

**UNIVERSITI TEKNOLOGI MARA**

**REMOVAL OF HEAVY METAL USING  
MICELLAR SOLUBILIZATION FOLLOWED BY  
COAGULATION FLOCCULATION PROCESS**

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## ABSTRACT

Contamination of wastewater with heavy metals has become a crucial issue to the environment. Recently, micellar enhanced ultrafiltration (MEUF) is a common method that is widely used for the elimination of metals ion using membrane but unfortunately, this method is unfavourable due to the membrane fouling problem. In this research, micellar solubilization process followed by coagulation flocculation process was applied for the removal of cadmium ion from wastewater. Sodium lauryl sulfoacetate (SLSA) was utilized as plant based surfactant in micellar solubilization process while both of ferric chloride and polyacrylamide were used in coagulation flocculation process. The effect of pH and effect of surfactant concentration on the cadmium,  $\text{Cd}^{2+}$  removal were studied to determine the efficiency of micellar solubilization process. Results obtained from this research study shows that the highest percentage removal for coagulation flocculation process was 99.76% while for the micellar solubilization was obtained at 99.78%. Both of these methods occurred at pH 11 for the best removal efficiency of  $\text{Cd}^{2+}$ . It was observed that highest removal efficiency of  $\text{Cd}^{2+}$  was achieved at 99.78% at surfactant concentration of 250 ppm. The regression analysis via Excel Software shows that  $R^2$  and adjusted  $R^2$  obtained for micellar solubilization were 0.85 and 0.82 respectively while  $R^2$  and adjusted  $R^2$  obtained for coagulation flocculation were 0.76 and 0.40 respectively. Regression statistics and ANOVA analysis justified that mathematical expression can be used to forecast the removal efficiency of  $\text{Cd}^{2+}$  from wastewater.

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## TABLE OF CONTENT

|                                            | Page        |
|--------------------------------------------|-------------|
| <b>ABSTRACT</b>                            | <b>i</b>    |
| <b>ACKNOWLEDGEMENT</b>                     | <b>ii</b>   |
| <b>TABLE OF CONTENT</b>                    | <b>iii</b>  |
| <b>LIST OF TABLES</b>                      | <b>vi</b>   |
| <b>LIST OF FIGURES</b>                     | <b>vii</b>  |
| <b>LIST OF ABBREVIATIONS</b>               | <b>viii</b> |
| <b>CHAPTER ONE: INTRODUCTION</b>           | <b>1</b>    |
| 1.1 Research Background                    | 1           |
| 1.2 Problem Statement                      | 2           |
| 1.3 Research Objectives                    | 4           |
| 1.4 Scope of Research                      | 4           |
| <b>CHAPTER TWO: LITERATURE REVIEW</b>      | <b>6</b>    |
| 2.1 Heavy metal                            | 6           |
| 2.2 Removal of heavy metal from wastewater | 7           |
| 2.2.1 Ion exchange                         | 7           |
| 2.2.2 Adsorption                           | 7           |
| 2.2.2.1 Activated carbon adsorbent         | 8           |
| 2.2.2.2 Carbon nanotubes adsorbent         | 8           |
| 2.2.2.3 Bio adsorbent                      | 8           |
| 2.2.3 Chemical precipitation               | 8           |

# CHAPTER 1

## INTRODUCTION

### 1.1 RESEARCH BACKGROUND

Heavy metals or known as trace metals are one of the persistent pollutants in wastewater. The existence of heavy metals in wastewater can lead to the several issues to human health and environments. According to the Abbasi, E. *et al.* (2011), highly toxic, carcinogen and non-biodegradable are the main consequences of heavy metals in wastewater (Abbasi-Garravand & Mulligan, 2014). The abundant levels of heavy metal present in an effluent discharge will cause the streams remains unused due to the detrimental effects. If these heavy metals are directly discharged without any sufficient treatment, it can originate to the toxicity of the environment. Therefore, the efficient and inexpensive preventive methods are needed to develop the existing techniques in order to comply with Department of Environment (DOE) requirement.

The variety of methods are available for the treatment and removal of metal ions such as chemical precipitation, adsorption, and membrane filtration but there are some limitation due to high operation cost and inefficient process (Jinhui Huang *et al.*, 2014). But, unluckily these methods have no capability to reduce the toxic level of each metals. From the previous studied, it is found that membrane separation is a better and achievable technique for the separation of heavy metals from wastewater. Assorted of membrane based separation technique including ultrafiltration and reverse osmosis (RO) have been used in industry to reject the unwanted contaminants from wastewater but these processes seems to be costly due to the high cost of membrane, membrane fouling issue and also high pressure (Mungray *et al.*, 2011).

Micellar solubilization followed by coagulation flocculation process are applied for treatment and removal of heavy metals from aqueous streams. Basically, micellar solubilization process implicated the use of surfactant for the rejection of contaminants from wastewater. Surfactant is added into wastewater to a