PALL Laboratory

order on VWR.COM

Application Note

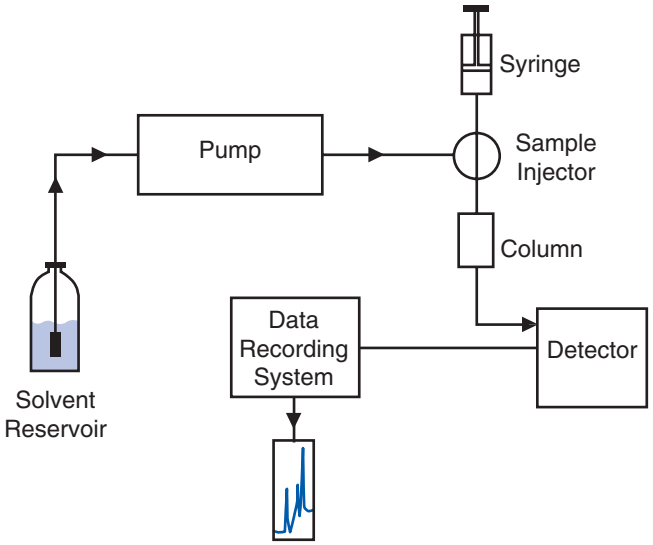
The Acrodisc One™ Syringe Filter Compared to Syringe Filters with Hydrophilic Polypropylene Membrane

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, reduce overall instrument wear and remove any particles that may interfere with the chromatogram. Sample filtration using syringe filters is a high impact, time effective and easy to implement method.

Figure 1

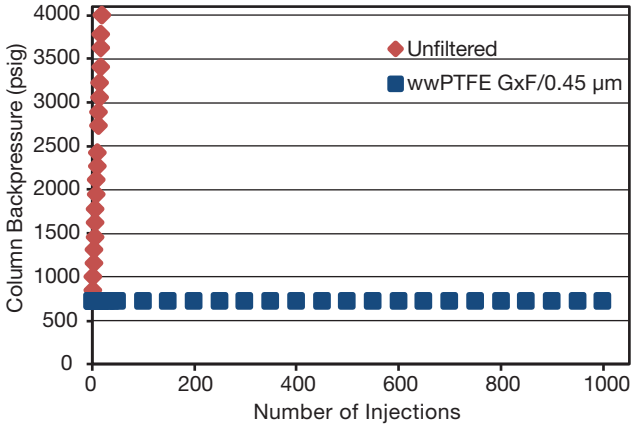
A Basic HPLC Configuration



Of the four common causes for HPLC column failure – plugging, voids, absorbed sample and chemical attack – plugging is the most frequently encountered by analytical chemist 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 (1)

Figure 2

Effects of Filters of HPLC Column Life



In the Analytical Technical Guide; Including HPLC and Dissolution Testing, 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. Particle blockages are prevented by filtering the mobile phase through a 0.2 µm or 0.45 µm disc filter, and 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.

Acrodisc One Syringe Filters with wwPTFE Membrane and Syringe Filters with Hydrophilic Polypropylene Membrane Extractables

In 1994, GHP (hydrophilic polypropylene) was launched as the universal membrane for analytical chemistry applications. Since that time, the hydrophilic polypropylene membrane has been the membrane of choice for HPLC applications using a wide variety of sample types. However, as different detection methods were developed and assay sensitivity increased, the need for the next generation of universal membranes became clear.

