

Study of metals contamination in different filter papers

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Abstract: Membrane filters have come into general use in recent years for the filtration of water samples prior analysis. Membranes are screen filters that remove suspended materials from the water in different size ranges. Filtration is widely accepted as a way of producing acceptable sample and filtration has become a first step in the preparation of water samples for trace metal analysis. Often, the filter is analyzed to study dissolved metal concentration. The investigated show the physical effects of filtration, the most micro fibre filters paper is contaminated by different amount of metal concentrations. On the other hand, there is no metal contamination in the membrane filters nylon.

I. Introduction

Some research studies have investigated possible contaminants associated with a range of filter types, and the adsorption capacity of filter papers (Dams et al., 1972; Habib and Minski 1981; Jardline et al., 1986; Walsh et al., 1988). Other research studies have been concerned with the physical effects of filtration, and have emphasized differences in trace metal concentrations that are likely to be measured if filters of different pore size are used (Liu et al, 1977; Bertsch, 1989). Berg and Royset 1993, found that, in different brands of filter paper, there are different concentrations of trace metals, for example glass fibre filter had considerable concentrations of metals such as Cr, and Zn. In addition, the quartz filter type showed measurable concentrations of elements including: B, Cr, Mg, Mo, Na, and Zn. Marvin et al. (1970) found that several types of filter paper are contaminated with Cu. Robertson, (1965); Spencer and Manheim, (1969) have determined that the heavy element content of membrane filters used in the filtration process of the water samples is a potential source of contamination.

Some studies have found that some of the factors associated with filtration can considerably change metals concentrations: such as: filter type, filter diameter, filtration method (Horowitz et al., 1992). Filter paper may be adsorbing some metal from the solution phase or may be releasing metals contamination the solution (Hedberg et al 2011). In the current work, probable contaminants associated with a range of filter paper products were measure to try to develop methods for removing them prior to use. Initially the study entailed a comparison of filter types, using glass micro fibre and nylon membrane of different diameter size (47, 90, 125 mm), of various pore sizes (1.2 μm and 0.2 μm).

II. Methods

A different filter paper is used and analysed to check the amount of metal contamination. Filtration was carried out using Whatman 1.2 μm pore size glass micro fibre of different diameter size (47, 125 mm), Whatman 1.2 μm pore size micro fibre filters (47mm) diameter (Acid Treated low Metal), 47 mm and 90 mm diameter 0.2 μm pore size membrane filters nylon.

Three replicates of filter from the same box were digested in 3:1 hydrochloric acid /nitric acid solution, an aqua regia digest. Filters were analyzed both before and following washing with 5 L of deionised water. Measurements of metals in the aqua regia digest of 1.2 μm and 0.2 μm pore size were done by atomic absorption spectrometry (AAS). A metal solution containing solvent only was used as a blank.

Acid treatment of 125 mm diameter, 1.2 μm pore-size micro-fibre filters

The filter papers were washed by 100ml of different concentrations of HNO_3 passing through the filter paper, to try to remove the contamination of metals in the filter paper. The 125 mm diameter, 1.2 μm pore-size micro-fibre filters were washed using 100ml of different concentrations of HNO_3 . The concentrations were 0.1 M, 1 M and 5 M HNO_3 . The acid was filtered through different filter papers, and a different paper was used for each concentration. The filter paper is washing by different concentrations of HNO_3 sequentially. This method applies the acid washing to the same filter paper, not like the previous method that applied the washing in different filter paper. 125 mm diameter, 1.2 μm pore-size micro-fibre filters was washed sequentially by different concentration of HNO_3 0.1 M, 1 M and 5 M.

III. Result and discussion

The results in table (1) indicate filter paper of 47 mm diameter, 1.2 µm pore sizes was contaminated by some metals and that levels of contamination were variable. The metal concentrations decreased after 5 liters deionized water was passed through the filter paper but, even so, the concentration is measurable and unacceptable for use to determine metals concentrations in suspended sediment. There are in fact two features that make the filter paper of 47 mm diameter, 1.2 µm pore-size not appropriate to use to assess metals in the suspended materials. These are the small diameter size, which affects the time of the filtration, and the high concentration of some metals.

