CHAPTER I

INTRODUCTION

In the near future, the exhausting of resources will become a more and more serious problem all over the world. In the past, electrolytic reactors have been developed and employed for the removal and recovery of metals from waste water solutions. Although such processes are applicable to the recovery of many heavy metals, these processes are not generally effective for the treatment of acidic solutions. This mainly due to the low current efficiencies associated with a competing reaction (that is, hydrogen evolution) occurring at the cathode. And other processes for the separation of mineral values from various solutions include solvent extraction method. Although such methods are capable of separation and the recycling of metals, these processes have generally exhibited one or more problems. For example, a significant problem is the loss of solvent during the process. Another problem that occurs is the difficulty encountered in the separation of organic and aqueous phases in the resulting solutions. Additionally, these processes generally require multi-stage operation to achieve a high enrichment factor. Moreover, they can be particularly susceptible to particulate concentration.

In addition to the above electrolytic and solvent extraction methods for metal separation, various membrane-based methods have been employed in the separation of precious metal. In particular, dialysis is employed as a continuous ion exchange process. This process employs a solid ion exchange membrane as a barrier between feed and eluent solutions. However, the method suffers from low removal rate, which is determined by the diffusion rate of ions through the solid, ion exchange membrane. However, it is nonetheless a continuous method and provides many advantages over conventional solvent extraction methods employing mixer/settler system. And increasing need for the removal of metal ions from aqueous solutions not only for reasons of the exhausting of resources, but also for the purpose of pollution control. Due to environmental legislation, the metal ions must be separated below the limits imposed by the environmental protection agencies in various countries. In the waste water solutions, one of metal ions found is copper ion. And in particular, the recovery of copper from waste water solution has been found to be particularly desirable for both of the exhausting of resources and pollution control.

Waste water containing copper ions are produced from electroplating industry, fertilizer industry, hydrometallugical industry, electronic part industry, and the like. Great concern is shown by environmental scientists for the treatment of waste water containing copper. At present, there are quite a few conventional methods for treating waste water containing copper ions, such as electrolytic process, solvent extraction, and ion exchange process. But there are some defects in each of the above method mentioned above.

The membrane separation processes are becoming more and more widely used for the recovery and separation of various solutes. Due to the absence of phase transitions, they need less energy and are specially useful for thermosensitive substances. The membrane processes offer a possibility for economical processing of poor natural sources and industrial waste solutions as well. The interest has recently increased in one specific class of membrane process, the so-called emulsion liquid membrane.

The emulsion liquid membrane, a novel separation technique invented by Li, has been widely used in many fields such as fractionation of hydrocarbons, environmental engineering, hydrometallurgical industry, nuclear industry, pharmaceutical and biological engineering. The emulsion liquid membrane has been noted as an advance technique for separating and concentrating metals, in comparison with solvent extraction. The process is capable of achieving a higher concentration of metals in fewer stages while maintaining the high selectivity of solvent extraction.

The emulsion liquid membrane process is unique and different from the other membrane processes. The membrane is a liquid phase involving an emulsion configuration. Emulsion liquid membranes, also called surfactant liquid membranes or liquid surfactant membranes, are essentially double emulsions, i.e., water/oil/water (w/o/w) systems or oil/water/oil (o/w/o) systems. For the w/o/w systems, the oil phase separating the two aqueous phases is the liquid membrane. For the o/w/o systems, the liquid membrane is the water phase that is between the two oil phases.

The main advantages of the emulsion liquid membrane extraction process are :

1. Very fast transfer rates because of the high specific surface areas.
2. Extraction and stripping in one stage, so that the product can be separated and concentrated at the same time.
3. The possibility of effective extraction from very dilute solutions, because it provides a maximum driving force for the transportation of extracted solutes.
4. Low energy consumption and minimal downstream unit operations.

One disadvantage of the system is swelling of the internal phase due to water transport from the external to the internal phase, resulting in a decrease in the degree if concentration of the solute achieved inside the membrane.

The improvement of the separation process is a method which can be used to minimized releasing of heavy and toxic metals to our environment. Emulsion liquid membrane is a method which has capability to achieve this aim. Therefore, this study will be focused on the separation of copper by emulsion liquid membrane process.

Objectives

The aims of this study are to explore the possibility of extracting copper from aqueous solution by an emulsion liquid membrane process and to find the optimum conditions for improving the extraction of copper by using emulsion liquid membrane according to the following objectives ;

1. To study the extraction of copper from aqueous solution by emulsion liquid membrane by using a batch reactor.
2. To study the extraction of copper from aqueous solution by emulsion liquid membrane process by using a continuous stirred tank reactor.
3. To study the variables that effect the extraction of copper from aqueous solution by emulsion liquid membrane process.
4. To study the optimum condition for the extraction of copper from aqueous solution by emulsion liquid membrane process.

Scope of This Study

The extraction of copper from aqueous solution by an emulsion liquid membrane process was studied according to the following conditions:

1. The concentrations of extractant (D2EHPA) were 0, 1, 5, 7, 10, 15, and 20% by volume.
2. The concentrations of surfactant (Span 80) were 0, 1, 3, 5, 7, 10, and 15% by volume.
3. The acidities (pH) of the feed solution were 2, 3, 4, 5, and 6.

4. The concentration of copper in the feed solution used was 100 ppm.

5. The concentrations of hydrochloric acid aqueous solution used as the stripping solution in the internal phase were 0.01, 0.05, 0.1, 0.5, 1.0, 2.0, and 3.0 N.

6. The ratio of organic phase (kerosene and additives) to the internal phase, hydrochloric acid aqueous solution was used 1:1.

7. The ratios of emulsion membrane phase to feed solution were 1:1, 1:2, 1:3, 1:4, 1:7, 1:9, 1:14, and 1:19.

8. The agitation speeds of the extraction equipment were 200, 300, 400, 500, 600, and 700 rpm.

9. The time of extraction was 60 minutes by kept sample periodically.

10. The volumetric flow rates of the feed solution and that of the membrane phase were kept constant.