Extraction of Gold (III) Ions from Aqueous Solutions Using Surfactant Liquid Membrane

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Abstract

Extraction of gold (III) ions from aqueous solutions by a polyamine type liquid membrane was investigated. Experimental results for the batch extraction of gold (III) ions by surfactant liquid membrane technique are presented. The effects of various parameters such as concentration of gold ions in the external phase, concentration of carrier, concentration of the internal phase reagents, pH of the external phase and the speed of agitation on the extraction rate were studied. Results showed that the use of this type of polyamine surfactant has a very good stability against both reducing-alkaline and acidic solutions and is suitable for this technique. The results showed that by proper selection of the extraction conditions, nearly all of the Au (III) ions present in a high concentrated feed solution was extracted within a few minutes.

Keywords: Gold; Emulsion; Surfactant liquid membrane; Carrier; Extraction.

1.Introduction

Gold appears to be the first metal known and used by man. It occurs in nature as a highly pure metal and is treasured because of its color, its extraordinary ductility, and its resistance to corrosion. Its early uses in medicine and dentistry dated to the ancient Chinese and Egyptians. In the Middle Ages the demand for gold led to the intense, unsuccessful efforts of alchemists to convert base metals into gold, which became the basis for chemical science. The search for gold has been an important factor in world exploration and the development of world trade [1].

Several techniques for gold extraction from aqueous solutions have been invented such as solvent extraction, carbon adsorption, ion exchange, cementation, etc.[2].

The idea to perform extraction in a three-phase system with emulsion liquid membranes (ELM's) is relatively new. The first papers on liquid membranes have appeared in 1968 by N.N. Li [3,4]. Separation techniques using ELM's have been noted as an attractive means of affecting a wide variety of separation of hydrocarbons [5], recovery and removal of organic acids and amines [6,7], waste water treatment [8-11], recovery and purification of metal ions [10-12] and biomedical applications such as artificial kidney [7].

Pertraction through liquid membranes explores a very simple idea: two homogeneous, completely miscible liquids, which may be referred to as donor solution (F), and an acceptor solution (R) are spatially separated by a third liquid (the membrane phase (S)), immicible and practically insoluble in the former two liquids (Figure 1).

With a few exceptions, F and R are aqueous solutions. Due to the favorable thermodynamic conditions created at the interface between the donor solution F and the organic membrane S, some components are extracted from the donor solution and transported into the membrane liquid. Simultaneously, at the second interface (S/R), conditions are created, which favor the reverse transport, i.e., the extraction of the above-mentioned components from the membrane liquid and their accumulation in the acceptor solution R [13].

Emulsion liquid membranes are typically made by, first dispersing the internal phase in an immiscible liquid and dispersing this emulsion in a third phase (called the external phase). Normally, the internal and the external phases