

CHAPTER I

INTRODUCTION

Chromium wastes discharged into water mainly come from industrial processes such as electroplating, manufacturing of dyes, ink, and paint pigments (Dunaway *et al.*, 1998). Plating wastewater contains toxic chromate ions and other anion species such as sulphate and nitrate ion etc. The chromate ions are environmentally concerned because Cr(VI) is more toxic than Cr(III) (Westbook, 1993) Chromic acid and its salts have a corrosive action on the skin and mucous membrane. Hexavalent chromium can enter a body through the skin or lung and has effects on the body including skin ulceration and lung cancer. Drinking water standards have been set at 1.0 mg/l total chromium because of the toxicity of chromium (VI) and the potential of the oxidation of chromium (III) to chromium (VI).

Treatment methods for such wastewater depend on the particular complexing agents and metal ions used as well as their concentrations. In general, the methods are grouped into three categories, chemical, physical and electrochemical (Spearot *et al.*, 1984). The chemical methods are substitution, reduction of the metal ions, oxidation of the complexing ligands and ion exchange. The physical methods include evaporation, reverse osmosis and activated carbon adsorption. The electrochemical methods are electrolytic plate out, electrowinning and electrochemical displacement (Yeh *et al.*, 1995). Ion exchange and reverse osmosis can be used to remove large quantities of both anions and cations, however these methods have high operation costs.

Membrane filtration processes are effective techniques for removal of metal ions due to their advantages of improving the effluent quality, saving on water purification chemicals and operation cost, easier operation maintenance, and saving in space and time, and cost of construction of water purification plants (Huang and Wang, 1996). One of the membrane techniques is polyelectrolyte-enhanced ultrafiltration (PEUF). The PEUF process involves use of water soluble polyelectrolyte binding to oppositely charged metal ions in water. Then solution is forced to pass through the ultrafiltration membrane which has pore size small enough to reject the polyelectrolyte-target ions complex. The solution passing through the membrane (permeate) is relatively good enough water to be drained off. The remaining solution containing polyelectrolyte-target ions complex which can not pass the membrane (retentate) is concentrated and can be treated to separate the polyelectrolyte for reuse. The PEUF has advantages in that low concentration in water of polyelectrolyte can remove trace quantities of highly poisonous or valuable multivalent counterions. It has potential to be more economical than other competitive methods because it's highly selective in separation and low energy requirement. Studies done in the past have demonstrated that use of a cationic polyelectrolyte for anions (Dunaway *et al.*, 1998) and an anionic polyelectrolyte for cations removal (Tabatabai *et al.*, 1995) give high percentage of rejection. A study on the PEUF process to remove chromate from water using the cationic polyelectrolyte, poly(dimethyldiallyl ammonium chloride) in a stirred-cell device reported that the chromate rejection substantially reduced in the presence of NaCl electrolyte, however the rejection can be increased by increasing the concentration ratio of QUAT to chromate (Sriratana *et al.*, 1996). In this study the effect of other anions such as sulphate or nitrate will be studied in comparison with chromate anion as well as gel

polarization concentration at very high QUAT to anions ratios will be investigated using a stirred cell system.