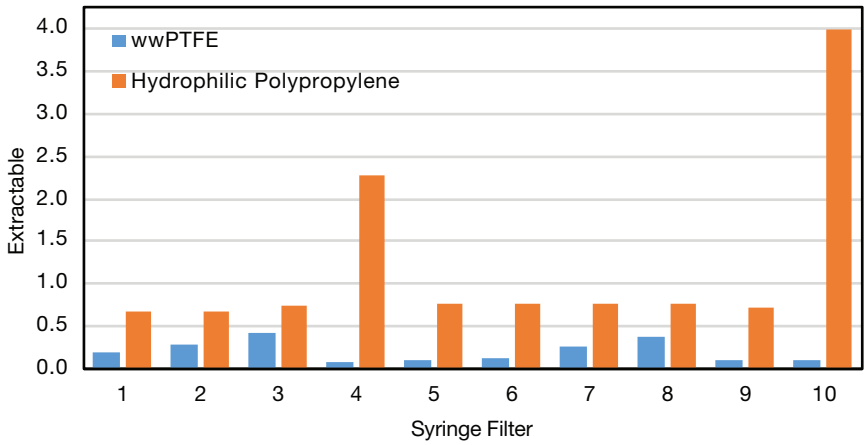
To address this need, Pall Laboratory introduced the wwPTFE membrane found in our Acrodisc One syringe filters. This hydrophilic wwPTFE membrane offers many significant improvements over hydrophilic polypropylene, to suit the requirements of today's analyst protecting their instrument and data. With the ability to filter a wide variety of sample solvents and complex matrices with minimal extractables, the Acrodisc One with wwPTFE membrane is the membrane of choice for HPLC and UHPLC applications as well as highly sensitive MS detection systems.

Extractables, or unwanted chemicals coming from the syringe filter are a critical concern when selecting which syringe filter to use. The polymeric resins, solvents, pore formers and other chemical components such as housing materials utilized during 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.

To determine the amount of extractable material present in both Acrodisc One syringe filters and syringe filters with hydrophilic polypropylene, filtrates from each type of syringe filter were compared with an internal standard after HPLC analysis.

Figure 3

Methanol filtrates from 10 Acrodisc One syringe filters and 10 syringe filters with hydrophilic polypropylene were analyzed by HPLC at a wavelength of 254 nm and the results compared to a known internal standard.



As the data presented indicates, in each of the 10 injections, the Acrodisc One syringe filter had lower level of extractable material than syringe filters with hydrophilic polypropylene membrane. This reduced level of contaminants found in the Acrodisc One is necessary for today's highly sensitive chromatographic techniques and cutting-edge research.

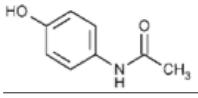
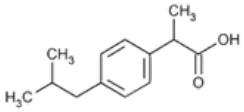
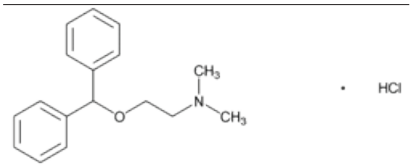
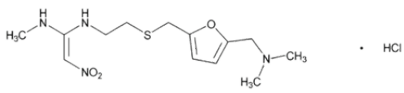
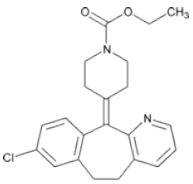
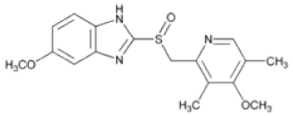
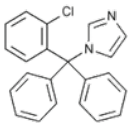
Acrodisc One and Hydrophilic Polypropylene Syringe Filter API Binding

When filtration is used as part of the sample preparation process, analysts must be concerned with potential binding of their target analytes as well as extractable contaminants. The potential for analyte binding is determined through pharmaceutical dissolution testing.

Filtration is a common method of sample preparation in dissolution testing prior to an HPLC injection. One potential drawback includes API adsorption from the drug mixture, leaving the concentration in the filtrate too low and out of specification (OOS). The drug product selection and product formulations in this study represent a wide variety of compounds that differ in chemical structures, ionization properties, and molecular weights, therefore they can differ in binding propensity. All experiments are designed based on well-characterized (validated) USP methods.

