

# CHAPTER I

## INTRODUCTIONS

### 1.1 Statement of the problems

The industrial sector has played an important role for economic development and competition in most countries. The large amounts of industries have been causing environmental problems such as air pollution, soil pollution, water pollution and hazardous waste. The metal surface treatment process is the main process in the metal industry which a large amount of water and chemicals is used in this process. Chemicals such as acid and alkaline are used for surface cleaning and removal of rust or scale, metal oxide, dust, oil and fat from the metal surface. Subsequently, the large amounts of waste and wastewater containing metals and chemicals have been generated [1].

Sulfuric acid ( $H_2SO_4$ ) has been extensively used for stainless steel surface treatment process before proceeding to next processes; i.e., rolling, electroplating, electrocoating, painting and pigment production because of its relative inexpensiveness and little acid gas generated compared with other acids. The spent solution after stainless steel surface treatment process usually contains heavy metals ions mainly iron (Fe), nickel (Ni), and chromium (Cr) that are hazardous to environment and human health due to its toxicity even in very low concentration. The wastewater treatment process is required for removal of heavy metals ions prior to releasing to the environment or reuse and recover of chemicals solution for the surface treatment process [1-3]. The spent sulfuric acid solution can be treated for removal of heavy metals ions by several treatment processes which can be classified into physical process, chemical process, biological process and physicochemical process e.g. chemical precipitation, activated carbon adsorption, solvent extraction, ion exchange and membrane separation etc [2, 4].

Membrane separation processes have been used for separation and preconcentration of solution or gas and solid mixtures by using of concentration difference, pressure difference and electric potential difference as driving forces such as particle filtration, microfiltration (MF), ultrafiltration (UF), nanofiltration (NF), gas separation, pervaporation, reverse osmosis (RO), dialysis (D), donnan dialysis, diffusion dialysis (DD) and electrodialysis (ED) etc. Several membrane separation processes have been extensively used for food, beverage, pharmaceutical, textile, chemical, electroplating, and surface finishing industries, as well as medical application, and waste treatment process because these processes have provided a lot of advantages such as high efficiency of treatment, low energy consumption and using of low chemical solution [5]. Nevertheless, pressure driven membrane process has encountered disadvantages such as fouling because of high suspended solids in feed, limited operational concentration ranges and limited operational temperature ranges, whereas concentration gradient driven membrane process has also suffered a long operation time.

In this research, an electrical potential driven membrane process called electrodialysis has been studied for removal of heavy metals ions from stainless steel surface treatment wastewater. Because this process uses electrical potential difference as a driving force, it provides many advantages such as selectivity, using of low chemical solution, and short operation time, than other membrane separation or ion exchange process.

## 1.2 Objectives

1. Study the electrodialysis process and factors influencing removal of iron ion from the stainless steel surface treatment wastewater.
2. Study the properties of treated waste for the possibility of being reused or recycled.

### 1.3 Scopes of this research

1. Study the removal of heavy metals ions from stainless steel surface treatment wastewater by electro dialysis process. Electro dialysis Cell Uit model: PCCell ED 64-4 equipment (PCCell GmbH, Germany) was employed in the research.

2. The influence of other factors such as electric potential, initial acid concentration and other elements were studied for the removal of iron ions from synthetic wastewater. The efficiency of removal of iron ions was considered from removal rate (%), current density, current efficiency (%), specific power consumption, concentration of acid, pH and concentration of sulfate.

3. The removal of heavy metals ions from real wastewater sample was treated by electro dialysis process. The wastewater sample was taken from the pickling baths, where the sulfuric acid was used for the removal of rust on metal surface, the Stainless Steel Home Equipment Manufacturing Co., Ltd.

### 1.4 Benefits of this research

Electro dialysis process can be used as an alternative process for the removal of heavy metals ions from stainless steel surface treatment wastewater or other metal industry and provided the possibility of treated waste to be reused or recycled.