Considerations for Proper Syringe Filter Selection

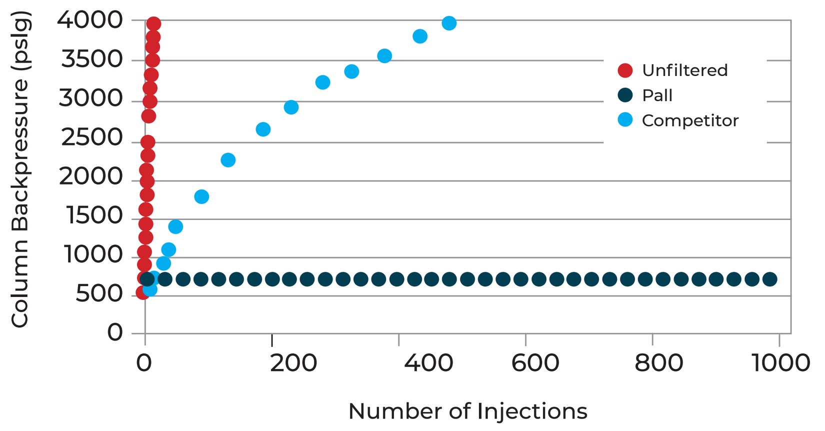
PALL CORPORATION

ABSTRACT

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.

EFFECT OF FILTRATION ON HPLC COLUMNS

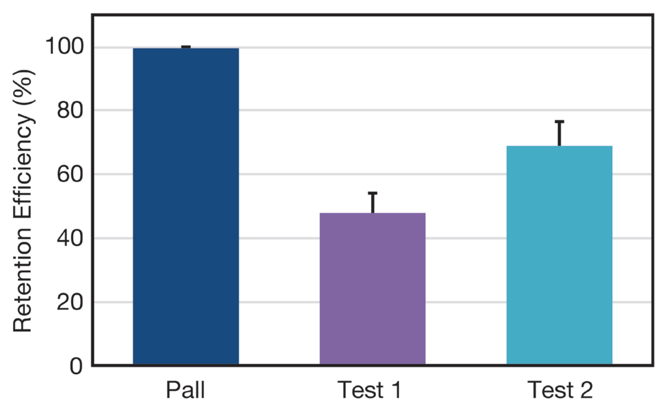
Effects of filters on HPLC column life following injections of unfiltered and filtered 0.05% latex sphere suspensions(1). With unfiltered samples, the column failed due to plugging after 19 injections. Samples passed through Competitor filters plugged the columns after 500 injections. No increase in backpressure was observed after 1000 injections of samples filtered with Pall Acrodisc® One syringe filters.



