Use of GD/XP syringe filters for accurate analysis of metals

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Introduction

In order to be able to determine the inorganic ion content (e.g., metals) of a sample as accurately as possible, it is important to avoid contamination during sample preparation such as a filtration step. Whatman™ GD/XP syringe filters (Fig 1) have been specifically designed to minimize inorganic extractables.

Fig 1. GD/XP syringe filter.

GD/XP syringe filters comprise a two-layer prefilter stack consisting of 20 µm and 5 µm polypropylene filters and a final membrane filtration layer positioned below the prefilter stack (Fig 2). This multilayer construction increase the volume of liquid that can be filtered compared to a filter with a single membrane layer.

Whatman GD/XP 0.45 µm PP filters (cat. number 6993-2504) were analyzed to determine the quantity of metals that might be released from the filters. The method involved flushing the filters with an acid solution and then analyzing the acid solution for metals by ICP-OES. These conditions should provide a realistic view of the quantity of metals leached during filtration prior to metal analysis.

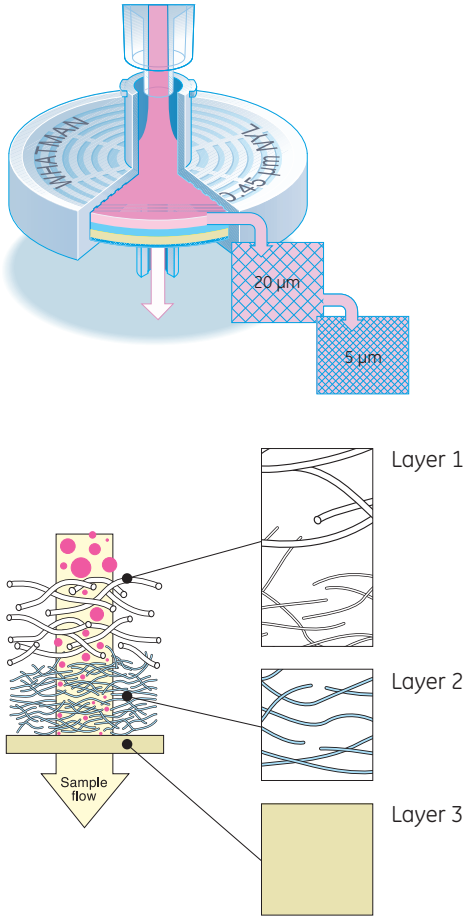

Fig 2. GD/XP syringe filters contain three filtration layers and this leads to an increase in the volume of liquid that can be filtered. Layer 1 is a 20 µm polypropylene filter, layer 2 is a 5 µm polypropylene filter, and layer 3 is a 0.45 µm filter (such as polypropylene, PTFE etc.).

Materials and methods

Three lots of GD/XP syringe filters (catalog number 6993-2504: 0.45 µm Polypropylene) were used in this study. Lot numbers used were O684, L925, and W466. The tests were performed at GE China Technology Center in Shanghai, China. Whatman GD/XP syringe filters were washed with 10 ml of HNO_3/HCl (1:2). This solution was evaporated at 90°C until almost dry. The residue was digested in 1 ml of HNO_3/HCl (1:2) until the residue completely dissolved. Each sample was diluted to 15 ml with deionized water. Blanks were prepared in an identical manner to the samples. Each lot of GD/XP filters were tested in duplicate. ICP-OES (Inductively Coupled Plasma Optical Emission) was used for determining the metal content of the samples.

ICP-OES conditions

RF power:	1400 W
Coolant flow:	13.00 L/min
Auxiliary flow:	0.80 L/min
Nebulizer flow:	0.80 L/min
Nebulizer:	Cross flow
Spray chamber:	Quartz scott type
Plasma torch:	Quartz standard

Discussion and conclusion

Critical metals such as Cd, As, and Pb were below the detection limits. Zn, Fe, Ba, Al, Cu, and Sr could be detected but they were present at low levels. Consider the following scenario: assume a GD/XP filter is used to filter a 10 ml solution. The filter will introduce 2.12 µg of Zn. Thus the back ground concentration of Zn due to the filter would be 0.21 ppm. In fact, Zn had the highest concentration. Hence the background levels for other metals that were detected would be lower. Therefore we may conclude that GD/XP, 0.45 µm PP syringe filters are suitable for the filtration of samples prior to metal analysis.

Results

Table 1. GD/XP metal content

	GD/XP metal content (µg per filter)							
GD/XP Lot #	**L925 (Filter 1)**	**L925 (Filter 2)**	**O684 (Filter 1)**	**O684 (Filter 2)**	**W466 (Filter 1)**	**W466 (Filter 2)**	**Ave.**	**Std dev.**
Metal								
As	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	-
Cd	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	-
Cr	< 0.01	< 0.01	< 0.01	0.03	< 0.01	< 0.01	< 0.01	-
Cu	0.04	0.04	0.04	0.05	0.03	0.05	0.04	0.01
Mo	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	-
Ni	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	-
Pb	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	-
V	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	-
Zn	1.33	1.58	1.56	1.85	3.51	2.94	2.12	0.88
Fe	4.35	1.27	0.68	2.29	1.12	0.71	1.74	1.41
Ba	< 0.01	< 0.01	< 0.01	< 0.01	0.03	0.02	0.02	-
Al	0.95	0.53	0.3	0.79	0.45	0.36	0.56	0.26
Sr	0.06	0.03	0.02	0.04	0.02	0.02	0.03	0.02

< = below detection limit

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