

A Comparison of 3M™ DF Series Filters and Hayward® Hayflow Filters

Objective

To evaluate and compare the performance characteristics of 3M™ DF Series filters and Hayward Hayflow filters.

Summary

Three elements of each grade of 3M DF series elements and Hayflow elements were tested and evaluated. For each grade tested, a performance characterization was developed. The elements of the characterization included particle reduction efficiencies, total through-put, and filter life. When combined, a true comparison can be performed resulting in the following conclusions:

- The 3M DF series filter is significantly more efficient than Hayflow filters when comparing efficiencies based on the published manufacturer filter rating;
- Each grade of 3M DF series filter exhibited particle reduction efficiencies equal to the next "tighter" grade of Hayflow filter;
- When comparing filters of equivalent reduction efficiency, 3M DF series filters can process at least 40% more than the Hayflow filters, providing significantly longer service life.

Background

Traditionally, bag filters have been used in many applications because they typically provide high through-put, low pressure drop, and easy disposal. Other filtration formats, such as filter cartridges, were deemed inappropriate because one or more of the bag filter characteristics were unattainable. Various filter designs have been developed by filter manufacturers to provide a "better" bag filter, but none have provided the combination of benefits demanded by the end-user. However, the 3M DF series filter element, provides the best features of cartridge filtration combined with the economics of bag filters.

The Hayward Hayflow filter element, the subject of this paper, *looks similar* to the 3M DF series product. However, this paper compares the two filters to determine if *performance is equivalent*. Three key parameters used in the comparison were:

Particle Reduction Efficiency: The Particle Reduction Efficiency was determined using laser particle counters situated up- and downstream of the test filters (Figure 1). The filters' Particle Reduction Efficiency was calculated using the following formula:

$$\text{PRE (\%)} = \frac{(\text{Total \# Challenge Particles In} - \text{Total \# Particles Out}) \times 100}{\text{Total \# Particles In}}$$

Through-put: Differential pressure across the filter measured at a continuous flow rate of 50 gpm, and the total through-put (gallons) of each filter was recorded when 20 psid was achieved.

Filter Life: Filter life is defined as the amount (grams) of contaminant captured by a filter prior to reaching a differential pressure of 20 psid.

Results & Discussion

Particle Reduction Efficiency

The Particle Reduction Efficiency (using the formula above) was determined for each of the filter grades. The average value of the three filters evaluated from each grade is tabulated in Table 1.

The method used by Hayward to establish the Hayflow reduction rating is unknown. However, since the reduction efficiency for each filter can be measured, charting the reduction efficiencies can be used to develop an equivalency between the two filter products, regardless of the manufacturer's published rating (Graph 1).

Table 1 – Particle Reduction Efficiency Comparison

Publish Manufacturer Reduction Rating (Micron)	(% Efficiency)	
	3M™ DF Series Filter Element	Hayflow Filter Element
1	N/A	99
5	98	79
10	79	47
25	59	44

The 3M™ DF series filter is significantly more efficient than the Hayflow filter when compared to published manufacturer reduction ratings, however, further analysis of the particle reduction efficiencies shows the following:

- The 1 µm rated Hayflow cartridge and the 5 µm rated 3M DF series cartridge are equivalent;
- The 5 µm rated Hayflow cartridge and the 10 µm rated 3M DF series cartridge are equivalent; and
- The 10 µm rated Hayflow cartridge and the 25 µm rated 3M DF series cartridge are equivalent.

For example: a customer can attain the same efficiency as a Hayflow 5 µm rated filter by using a 10 µm rated 3M DF series filter.

Through-put

The through-put (gallons) was determined for each grade of filter tested. Table 2 presents a comparison of the through-put for each manufacturer by grade.

Table 2 – Comparison of % Through-Put

3M™ DF Series Rating (Microns)	Hayflow Rating (Microns)	3M™ DF Series % Greater Through-put
5	1	54%
10	5	42%
25	10	69%

For each grade tested, the 3M DF series filter provided a minimum of 42% more through-put than the equivalent Hayflow filter. Graph 2 presents the relative through-put calculated:

$$\text{Relative Through-put (\%)} = \frac{\text{Hayflow}}{\text{3M DF series}} \times 100$$

The graph clearly shows that the 3M DF series filter consistently processed significantly more than did the Hayflow elements.

