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MEMBRANE EXTRACTION - TECHNIQUE FOR MONITORING INORGANIC POLLUTANTS

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Introduction

Inorganic pollutants represent a major risk to the health of the population and ecosystems because they are not biodegradable. Due to the mobility in the environment, they can get into the food chain and thus can seriously affect the health of the population. The most important source of pollution is anthropogenic nature and is mainly due to industrial activity. Mining and processing activities, metal coatings, tailings deposits, waste discharges have a special impact on surface water which is a vector for the transmission of contaminants at a distance (soil, groundwater).
Monitoring them is a first utility activity.
In this paper are presented the results obtained at the separation of some metallic cations: Zn^{2+}, Cu^{2+} frequently found in wastewater or other industrial residues.
The presence of high doses of these cations severely affects people's health. Copper causes anemia and diseases of the liver and kidneys. Zinc intoxication in humans causes gastric irritation and other digestive phenomena with complex metabolic consequences. Zinc also causes respiratory disorders, but also nutritional disorders.

Materials and methods

For the studies analytical grade reagents were used without further purification. Metal cations, in the form of chlorides were purchased from Merck and were used to prepare the feed phase. Sodium chloride (Merck) was used to provide the complexing medium in the feed phase. Membrane extraction was performed through a chloroform-based membrane (Merck) in which the Cyphos IL 102 transporter (trihexyltetradecyl phosphonium bromide) purchased from Sigma-Aldrich was dissolved. The laboratory experiments were performed in a tube-in-tube type transport cell.
The membrane system used consisted of:
- Feed phase (FP) - metallic cation solution (each in a concentration of $5x10^{-2}$ mol/L) in the presence of NaCl (0.5 - 2.5 mol/L), V_{FP} = 25 mL;
- Membrane (M) - Cyphos IL 102 concentration 10^{-2} mol/L in chloroform, V_M = 50 mL;
- Stripping phase (SP) - NaCl solution concentration (0.5 - 2.5mol / L), V_{SP} = 7 mL.
The transport time was 8 hours and the stirring speed of the phases was 200 rpm. The content of metallic cations in the aqueous phases of the membrane system at the end of the extraction process were performed by atomic absorption spectrometry using an Atomic Absorption Spectrometer type M6 Dual Thermo Electron.

Results and conclusions

A series of metal cations among which those who are the subject of this study in the presence of NaCl have the property of forming complex anions (complex chlorides) likely to interact with phosphonium salts forming easily soluble structures in organic phases such as chloroform. Due to these properties, the metal cations can be easily transferred from an aqueous feed phase to another aqueous stripping phase by means of organic membranes containing a suitable carrier.

The process is characterized by a high selectivity determined by the ability of metal cations to form complex anions in chlorinated medium. In the feed phase containing Zn^{2+} and Cu^{2+} each in a concentration of $5x10^{-2}$ mol/L in the presence of 2.5 mol/L NaCl, the zinc cation forms $ZnCl_4^{2-}$ while copper remains in the form of Cu^{2+}.

The Cyphos IL 102 carrier will interact with the zinc complex anion and transfer it to the stripping phase where the Cl^- concentration is low and no longer ensures the stability of the zinc complex. Thus, a practical quantitative separation of Zn^{2+} from Cu^{2+} is obtained with possible analytical applications (Figure 1).

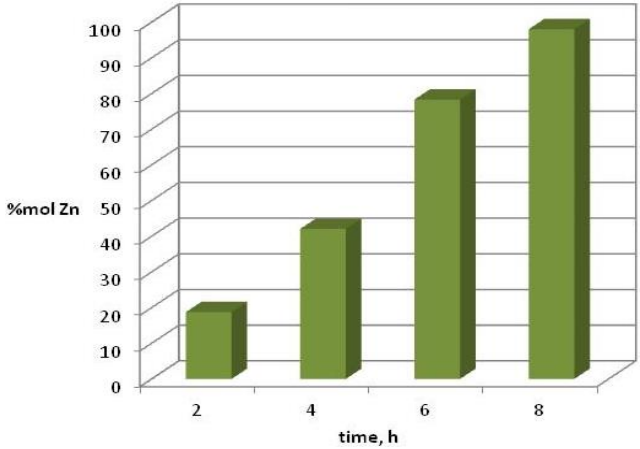

Figure 1. The time variation of the recovered content by the Zn^{2+} in the liquid membrane system.

The results of this study demonstrate the applicability of transport through liquid membranes to the separation of metallic cations from complex matrices for analytical purposes.