CHAPTER I
INTRODUCTION

Chromium is a heavy metal that is used in many industries such as corrosion-resistant plating, decorative plating, alloying, pigment production and leather tanning process. Most chromium exists in the hexavalent and trivalent chromium (Manahan, 1990). Chromium does not naturally degrade and is dangerous to the environment. Especially, hexavalent chromium or chromate affects the health such as lung cancer and skin ulcers (Sax, 1979). Chemical precipitation is the commonly used process to separate toxic heavy metal ions from wastewater streams. Ferrous sulfate and sulfur dioxide must be added to reduce chromate to the trivalent form. Subsequently, alkaline treatment precipitates as chromic hydroxide (Morisset, 1954). This process is expensive due to the addition of chemicals and the sludge removal (Morisset, 1954).

Ultrafiltration is the pressure-driven membrane separation process to selectively remove particles or molecules that approximately range from molecular weight of 1,000-1,000,000. It consumes low energy and can be operated at ambient temperature. It does not require complicated heat transfer or heat-generating equipment (Cheryan, 1986).

Polyelectrolyte-enhanced ultrafiltration (PEUF) or polymer-enhanced ultrafiltration is an ultrafiltration process used in many applications by adding water-soluble polymer or polyelectrolyte to the aqueous streams to bind the target ions (Tabatabai *et al.*, 1995, Sriratana *et al.*, 1996, Müslehiddinoğlu *et al.*, 1998, Juang and Chiou, 2001 and Tangvijitsri *et al.*, 2002). Two phenomena in PEUF compose of binding of target ions to a water-soluble polymer or polyelectrolyte and ultrafiltration. For example, the cationic polyelectrolyte has been used to remove chromate ions from contaminated water. The water can pass through an ultrafiltration membrane with pore sizes small enough to reject the polymer with the bound target ions (Sriratana *et al.*, 1996, and Tangvijitsri *et al.*, 2002).

Previous studies of PEUF have demonstrated use of anionic polyelectrolyte, sodium polystyrene sulfonate (PSS), for removal of Ca^{2+} and Mg^{2+} cations

(Tabatabai *et al.*, 1995) and the usage of cationic polyelectrolyte, poly (diallyldimethyl ammonium chloride) or QUAT, for chromate removal (Sriratana *et al.*, 1996) and for removal of chromate, sulfate and nitrate (Tangvijitsri *et al.*, 2002) giving high rejection of the target ions. The removal of chromate and sulfate using cationic polyelectrolyte, QUAT, in PEUF has attained high rejection that can be further increased by increasing the concentration ratio of polyelectrolyte to target ion (Tangvijitsri *et al.*, 2002). In this study the effect of the mixture of chromate and sulfate anions will be investigated at different concentration ratios of polyelectrolyte/chromate/sulfate. Also, the economic feasibility of the recovery of polyelectrolyte by equilibrium precipitation will be studied.