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A novel membrane-based approach for the remote screening of as in waters

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Introduction

The presence of arsenic in water, especially groundwater, is a major problem in different areas of the world. It is considered a potent human carcinogen, associated with increased risk of cancer. In the current context of water scarcity, or in developing countries where access to treated water is limited, the use of groundwater has become an important alternative source of potable water. However, this water may contain, in certain cases, higher concentrations of arsenic than the regulated values (10 μg L^{-1}) according to WHO. Therefore, in this study, we propose to develop a membrane-based device to quickly detect the arsenic present in different types of natural waters to allow the *in-situ* determination of its concentration level.

Some tests have been developed based on colorimetric methods for *in-situ* detection of arsenic, which are based on the reduction to arsine (highly toxic) and formation of a colored complex. In the present study, the formation of a colored complex is also the basis of the detection, but following a preconcentration step involving a membrane system.

Previous results conducted in a permeation cell with natural waters containing As(V) at a pH of about 7 demonstrated that an SLM consisting of 0.5 M Aliquat 336 in dodecane and 4% dodecanol and a 0.1 M NaCl as a stripping solution allowed quantitative arsenic transport [1]. In order to explore other membrane-based possibilities, we also investigated the use of polymer inclusion membranes (PIM) as well as commercial ion-exchange membranes (AEM). Both types of membranes are known to have better stability than SLMs. In the PIM system, better results were obtained when the cellulose triacetate membranes did not contain any plasticizer and Aliquat 336 content was 47.6% [2]. For the AEM, membranes with different anion permselectivities were investigated and the non-mono-anion permselective membrane allowed the quantitative transport of As(V) [3].

To provide further insight into the different membrane possibilities for As transport, in this work PIM membranes based on poly(vinyl chloride) (PVC) have been developed and tested for As extraction. Parameters affecting the membrane composition as well as the effect of different ions present in natural waters have been studied.

Methods

PIMs performance was tested using a cell with an exposed membrane area of 11.5 cm^2. Usually feed solution consisted of 190 mL of trace levels of As at pH 7 while the stripping solution consisted of the same volume of 0.1 M NaCl.

Moreover, a more appropriate tailor-made device was also used to allow As preconcentration next to the colorimetric detection in a single-step. For that, large volumes of natural waters

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containing As were contacted with the membrane placed into the device. The detection of As is currently based on the molybdenum blue reaction but the possibility of using other color reactions for the detection of As is under investigation.

Results

Different membrane compositions have been investigated for As transport. Results are shown in Table 1 where it can be observed that the addition of plasticizers to the membrane did not result in improved membrane extraction and transport properties.

Table 1. Effect of membrane composition on As(V) transport. Feed solution: 10 mg L^{-1} As(V) pH=7; stripping solution: 0.1 M NaCl

PVC (%)	Plasticizer (%)	Aliquat 336 (%)	Transport As(V) (%) (24 h)
57 %	15 % NPOE	28	32.0
57 %	15 % Bis(2-ethyl hexyl)phthalate	28	62.2
57 %	15 % Bis(1-butyl pentyl)adipate	28	50.1
57 %	15 % Dibutyl sebacate	28	19.5
70%	-	30	100

Moreover, the effect of the amount of carrier contained in the PIM on As(V) flux was also investigated and it was observed that significant transport did not occur until the carrier content of 17% (w/w) while a content higher than 23% (w/w) ensured the maximum flux.

Discussion

The obtained results show that the designed PVC based PIM systems effectively transport As(V) contained in waters, and thus, it will facilitate its preconcentration for detection purposes. With respect to membrane composition, PIMs prepared with both PVC and CTA polymers give similar results: enhanced transport is obtained with membranes prepared without plasticizer.

References

[1]. R. Güell, C. Fontàs, V. Salvadó, E. Anticó, *Sep. Purif. Technol*..72 (2010) 319.

[2]. R. Güell, C. Fontàs, E. Anticó, V. Salvadó, J.G. Crespo, S. Velizarov, *Sep. Purif. Tecnol.,*80(2011)428.

[3]. R. Güell, E. Anticó, S. D. Kolev, J. Benavente, V. Salvadó, *C. Fontàs, J. Membr. Sci.* 383(2011)88.

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