Application Note

The Acrodisc One™ Syringe Filter with wwPTFE Membrane Compared to Syringe Filters with Regenerated Cellulose Membrane

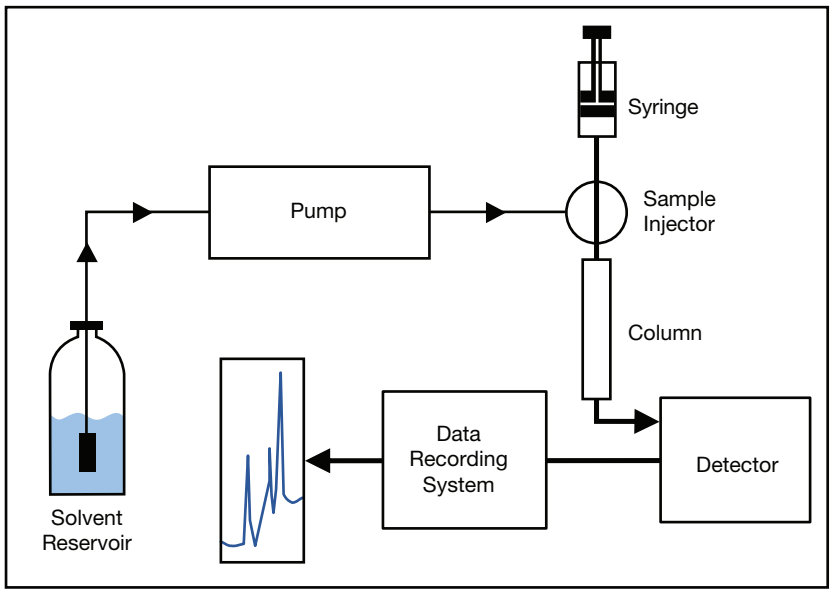
Introduction

In many laboratories, the need to consistently generate high-quality data means that laboratory managers and technicians need to ensure their instruments are performing optimally around the clock. Filtering samples before injection into a chromatography instrument is one of the primary ways that an analyst can protect their column and instrument from unnecessary wear and excess downtime.

Filtration of both the sample and mobile phase prior to analysis helps increase the lifespan of chromatography columns reducing overall instrument wear and removing any particles that may interfere with the chromatogram. Sample filtration is most often performed using syringe filters as it is time effective and easy to implement method.

Figure 1

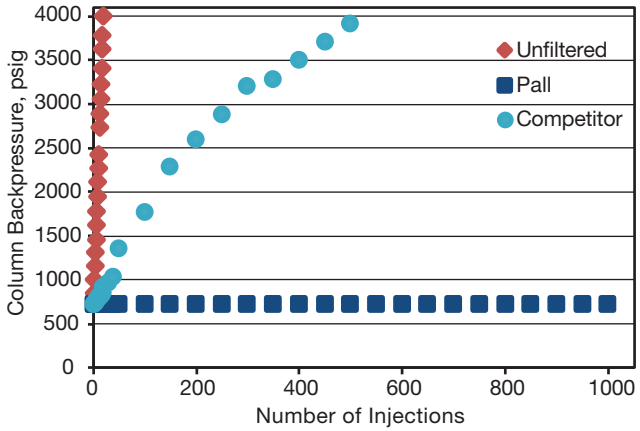
A Basic HPLC Configuration



Of the four common causes for HPLC column failure – plugging, voids, absorbed sample and chemical attack – plugging is the most frequently encountered by analytical chemists or analysts. Injection of samples containing particulates will eventually block the column inlet and column packing, cause high column back-pressure and shorten the normal lifetime of the column.

Figure 2

Effects of Filters on HPLC Column Life



In the Analytical Technical Guide, we have shown that particulate removal through filtration can extend column life up to at least 52 times (Figure 2) over unfiltered samples. In addition to extending the life of the column, particulate removal also protects the pump, injector, and other components from premature wear.