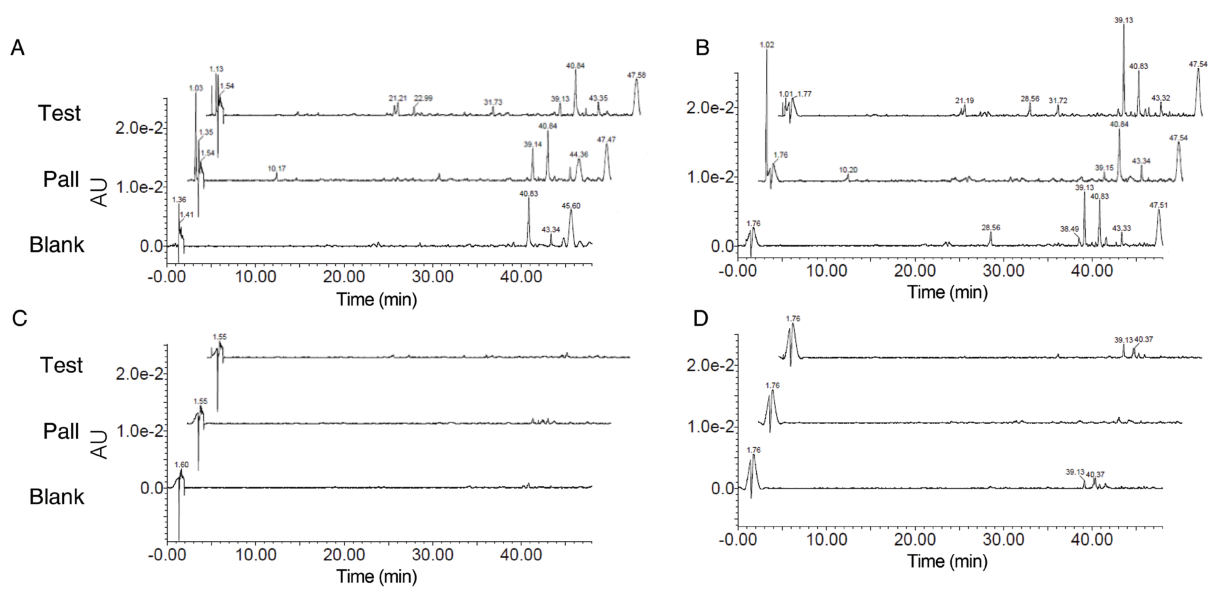
WATER WETTABLE PTFE (WWPTFE) AND REGENERATED CELLULOSE COMPARISON

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	Regenerated Cellulose 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



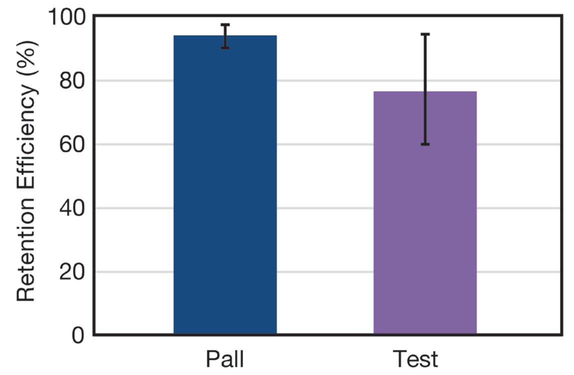
Chromatograms of Pall Acrodisc One syringe filter and regenerated cellulose membrane syringe filters (Test). The filtrates and solvent blanks with an injection volume of 50 µL were analyzed under gradient conditions with a mobile phase consisting of water and acetonitrile with a flow rate of 1.0 mL/min 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.



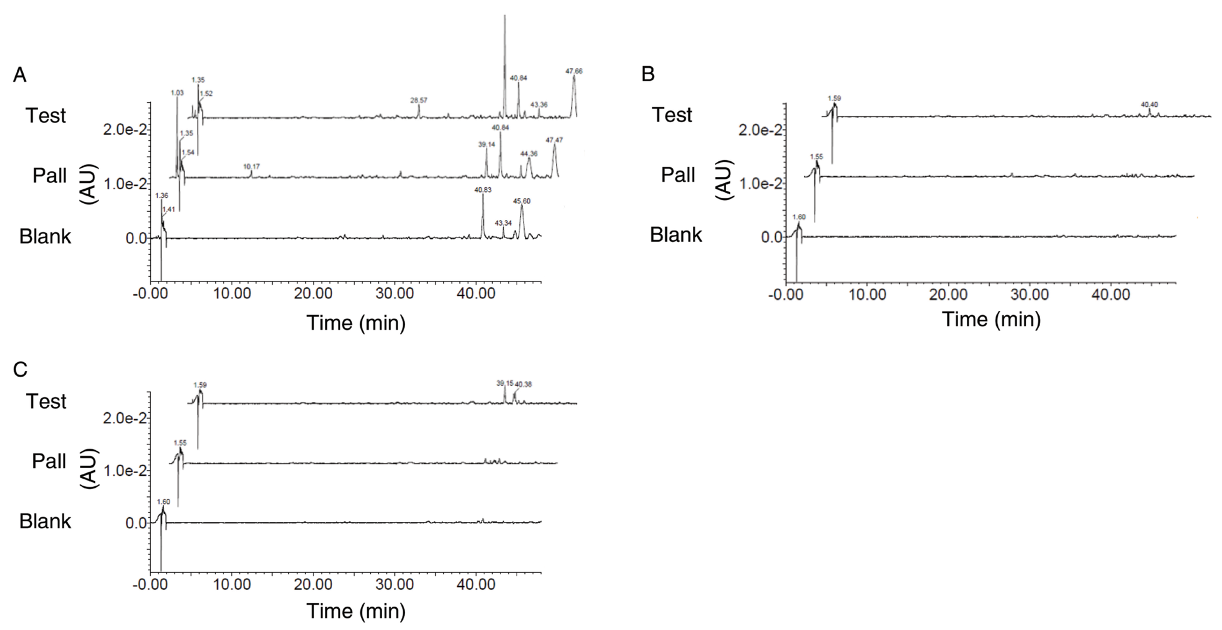
wwPTFE AND LOW COST HYDROPHILIC PTFE COMPARISON

