

CHAPTER I

INTRODUCTION

Toxic anionic metal complexes such as chromate discharged as waste water can come from such industrial processes as electroplating and manufacturing of dyes, ink and paint pigments. Chromate is also present in many polluted groundwater, aquifers around the world (Chang and Hwang, 1996, Sriratna *et. al.*, 1996)

A novel separation technique which is useful in removing multivalent ions from water is polyelectrolyte - enhanced ultrafiltration (PEUF) (Sriratana *et. al.*,1996, Christian *et. al.*,1990, Amajad, 1990). In PEUF, a water soluble polyelectrolyte of opposite charge to the target ion is added to the water. The target ion binds onto the polymer and the solution treated by an ultrafiltration membrane with pore sizes small enough to reject the polyelectrolyte and bound ion. The purified solution passing through the membrane (permeate) can be emitted to the environment or reused in the process or further purified in subsequent PEUF stages. The solution not passing through the membrane (retentate) contains polymer and target ion in high concentration and the polymer must be recovered from it for reuse for an economical operation.

We have specifically investigated the removal of divalent anion chromate (CrO_4^{2-}) from polluted waters using PEUF using the cationic polyelectrolyte poly(diallyldimethyl ammonium chloride) or QUAT (Sriratana, *et. al.*, 1996, Tucker *et. al.*,1992). Sriratana *et. al.* demonstrated that chromate rejections of greater than 99 % are attainable and that the gel point (QUAT concentration at which flux = 0) of 0.55 M. This means that the solution can be ultrafiltered to a fairly high QUAT concentration (e.g., 0.3 M) before flux becomes

unacceptably low, resulting in a concentrated retentate solution. The chromate can be separated from QUAT in this retentate by adding divalent cation barium (Ba^{2+}), which precipitates the chromate as barium chromate (BaCrO_4). This process is shown schematically in Fig 1.1. After the precipitate is removed from the solution by filtering, centrifuging, or settling, the concentrated QUAT solution can be reused in the PEUF process. One advantage of this process over competitive techniques is that the only waste emitted is the solid barium chromate, a very low volume solid waste.

The purpose of this study is to determine the equilibrium fraction of chromate precipitated by barium from solutions with QUAT representative of PEUF retentate. This will indicate the maximum separation efficiency attainable in an equilibrium stage and indicate the minimum excess barium (which does end up in the PEUF permeate) needed for removal of a given chromate fraction from the retentate.

It might be noted that ligands have been bound to polyelectrolytes to give PEUF selectivity on a basis other charge (Tucker *et.al.*,1992, Tuncay *et. al.*, 1994), but that is not further addressed here.

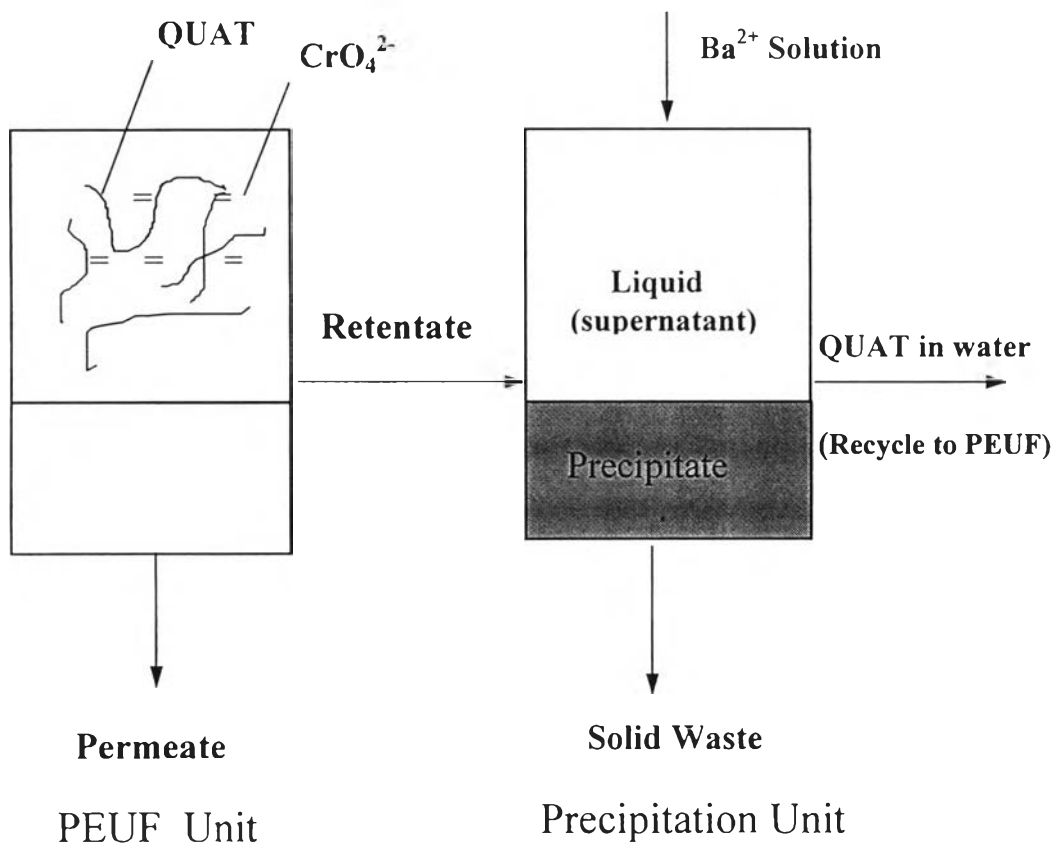


Figure 1.1 Schematic diagram of precipitation to separate CrO_4^{2-} from QUAT.