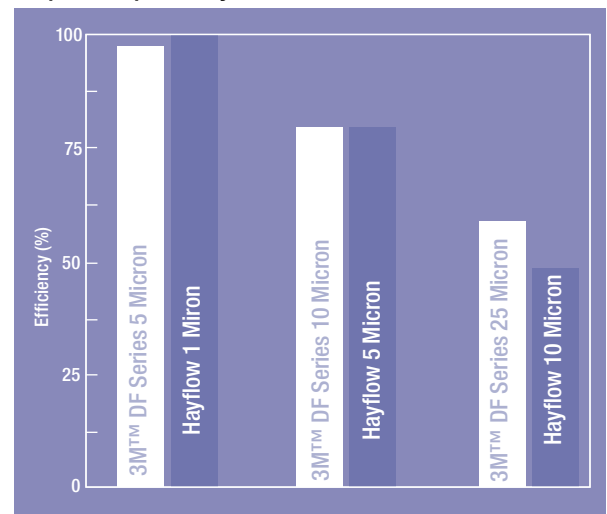
Relative Life

The amount of contaminant captured by the filters was determined for each of the grades. The average of three test filters from each manufacturer grade was compared (Table 3):

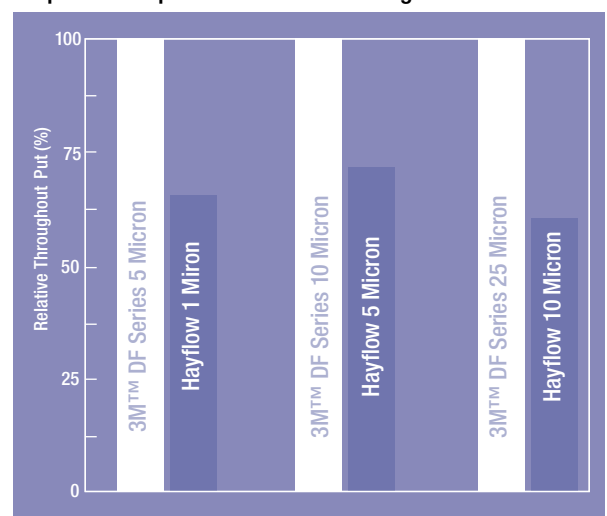
Table 3 – Comparison of % Contaminant Captured

3M™ DF Series Filter Rating (Microns)	Hayflow Filter Rating (Microns)	Comparison of Relative Through Put
5	1	50%
10	5	47%
25	10	48%

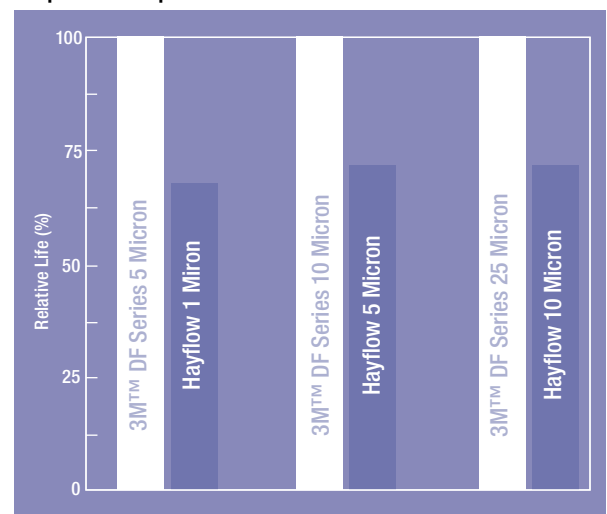
Graph 1 – Equivalency Correlation



Graph 2 – Comparison of Relative Through-Put



Graph 3 – Comparison of Relative Life



In all cases, the 3M™ DF series element captured at least 47% more contaminant than the equivalent Hayflow element. Graph 3 presents the relative filter life calculated:

$$\text{Relative Life (\%)} = \frac{\text{Amount Captured by Hayflow Filter}}{\text{Amount Captured by 3M DF Series Filter}} \times 100$$

The life of the 3M DF series filters across all grades was consistently longer than the equivalent Hayflow filter.