Latex sphere retention of syringe filters with 0.45 µm pore size ratings. *Results may vary.*

Filter	Pall	Test
1	98.0	67.3
2	89.8	87.8
3	93.9	53.1
4	95.9	79.6
5	93.9	98.0
Average	94.3	77.1
Std Dev	3.03	17.52



Solvent extractable properties of syringe filters equipped with 0.2 µm wwPTFE or low cost hydrophilic PTFE membrane. Ten microliter injection volumes of the methanol solvent blank (Blank) and filtrates obtained with the Pall Acrodisc One syringe filter (Pall) or commercially available syringe filters (Test) were analyzed using a Waters Acquityu UPLC H-Class system with a Diode Array Detector and a Nova-Pak 4 µm C18, 4.6 mm x 150.0 mm column. 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 at 214 nm, 254 nm, and 280 nm (Panels A, B, and C, respectively). *Results may differ.*



NYLON RETENTION

Latex sphere retention of syringe filters with 0.2 µm and 0.45 µm pore size ratings. *Results may vary.*

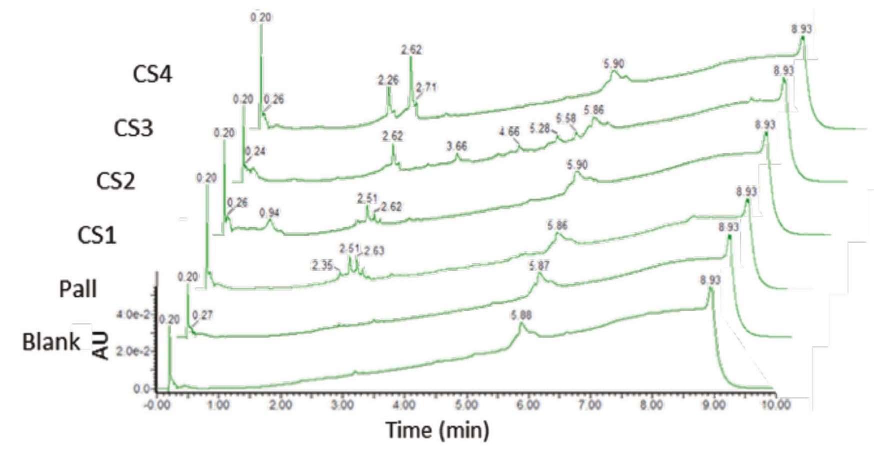
Replicate	Rentention Efficiency (%) 0.2 µm	0.45 µm
1	90.8	92.2
2	81.6	92.1
3	89.0	92.0
4	75.4	91.6
5	88.9	91.8
Average	85.1	91.9
Std Dev	6.5	0.2

NYLON EXTRACTABLES COMPARISON

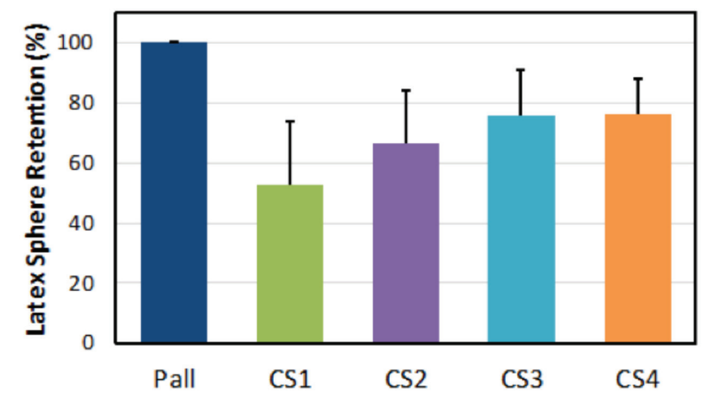
Solvent extractable properties of syringe filters equipped with 0.2 µm nylon membrane. Ten microliter injection volumes of the methanol solvent blank (Blank) and filtrates obtained with the Pall Acrodisc (Pall) or commercially available syringe filters (CS1-4) were analyzed using a Waters Acquityu UPLCu H-Class system with a Tunable UV Detector and a 2.1 x 50 mm, 1.7 µm Waters Acquity UPLC BEH C18 reverse phase column under gradient conditions with a mobile phase consisting of water and a cetonitrile with a flow rate of 0.6 mL/min and a column temperature of 35 °C.