Table (1) metal contamination in filter paper 1.2 µm pore size microfiber filters (47 and 125) mm

Filter paper size		Concentration mg/g Before and after washing			
		Fe	K	Na	Zn
Filter paper 1.2 µm, 47 mm	No washing	0.147- 0.20	4.1- 4.7	12-13	5.57- 5.76
	5 L deionised water	0.145- 0.20	2.0-2.38	5.1-5.5	2.50-2.60
Filter paper 1.2 µm, 125 mm	No washing	0.075- 0.079	3- 3.7	12.5- 13.3	5.1- 5.5
	5 L deionised	0.04- 0.043	1.8- 2	4.5-5.9	2.4-2.6

Table (1) shows 125 mm diameter, 1.2 mm pore-size microfiber filters measurable concentrations of a number of metals. That before and after filtering through 5 liters deionized water, and after the filter paper has been left in the air to dry. The larger size of diameter of the filter paper makes the filtration process faster, and reduced the filtration time taken. On the other hand, there were high contaminations levels measured in filter papers that make their use not appropriate.

The 125 mm diameter, 1.2 µm pore-size microfiber filters were washed using 100 ml different concentrations of HNO₃. The concentrations were 0.1 M, 1 M and 5 M HNO₃. The acid was filtered through different filter papers, and different paper was used for each concentration. Based on the result, there is still an unacceptable contamination in the filter paper. Another method for acidic treatment in the filter paper may be able to help to remove the contaminations in the filter paper digest, washing a filter sequentially with several concentrations of acid.

The filter paper is washing by different concentrations of HNO₃ sequentially. In the separately acid washing, some decreased in the metals concentration was measured, comparing with concentration measured after washing by 5 litres deionised water. Even that the concentration was unacceptably in the both ways. There is no different contamination level between 125 mm and 47 mm 1.2 µm pore size micro-fibre filters. Application of an acid pre- treatment could possibly remove the contamination from the filters. Therefore this was performed. The most micro fibre filters paper investigation is contamination by different metal concentration, which means this filter paper, is not suitable to determine the mineral deposits in the sediment.

1.2 µm micro fibre filters (47 mm) (Acid Treated low Metal) had a low concentration of Zn, and Fe are shown in table (2). The concentrations decreased after the 5 litres of water was passed through the filter paper, but there was no marked change in the contamination amount after the washing. In spite of the small diameter of the 1.2 µm micro fibre filters (47 mm) (Acid Treated low Metal) that adversely affects the time of the filtration. Hedberg et al 2011 found membrane filtration is not appropriate to determine the dissolved metal fraction. The presence of varying amounts of other metals in the 1.2 µm pore-size micro fibre filter apparently cannot be eliminated or reduced. On the other hand, there is no metal contamination in the 47 mm and 90 mm diameter 0.2 µm pore size Membrane Filters Nylon. The small diameter size (47 mm) caused a long filtration time. On the other hand, the large diameter size (90 mm) causes the filtration time to be shorter.

Table (2) metal contamination in filter paper 1.2 µm micro fibre filters (47 mm) (Acid Treated low Metal)

Filter paper 1.2 µm	Concentration mg/g					
	Ca	Fe	K	Mg	Na	Zn
No washing	2.9-3.1	0.043-0.05	4.1-4.4	1.07-1.11	7.4-7.9	0.011-0.012
5 Litres deionised water	2.8-3	0.039-0.04	2.9-3.4	0.095-0.99	6.3-7.1	0.010-0.010

IV. Conclusion

The investigation of the physical effects of the nomination show the most filter paper employ is contamination by different metals, which means this filter paper is not appropriate to determine metal in the sediment especial micro fibre filters. Because there is some industry contamination in the membrane filters. The filter paper may be can be use to determine trace metal in suspended sediment after subtracting the contaminated concentration, measured in the digested blank filter paper, from the total concentration measured in the digested suspended sediment from the river sample. On the other hand, there is no metal contamination in the membrane filters nylon.

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