Table 1

Pharmaceutical Products

Drug Product (Brand Name)	Molecule Type	Molecular Structure	HPLC Mobile Phase
Acetaminophen (Tylenol◆) Tablets	Acetamide MW 151.16		Mixture of organic (MeOH) and water (25:75)
Ibuprofen (Motrin◆) Tablets	Phenylpropionic acid MW 206.28		Mixture of organic (ACN), and aqueous chloroacetic acid buffer (60:40), pH 3.0
Diphenhydramine (Benadryl◆) Tablets	2-(Diphenylmethoxy)-N, N-dimethylethylamine MW 291.82		Mixture of organic (ACN), and aqueous phosphate buffer, pH 3.0
Ranitidine (Zantac◆) Tablets	Hydrochloric salt MW 350.87		Mixture of organic (ACN), and aqueous phosphate buffer, pH 7.1
Loratadine (Claritin◆) Tablets	Pyperidine carboxylate MW 382.88		Mixture of organic (ACN and MeOH), and aqueous phosphate buffer (60:60:70), pH 7.2
Omeprazole (Prilosec◆) Tablets	Benzimidazole MW 345.42		Mixture of organic (ACN and MeOH), and aqueous glycine buffer, pH 9.0
Clotrimazole (Lotrimin◆) Tablets	1-[(2-chlorophenyl)-diphenylmethyl]imidazole		Mixture of organic (ACN) and aqueous phosphate buffer (75:25) MW 344.84

Results are obtained by HPLC analysis with UV detection. All calculations are performed according to each specific USP procedure against the appropriate, well-characterized (certified), corresponding USP reference standard. Label claim percentage (% LC) of each drug is calculated as a ratio of the amount of drug that is found during analysis in each filtrate to the amount known (or claimed) to be present in the tested solution, and expressed as a percentage. Recovery of each drug upon filtration (i.e., % LC to centrifuged) is calculated as a ratio of the amount that is found during analysis in each filtrate to the amount that is found in the centrifuged sample, and expressed as a percentage.

Twenty milliliters of the sample solution are run through each filter. The 1st, 2nd, 3rd, 5th, 10th, 15th and 20th individual 1 mL aliquots are collected and analyzed. The drug concentration is measured after filtration. Duplicate HPLC injections of the seven 1 mL aliquots are performed for each filter, with each drug evaluated (280 samples total). The flush volume evaluation is determined as sufficient when the recovery value for the filtered sample is within 97-103% of the centrifuged sample. The recovery of each drug preparation is determined as a percentage of label claim and as a ratio of percentage of label claim to the centrifuged sample, according to USP methodologies.

Table 2

Amount of API expressed as percentage of label claim in centrifuged samples (%LCC) and in samples filtered with Acrodisc PSF GxF/0.45 µm GHP (%LCF). The difference in the magnitude in recovery of each drug following filtration or centrifugation is shown as %LCΔFC. API concentrations were determined by HPLC analysis with UV detection at 243 nm for Acetaminophen, 254 nm for Ibuprofen, 230 nm for Ranitidine HCl, 254 nm for Loratidine, 305 nm for Omeprazole, and 206 nm for Clotrimazole according to USP methods.

Fraction Collected	Acetaminophen Tylenol		Ibuprofen Motrin		Diphenhydramine HCl Benadryl		Ranitidine Zantac		Loratadine Claritin		Omeprazole Prilosec		Clotrimazole Lotrimin	
	% LC_F	% $LC_{\Delta FC}$	% LC_F	% $LC_{\Delta FC}$	% LC_F	% $LC_{\Delta FC}$	% LC_F	% $LC_{\Delta FC}$	% LC_F	% $LC_{\Delta FC}$	% LC_F	% $LC_{\Delta FC}$	% LC_F	%$LC_{\Delta FC}$
%LC_C	**101.3**		**101.2**		**101.6**		**99.0**		**96.0**		**99.6**		**100.8**	
1st mL	101.3	0.1	101.4	0.2	64.4	-36.6	99.1	0.1	95.6	-0.4	99.9	0.2	101.1	0.3
2nd mL	100.7	-0.6	101.2	0.0	101.4	-0.1	99.3	0.2	97.3	1.4	99.9	0.3	101.1	0.3
3rd mL	100.8	-0.4	101.7	0.5	101.0	-0.6	99.3	0.3	97.6	1.7	99.9	0.2	101.1	0.3
5th mL	101.0	-0.3	101.6	0.4	99.9	-1.6	99.2	0.2	98.2	2.3	99.9	0.2	101.0	0.2
10th mL	101.0	-0.2	101.4	0.2	101.8	0.2	99.1	0.1	97.8	1.9	99.9	0.3	100.7	-0.1
15th mL	100.5	-0.8	101.8	0.6	100.9	-0.6	99.2	0.2	98.0	2.1	100.2	0.6	102.2	1.4
20th mL	100.8	-0.5	101.0	-0.1	101.7	0.1	99.1	0.1	98.1	2.3	100.0	0.4	102.6	1.7