NYLON EXTRACTABLES COMPARISON (CONTINUED)

Initial conditions of 5% acetonitrile were held for 0.5 min, followed by a linear gradient of 5-100% acetonitrile over 6.9 min, and then to remain at 100% acetonitrile for 0.9 min. Data was collected at a wavelength of 214 nm. *Results may vary.*



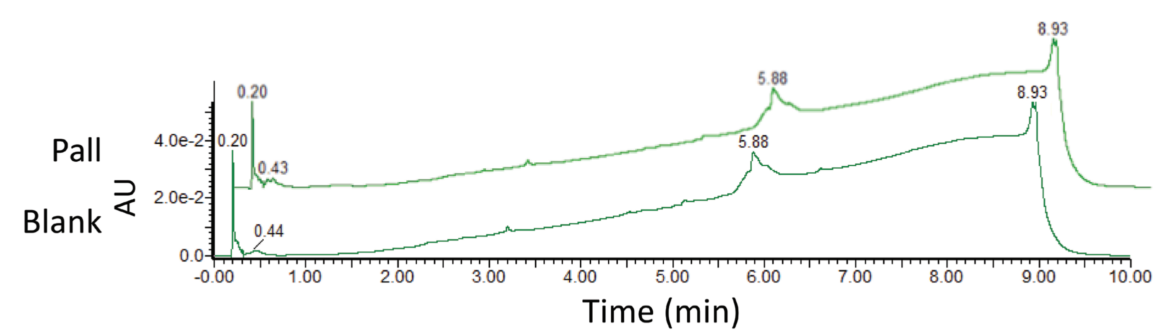
HYDROPHOBIC PTFE RETENTION COMPARISON



Latex sphere retention of syringe filters with pore size ratings of 0.2 µm. Shown are data for Pall PTFE syringe filters (Pall) and commercial sample syringe filters (CS1-4). The data is normalized to the Pall filter retention. The data is an average of five filters and the bars represent the standard deviation. *Results may vary.*

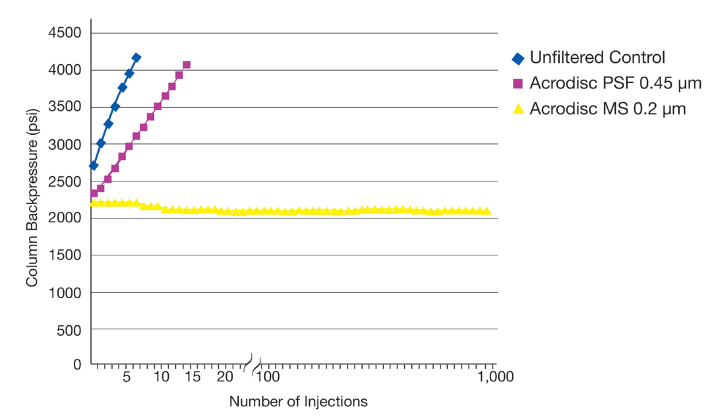
HYDROPHOBIC PTFE EXTRACTABLES

Solvent extractable properties of Pall Acrodisc syringe filters with 0.2 µm hydrophobic PTFE membrane. Filtrate (Pall) and solvent blank (Blank) (10 µL injection volume) were analyzed using a Waters Acquityu UPLCu H-Class system with a Tunable UV Detector and a 2.1 x 50 mm, 1.7 µm Waters Acquity UPLC BEH C18 reverse phase column under gradient conditions with a mobile phase consisting of water and acetonitrile with a flow rate of 0.6 mL/min and a column temperature of 35 °C. Initial conditions of 5% acetonitrile were held for 0.5 min, followed by a linear gradient of 5-100% acetonitrile over 6.9 min, and then to remain at 100% acetonitrile for 0.9 min. Data was collected at a wavelength of 214 nm. *Results may vary.*



