filters.

Finally, bag filters are easier and quicker to change-out, so labor costs are significantly less versus cartridge filters. Performing a change-out on a bag filter takes about half the time than on a cartridge filter that is handling a comparable flow-rate. This is partly due to not having any cartridge seal caps and hold-down springs to fool with bag filters and also because you are always dealing with many fewer filters to change-out. Less down-time means more product processed and greater efficiency in the plant.

**Case study**

An example of the worth of using bag filters over cartridges can be seen in the following case study. We recently had a customer that was installing an Ultra-filtration system to prepare make-up water for a new industrial boiler at a large refinery. They needed 1200 gpm of flow and had preliminarily decided on a 55 round cartridge vessel using 40" cartridges. We approached them with the alternative of using a 10 bag Multi-bag filter and made a presentation using some of the data below in Chart 3.

| Chart 3 | | Depth Cartridges Vs. Bags |
|---|---|---|
| | | **Various Reductions resultant from switching from Depth Cartridges to Depth Bag Filters** |
| **Number of filters needed** | | 80% |
| **Number of sealing points** | | 91% |
| | | |
| **Cost per change out** | | 92% |
| **Hardware Cost** | | 22% |
| **Freight cost per change-out** | | 82% |
| | | |
| **Change-out time** | | 50% |

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The customer was planning on using 40" string-wound cartridges, and instead they tried out our DURAGAF POXL 5 micron filter bags. These bags proved to be an excellent choice for this application and enabled the customer to reduce their projected filter expenditure to an extent where the savings experienced are projected to pay for the hardware in under three years.

**Summary**

Is a depth bag filter always a better choice than a depth cartridge filter? No. But the improvements in bag filter manufacturing techniques and materials have made bag filters almost always worthwhile considering. Their demonstrable advantages in performance, ease of use, and cost of ownership make them the go-to filter of choice for just about any filter application where string wound or poly-spun cartridges have been used in the past.

| Bag Filters Give Better Performance | Bag Filters Have a Lower Cost of Ownership |
|---|---|
| More Surface Area | Unit Cost |
| Dirt Stays in the Bag | Disposal Cost |
| Lower Start-up ΔP | Storage Cost |
| Fewer Sealing Surfaces | Freight Cost |
| Simpler, easier change-out | Labor Cost |

For more information, please contact:
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