# UNIVERSITI TEKNOLOGI MARA

# EMULSION LIQUID MEMBRANE FOR COPPER AND CADMIUM REMOVAL IN TAYLOR-COUETTE COLUMN

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# ABSTRACT

In this study, Emulsion Liquid Membrane (ELM) was used for copper and cadmium removal in Taylor-Couette Column (TCC). ELM is a double emulsion of water/oil/water (W/O/W) system consists of three main phases which are membrane phase, internal phase and external phase, while TCC was used to obtain a better mixing condition with a uniform and relatively low fluid shear to maintain the emulsion stability. The chemicals used in this study are Bis(2-ethylhexyl) phosphate (D2EHPA) as carrier, Span 80 as surfactant, kerosene as diluent and hydrochloric acid (HCl) as internal phase. Meanwhile, copper nitrate (Cu(NO3)2) and cadmium nitrate (Cd(NO3)2) solution were used as the external phase. The extraction of copper was executed in a counter rotating TCC and samples were analyzed using Atomic Absorption Spectrophotometer (AAS) to determine the copper and cadmium concentration in external phase. This research was done to study the mixing of water-oil-water (W/O/W) emulsions in Taylor-Couette flow and to identify the best condition to achieve high copper and cadmium removal using ELM in TCC. The parameters involved are the external phase pH, extraction time and rotational speed of the TCC outer cylinder. It was found that pH 4 was the most optimum pH to achieve the maximum extraction efficiency of copper (92.72%) and cadmium (81.29%). While the highest efficiency for copper was at stirring speed of 200 rpm in 5 minutes (96.38%) and cadmium at 600 rpm in 3 minutes (81.59%).

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# INTRODUCTION

## 1.1 Research Background

Reducing hazardous metals content in liquid effluent streams has already been a general discussion nowadays. Virulent heavy metal ions commonly found in discharged industrial waste water has been of great concern to not only the environment, but also towards humans' health. It is no doubt that in the forthcoming future, the problem of heavy metals exhaustion originated from industry will be getting worse in the entire globe (Othman et al., 2018).

According to the World Health Organization, WHO (2011), some of the metals with the greatest concern include copper, aluminum, arsenic and cadmium. Heavy metals are non-biodegradable in nature; hence they have the tendency to be accumulating in living creatures, which leads to several disorders and diseases (Liu et al., 2007). Copper(II) ions are released in huge amounts into the open water in environment through the wastewater originated from various industries such as steelworks, metallurgy, mining, plating, petroleum refining, paper and pulp, wood preservatives, fertilizer and circuit printing (León et al., 2017). Other than that, cadmium exists naturally as a minor constituents of base metal ores and coal deposits, and also exists as a toxic heavy metal found in industrial discharges of various industries such as manufacturing of cadmium, nickel batteries, phosphate fertilizers, pigments, stabilizers, alloys and electroplating industries which is very harmful towards the environment (Mortaheb et al., 2008). In the way to overcome the barrier towards a sustainable future with favorable environment, many methods are issued by researchers to extract heavy metals from waste water. The way to achieving the most perfect method however, is still too far with most of the methods proposed still need to be improved.

Liquid membrane process was proposed as one of the promising techniques to overcome those problems, where it offers a potentially powerful technique for metal separation and recovery. Some special feature of liquid membrane extraction that are not in conventional membrane processes includes simple operation, high efficiency,