Accurate, reproducible data depends upon proper HPLC column performance. Column blockages are prevented by filtering the mobile phase through a 0.2 µm or 0.45 µm disc filter, filtering samples through a 0.2 µm or 0.45 µm Pall Acrodisc One syringe filter, and utilizing inline filtration within the instrument. Without filtration, particles present in the sample can cause higher system pressures, shifted retention times, poor peak shape and separation.

wwPTFE Retention

The validation process can be long and time-consuming, especially if different filters must be validated for each analysis. Because of this, broad chemically compatible filters are popular in many labs. The wwPTFE membrane is Pall Laboratory's next generation universally compatible hydrophilic polytetrafluoroethylene membrane. Its low binding nature and HPLC certification make it a popular choice in many labs today.

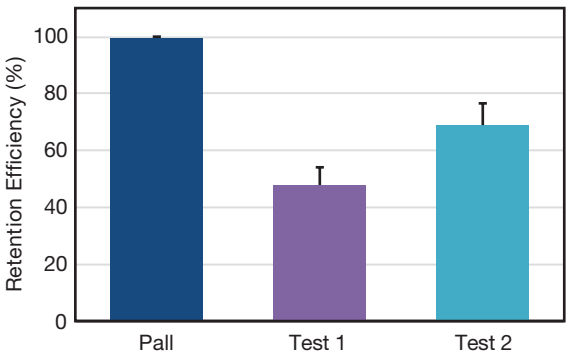
Regenerated cellulose is another type of membrane typically found in syringe filters. The low cost and relative chemical compatibility mean this is a product that can be found in the lab with wwPTFE.

While closely examining the performance differences between the two types of products the retention efficiencies, which are indicative of column protection ability, were compared. The retention efficiency of manufacturer rated 0.45 µm syringe filters were determined by passing through each syringe filter a 3 mL volume of a 0.05% suspension (w/w) in 0.1% Triton™ X-100 (Sigma) of polystyrene latex beads (Sigma) with average diameters of 0.46 µm. For each filter, a total of five test pieces were evaluated. The bead concentrations of the challenge suspension and the filtrate were determined spectrophotometrically and used to calculate the latex bead retention efficiency.

Figure 3

Latex sphere retention of 0.45 µm Pall Acrodisc One syringe filters and regenerated cellulose syringe filters. Results may differ.

Test Piece	wwPTFE Pall	Regenerated Cellulose Test 1	Test 2
1	99.1	47.6	66.4
2	100.0	58.0	67.9
3	99.6	41.1	72.8
4	99.3	48.5	57.7
5	99.4	44.0	79.1
Average	99.5	47.9	68.8
Std Dev	6.5	14.1	7.9



Due to the low cost of regenerated cellulose, it is tempting to include it in the filter selection process. However as demonstrated in Figure 3, regenerated cellulose can have significantly lower retention efficiency than the Pall Laboratory wwPTFE membrane. The unretained particulates in the filtrate can have a variety of negative effects on the column and the entirety of an HPLC system. As shown in Figure 2, particles block the chromatography column, drastically shortening its useful life. In addition to affecting the column, particles circulating within an HPLC system can accumulate within the column and tubing. Over time, this build up will cause a steady increase in system pressure, slowly shifting retention times and affecting peak shape. Particles can also cause excessive wear on the seals of the pump and the injector, all leading to increased instrument downtime and maintenance.

