UNIVERSITI TEKNOLOGI MARA

COAGULATION AND FLOCCULATION PROCESS FOR REMOVAL OF HEAVY METAL FROM ELECTROLESS PLATING PROCESS INDUSTRIAL RAW EFFLUENT VIA HYDROXIDE PRECIPITATION VERSUS SULPHIDE PRECIPITATION

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ABSTRACT

Electroless plating is deposition of thin protective layer by using chemical reaction, without using current. Electroless plating raw effluent was study in this research because it contains several types of metals compare to other industries. Common heavy metals are nickel, chromium, zinc, copper, cadmium and lead. Hydroxide precipitation method does not suitable for mixed metals effluents because it cannot remove multiple metals at single pH because each metal hydroxide has different pH to precipitate. Hydroxide precipitates tend to resolubilize if the solution pH is changed. Sulphide precipitation has advantages over hydroxide precipitation. It can remove multiple metals at single pH due to the lower solubility of metal sulphide over a broad pH range. However, sulphide precipitation is still not used as widely because the production of hydrogen sulphide (H_2S) gas. In this study, we will focus on nickel, copper and zinc removal. Two samples are tested in this study. First sample is acid rinse from electroless copper plating process in Company A while second sample is nickel rinse from electroless nickel plating process in Company B. First, optimum pH and coagulant dosage for both samples are determine using jar test method. The optimum pH for acid rinse sample and nickel rinse sample are pH 8 and pH 10 respectively. At the optimum pH, the turbidity value is the lowest. The optimum coagulant dosage for acid rinse sample using hydroxide precipitation and sulphide precipitation are 0.4 ml and 0.6 ml respectively. The optimum coagulant dosage for nickel rinse sample using hydroxide precipitation and sulphide precipitation are 0.6 ml and 0.4 ml respectively. Sludge production for acid rinse sample using hydroxide precipitation and sulphide precipitation are both 0.02 g. Sludge production for nickel rinse sample using hydroxide precipitation and sulphide precipitation are 0.01 g and 0.02 g respectively. Sulphide precipitation remove metal more efficient. For acid rinse sample, 95.32% of nickel is remove using sulphide precipitation while 76.66% removal using hydroxide precipitation. 100% of copper is remove for both hydroxide and sulphide precipitation. For nickel rinse sample, 93.75% of zinc is remove using sulphide while 68.75% removal using hydroxide. 65.79% of nickel is remove using both sulphide and hydroxide. While 100% removal of copper for both sulphide and hydroxide precipitation.

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CHAPTER ONE

INTRODUCTION

1.1 RESEARCH BACKGROUND

Industrial raw effluent is any waste in the form of liquid or wastewater generated from manufacturing process such as electroplating, battery manufacturing, iron and steel industry, food industry and textile industry. These raw effluents are usually acidic but can be basic and contain oil and grease, suspended solids and heavy metals such as nickel, chromium, zinc, cadmium, copper, lead and silver at high level that can affect human health and environment (Kanluen & Amer, 2011). Because of the highly toxicity of heavy metals, this research will focus on the removal of heavy metals. In general, long-term overexposure to nickel can cause decreased body weight, heart and liver damage, and skin irritation. Low-level exposure to chromium can irritate the skin and cause ulceration. While long-term exposure can cause kidney and liver damage, and damage to circulatory and nerve tissue. Because of the high toxicity and corrosiveness of heavy metals, the raw effluents are required to be treated before discharge, according to Industrial Effluent Regulations 2009 (IER 2009). Nowadays, it is a necessity for more effective and efficient methods for removing heavy metals due to the continuously increasing quantities of wastewater produced and the discharge standards becoming increasingly stricter (Pang, Teng, Teng, & Mohd Omar, 2009). Raw effluents from coal combustion, wastewater, the disposal of product waste, mining and extraction operations, nuclear power, textiles activities, metal finishing and electroplating industry are some common sources of raw effluents that contain heavy metals. Electroplating process is the deposition of thin protective layers on the surfaces of metal using electrochemical processes (Akpor, 2014; Kobielska, Howarth, Farha, & Nayak, 2018). It is to protects the metal surface and prevents it from corrosion. Electroless plating industrial raw effluent contains several heavy metals such as nickel, chromium, zinc, cadmium and copper. Electroless plating raw effluent was chosen in this research because it contains several types of metals compare to other industries. There are