UNIVERSITI TEKNOLOGI MARA

SIMULTANEOUS REMOVAL AND RECOVERY OF HEAVY METAL BY EMULSION LIQUID MEMBRANE (ELM): KINETIC STUDY

NUR ILYANI NAJMI BINTI ZAINUDDIN

Thesis submitted in fulfillment
of the requirements for the degree of
Bachelor Eng. (Hons.)
(Chemical)

Faculty of Chemical Engineering

January 2020

ABSTRACT

The presence of heavy metal in industrial effluents has become one of the major factors leading to environmental pollution and human health deficiencies. Owing to this issue, the emulsion liquid membrane (ELM) has been discovered as an advanced and effective technique for heavy metal removal from aqueous solution. This study is aimed to conduct component selection and kinetic study for ELM in favor of Cd(II) and Cu(II) ions removal from synthetic wastewater. On top of that, the selectivity of extraction process in ELM system was identified. Two different types of facilitated carrier; di-(2-ethyhlhexyl) phosphoric acid (D2EHPA) and trioctylamine (TOA) were studied and compared. Membrane phase was incorporated of 0.05 wt% of carrier and 0.95 wt% of kerosene. HCl and NaOH are as the stripping agent accompanied by the carrier were kept constant at 1M concentration while the feed phase was maintained at pH 4. The results revealed that D2EHPA is more preferred as carrier compared to TOA due to higher extraction efficiency (>98%) achieved. Furthermore, it was analyzed that both carriers are being more selective toward Cu(II) removal. The system's ability to remove Cu(II) ions from the feed phase was identified through the use of dimensional reduced concentration, Rf. It was identified that the reaction rate constants for extraction and stripping on Cd(II) removal were found to be 7.66 h–1 and 22.95 h–1 for D2EHPA system and 0.11 h-1 and 2.49 h-1 for TOA system. Meanwhile, as for Cu(II) extraction, reaction rate constants for extraction and stripping obtained for D2EHPA system were 3.66 h-1 and 2.87 h-1, whereas 0.17 h-1 and 3.20 h-1 for TOA system.

ACKNOWLEDGEMENT

First and foremost, praises to Allah, the Almighty, I am truly grateful for the good health and wellbeing that were necessary to complete this thesis and for the opportunity to embark on my bachelor degree and for completing this long and challenging journey successfully.

I would dedicate my sincere gratitude to my research supervisor, Mr Meor Muhammad Hafiz Shah Buddin for providing me invaluable guidance and support throughout this research. I am very thankful for the great privilege and honour to work and study under his supervision. His sincerity and motivation really inspired me. My deep appreciation goes to the higher management and staff of FKK who provided the facilities and assistance during laboratory session and result analysation. Also, special thanks to all my lectures and friends who have been always helping and encouraging me throughout the year.

Finally, I extend my deepest thanks towards both of my parents and family for their love, prayers, and caring. With their support, I could overcome difficulties during this year with much ease.

TABLE OF CONTENTS

CHAPTER ONE

INTRODUCTION

1.1 Research Background

A wide range of highly toxic inorganic and organic chemicals are released into the ecosystem as industrial effluent or waste. This phenomenon later leads to environmental pollution. Water pollution caused by toxic heavy metal ions such as silver (Ag), platinum (Pt), copper (Cu), and cadmium (Cd) is a serious environmental problem. These heavy and high toxic metals are normally originates from anthropogenic sources such as chemical manufacturing, metal finishing, welding, alloys manufacturing, painting, mining, extractive metallurgy, plating, tannery and battery industry and industries that use metal-containing fertilizers and pesticides (Bradl, 2005).

Liquid membrane technology was invented by Li in 1968 (Li, 1968). Since then, liquid membrane technology has been known as auspicious technique in order to overcome these drawbacks that has potential to substitute existing separation and purification technologies. Liquid membrane is an homogeneous, non-porous and insoluble liquid, usually an organic solvent which is selective for a solute, separating two other liquid phases. To date liquid membrane may be classified into three types (Figure 1.1) which are bulk liquid membrane (BLM), supported liquid membrane (SLM) and emulsion liquid membrane (ELM).