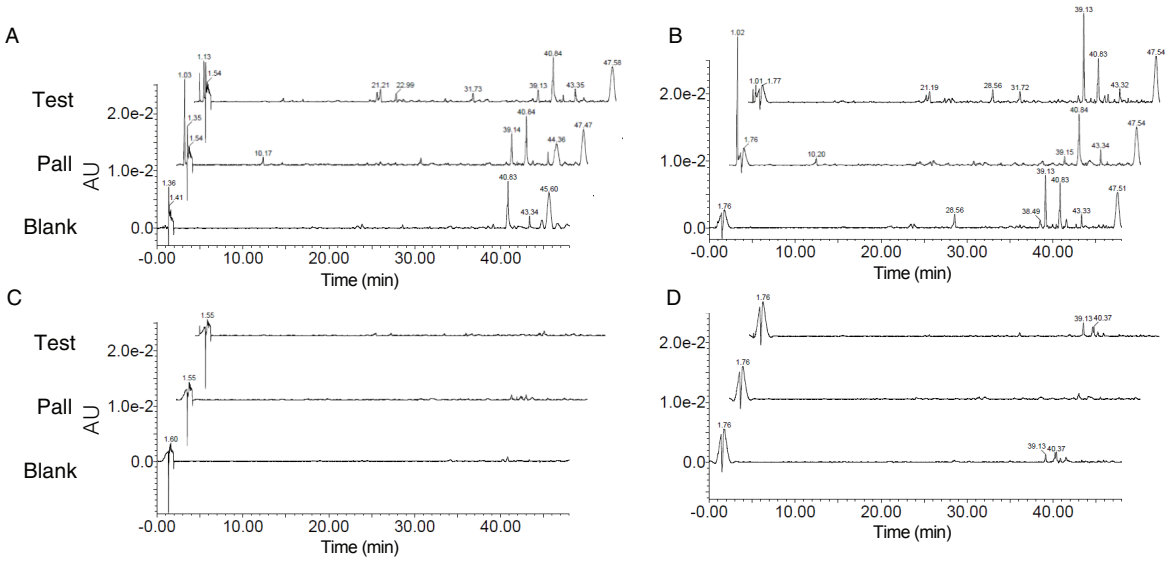
wwPTFE Extractables

Extractables, or unwanted chemicals coming from the syringe filter, are another area of concern when selecting which syringe filter to use. An extractable is an undesired substance added to the sample from the syringe filter. The polymeric resins, solvents, pore formers and other chemical components such as housing materials utilized during device manufacturing may potentially leach chemicals or residues into a sample if they are not compatible with the fluid being filtered. Extractable materials contaminating the sample can jeopardize analytical results through sample absorption, coelution, and extraneous peaks.

In many cases, one filter type will not function for all applications due to limitations in wettability and chemical compatibility. However, wwPTFE comes very close to being a universal membrane for all applications. The wwPTFE membrane has excellent chemical compatibility for aqueous and aggressive organic solvents, is hydrophilic, and is ideal when selection is difficult for complex sample matrices.

Figure 4

Chromatograms of Pall Acrodisc One syringe filter and regenerated cellulose membrane syringe filters (Test). The filtrates and solvent blanks with an injection volume of 50 µL were analyzed under gradient conditions with a mobile phase consisting of water and acetonitrile with a flow rate of 1.0 mL/min and a column temperature of 30 °C. Initial conditions of 5% acetonitrile were held for 3 min, followed 100% acetonitrile, during which data was collected. Data was collected at a wavelength of 214 nm (Panels A and B) and 280 nm (Panels C and D). All filtrations were performed in accordance with publicly available instructions for use. ***Results may differ.***



As shown in the data presented, the universal nature of the wwPTFE membrane can provide cleaner chromatograms than the regenerated cellulose filters in multiple solvents and across multiple wavelengths. By having little to no effect on the sample, the analyst can be confident that the data generated is accurate and has not been contaminated by the presence of unwanted chemicals.

Conclusion

The choice of whether to filter is an easy one to make. The benefits that filtration provide to the instrument and data help keep the laboratory running. Making the right filter choice is more difficult. Even when considering similarly rated filters, performance between membrane types can vary drastically.

An analyst must carefully consider the retention efficiency of the filter to ensure they are getting the best protection for their column. Every analyst must consider the effects of potential extractables. Contaminants lead to unreliable data which can have disastrous consequences. Pall's Acrodisc One syringe filters can provide better column protection than other broadly chemically compatible products. When column protection and low extractables are considered together, it becomes clear that an Acrodisc One syringe filter is the filter of choice.

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