

CHAPTER I

INTRODUCTION

Copper has been known as one of the most common toxic metals, which finds its way to the water stream from industries like electroplating, mining, electrical and electronics, iron and steel production, the non-ferrous metal industry, the printing and photographic industries and metalworking and finishing processes (Hayrunnisa *et al.*, 2010). The excessive intake of copper by men leads to severe headaches, hair loss, hypoglycemia, increased heart rate, nausea, damage of kidney, and liver. It may also cause psychological problems, such as brain dysfunction, depression, and schizophrenia. The world health organization (WHO) recommended a maximum acceptable concentration of Cu (II) in drinking water of 1.5 mg l^{-1} . It is essential that potable waters be given some treatment to remove copper before domestic supply (Aman *et al.*, 2008). Nowadays, numerous methods have been proposed for efficient heavy metals removal from water, including but not limited to chemical precipitation, ion exchange, adsorption, membrane filtration, reverse osmosis and electrochemical technologies (Hua *et al.*, 2012). Humic acid, which is involved in many chemical and physicochemical interactions in aqueous systems, acts as an ion exchange resin (Saied *et al.*, 2005). Humic acid can chelate heavy metal effectively and has potential to be used in wastewater treatment for heavy metal removal by binding of metal-humic acid interactions.

Polybenzoxazine is a new type of phenolic resin that has been used as precursors for organic xerogels. Polybenzoxazine has great properties such as good mechanical properties, low shrinkage, low water absorption, high thermal stability, high molecular design flexibility and flame retardance. Benzoxazine monomers can be synthesized from phenols, amines, and formaldehyde. In this study, a coating of humic on polybenzoxazine xerogel was prepared via the layer-by-layer surface modification method. Effects of number of layers on a thin film were investigated. First of all, a polybenzoxazine xerogel was synthesized from bisphenol-A, formaldehyde, and aromatic diamine reactants. FTIR, DSC, TGA, and SEM measurements were used to characterize the properties of polybenzoxazine xerogel. Later, a thin film was prepared at room temperature with the humic concentration of

0.1 %w. UV-VIS measurement was used to study the absorbance of humic substance at each humic layer after coating. Afterwards, the ability of synthesized material for removing copper was examined.