Table 3

Amount of API expressed as percentage of label claim in centrifuged samples (%LCC) and in samples filtered with Acrodisc One syringe filter GxF/0.45 µm wwPTFE (%LC_F). The difference in the magnitude in recovery of each drug following filtration or centrifugation is shown as %$LC_{\Delta FC}$. API concentrations were determined by HPLC analysis with UV detection at 243 nm for Acetaminophen, 254 nm for Ibuprofen, 230 nm for Ranitidine HCl, 254 nm for Loratidine, 305 nm for Omeprazole, and 206 nm for Clotrimazole according to USP methods.

Fraction Collected	Acetaminophen Tylenol		Ibuprofen Motrin		Diphenhydramine HCl Benadryl		Ranitidine Zantac		Loratadine Claritin		Omeprazole Prilosec		Clotrimazole Lotrimin	
	% LC_F	% $LC_{\Delta FC}$	% LC_F	% $LC_{\Delta FC}$	% LC_F	% $LC_{\Delta FC}$	% LC_F	% $LC_{\Delta FC}$	% LC_F	% $LC_{\Delta FC}$	% LC_F	% $LC_{\Delta FC}$	% LC_F	%$LC_{\Delta FC}$
%LCC	101.3		101.2		101.6		99.0		96.0		99.6		100.8	
1st mL	100.7	-0.5	101.2	0.0	93.2	-8.3	99.4	0.3	99.5	3.7	100.5	0.9	100.3	-0.5
2nd mL	100.2	-1.1	101.2	0.0	100.8	-0.7	99.3	0.3	99.1	3.2	100.5	0.9	100.2	-0.6
3rd mL	101.6	0.3	101.5	0.4	101.2	-0.3	99.3	0.3	99.7	3.9	100.3	0.7	100.3	-0.5
5th mL	99.9	-1.3	101.4	0.3	100.9	-0.7	99.3	0.3	99.0	3.2	100.4	0.8	100.2	-0.6
10th mL	100.2	-1.0	101.1	-0.1	100.7	-0.9	99.3	0.3	99.0	3.2	100.4	0.8	100.1	-0.7
15th mL	100.8	-0.4	101.6	0.4	99.4	-2.1	99.1	0.1	98.1	2.2	100.4	0.8	99.8	-1.0
20th mL	100.5	-0.7	101.3	0.1	100.7	-0.9	99.0	0.0	98.1	2.2	100.3	0.7	100.9	0.1

Unlike previous studies showing that a flush volume of up to 3 mL can be required to compensate for OOS results when filtering API, the data obtained using the Acrodisc One syringe filter show no such requirement for any of the drugs tested. Both the Acrodisc One syringe filter and syringe filters with hydrophilic polypropylene required a 1 mL flush for diphenhydramine. However, when comparing the actual results, we can see that the syringe filters with hydrophilic polypropylene bound over 36% of the API present. The syringe filter with hydrophilic polypropylene required a flush for loratadine as well, which was not required by the Acrodisc One with wwPTFE membrane. The data obtained from the binding study shows the ultra-low binding nature of the wwPTFE membrane used in the Acrodisc One syringe filter simplifies testing procedures and methods.

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.

Highly sensitive assays and analyses performed by today's laboratory analysts and researchers require a filter that will not leach extractable contaminants or bind target analytes. Both contaminants and binding lead to unreliable data which can have disastrous consequences.

Pall Laboratory's Acrodisc One syringe filter:

- Extend column life up to 52 times over an unfiltered sample
- Provide up to 10x lower extractable materials than hydrophilic polypropylene when compared to an internal standard
- Bind less API than syringe filters with hydrophilic polypropylene when performing dissolution testing.

PALL® Laboratory

Ordering:
vwr.com

5/19, PDF, GN19.0426

Filtration. Separation. Solution.SM