Conclusion

3M DF series elements clearly provide an advantage to the user when compared to the Hayflow filter. 3M DF series filters display > 47% more service life and can process at least 42% more fluid. With these benefits, a major reduction in total filtration cost can be achieved by reducing the number of filters used, the number of times the filter must be changed, and the loss in productivity caused by the associated process downtime.

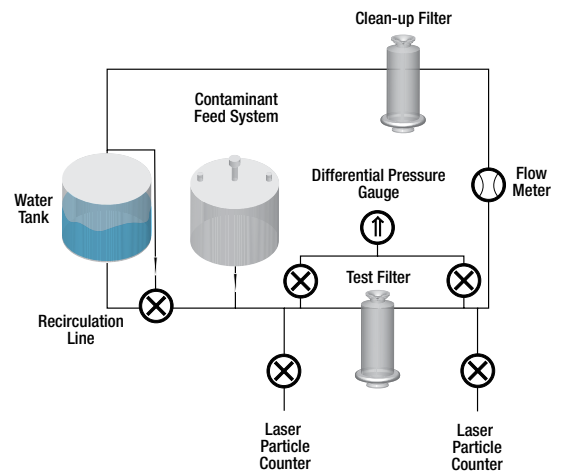
Test Protocol:

For each grade tested, three polypropylene 3M DF series elements and three Hayflow filters were evaluated for comparison. The reported numbers are the average of the three filters tested. The single pass test method (See Figure 1) used to evaluate the filters was generally based on:

1. ASTM F795-93 "Standard Practice for Determining the Performance of a Filter Medium Employing a Single-Pass, Constant-Rate, Liquid Test."; and
2. Taylor, J.K., "Quality Assurance of Chemical Measurements", Lewis Publishers, NY, 1987.

A standard AC Coarse Test Dust particle challenge was set upstream (0.4 g/gal) of the filters and the test stopped when the differential pressure reached a maximum value (20 psid).

Figure 1 – Filter Test Stand



Important Notice

The information described in this literature is accurate to the best of our knowledge. A variety of factors, however, can affect the performance of the product(s) in a particular application, some of which are uniquely within your knowledge and control. **INFORMATION IS SUPPLIED UPON THE CONDITION THAT THE PERSONS RECEIVING THE SAME WILL MAKE THEIR OWN DETERMINATION AS TO ITS SUITABILITY FOR THEIR USE. IN NO EVENT WILL 3M PURIFICATION INC. BE RESPONSIBLE FOR DAMAGES OF ANY NATURE WHATSOEVER RESULTING FROM THE USE OF OR RELIANCE UPON INFORMATION.**

It is your responsibility to determine if additional testing or information is required and if this product is fit for a particular purpose and suitable in your specific application.

3M PURIFICATION INC. MAKES NO REPRESENTATIONS OR WARRANTIES, EITHER EXPRESS OR IMPLIED, INCLUDING WITHOUT LIMITATION ANY WARRANTIES OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE OR OF ANY OTHER NATURE HEREUNDER WITH RESPECT TO INFORMATION OR THE PRODUCT TO WHICH INFORMATION REFERS.

Limitation of Liability

3M Purification Inc. will not be liable for any loss or damage arising from the use of the Product(s), whether direct, indirect, special, incidental, or consequential, regardless of the legal theory asserted, including warranty, contract, negligence or strict liability. Some states and countries do not allow the exclusion or limitation of incidental or consequential damages, so the above limitation may not apply to you.



3M Purification Inc.

400 Research Parkway
Meriden, CT 06450
U.S.A.
(800) 243-6894
(203) 237-5541
Fax (203) 630-4530
www.3Mpurification.com

Your Local Distributor:

3M is a trademark of 3M Company.
All other trademarks are the property of their respective owners.
© 2011 3M Company. All rights reserved.
Please recycle. Printed in U.S.A.
70-0201-8793-9 REV 1011b