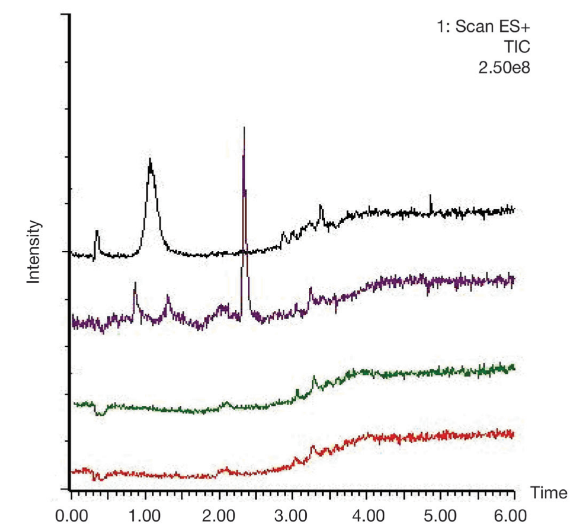
UHPLC COLUMN LIFE EXTENSION

Columns last 111 times longer than without filtration

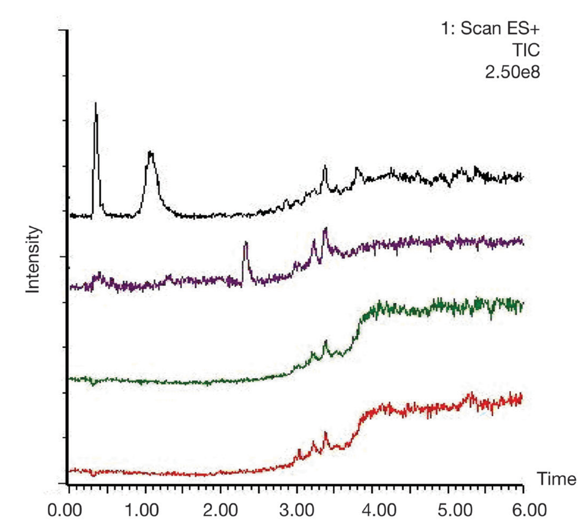


A 0.05% microsphere suspension (average diameter 0.31 µm) in 0.002% Tritonu X-100 (prepared from a 10% w/w polymer stock), was filtered using either 0.2 µm Acrodisc MS syringe filters or 0.45 µm Acrodisc PSF syringe filters with nylon membrane. Injection of the unfiltered and the 0.45 µm filtered suspensions resulted in a rapid and significant increase in the backpressure of the Acquity UPLC column, after 9 and 16 injections, respectively. By contrast, column plugging was not observed even after 1,000 injections of the effluents from the Acrodisc MS syringe filters.

ACRODISC MS (wwPTFE)



Overlaid TIC chromatograms of the (A) Control, (B) Effluent from Pall Acrodisc MS syringe filter, (C) Competitor, (D) Competitor filter using Methanol: Water (50:50, v/v) as the test fluid.



Overlaid TIC chromatograms of the (A) Control, (B) Effluent from Pall Acrodisc MS syringe filter, (C) Competitor, (D) Competitor filter using pure Methanol as the test fluid.

IC ACRODISC (SUPOR PES)

Analysis of 4 Anions in 18 Megohm Water

	(mg/L) CL^-	NO_3^-	PO_4^{3-}	SO_4^{2-}
Sample 1	0.0	0.000	0.0	0.00
Sample 2	0.0	0.000	0.0	0.00

Concentration of 4 Anions in the Standard Solution

	(mg/L) CL^-	NO_3^-	PO_4^{3-}	SO_4^{2-}
Sample 1	0.2	0.973	0.5	1.53
Sample 2	0.2	0.951	0.5	1.5
Sample Average	0.2	0.962	0.5	1.52

Concentration of 4 Anions After Passing the Standard Solution Through the Test Filters

	(mg/L) CL^-	NO_3^-	PO_4^{3-}	SO_4^{2-}
Pall Laboratory	0.3	0.991	1.5	1.56
Competitor 1	0.9	1.03	1.5	1.67
Competitor 2	0.3	1.207	0.0	1.47
Competitor 3	0.3	1.000	1.5	1.79

Difference Between Table 2 and Table 3 for Test Filters

	(mg/L) CL^-	NO_3^-	PO_4^{3-}	SO_4^{2-}
Pall Laboratory	0.1	0.029	0	0.04
Competitor 1	0.7	0.068	0	0.15
Competitor 2	0.1	0.245	-1.5	0.05
Competitor 3	0.1	0.038	0	0.27

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. However, choosing the right filter requires more consideration. Retention efficiency of the syringe filter is key to getting the best protection for chromatography columns, ensuring optimum performance, and data integrity. Particulate build up is directly related to increased column back pressure and poor peak resolution. In addition, data quality can also be compromised by filter materials that add extractables affecting the data integrity by coelution or adding extraneous peaks.