UNIVERSITI TEKNOLOGI MARA

PVA/CHITOSAN/TEOS HYBRID MEMBRANE FOR COPPER AND FERUM IONS REMOVAL

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ABSTRACT

The removal of ferum (Fe) and copper (Cu) metal ions from industrial wastewater is a crucial due to its harmful effects on human health and living organisms in the environment. There are various methods used in order to solve this problem, such as ion – exchange, chemical precipitation, adsorption and membrane technology. Membrane technology is an attractive method compared to the other methods due to its high efficiency of metal ions removal. However, this method has its drawback such as membrane fouling. Thus, in this study a new composite membrane is fabricated to remove copper and ferum ions. The composite membrane consist a thin layer of hybrid membrane as a barrier layer and polysulfone (psf) as a support layer. During the formulation of hybrid membrane, a polymer blend of poly(vinyl alcohol) (PVA) with chitosan (cs) was chosen as organic polymer and it was cross-linked with tetraethylorthosilicate (TEOS), using sol-gel method to prepare the hybrid membrane. Concentration of TEOS cross linker was varied at (0wt%, 1wt%, 3wt% and 5wt%) and chitosan was varied at (1wt%, 2wt% and 3wt%) respectively with fixed concentration of poly(vinyl alcohol) (PVA) solution (10wt%). These membranes were characterised using various tests such as fourier transform infrared spectroscopy (FTIR), thermal analysis via thermogravimetry analyzer (TGA) and differential scanning calorimetry (DSC), mechanical strength, water contact angle, swelling measurement and anti-fouling behaviour. Results showed that, the composite membrane was successfully formulated due to its great characteristics in term of thermal stability, mechanical strength and anti-fouling properties. It also exhibit better anti – fouling performance where it resulting lower flux declining rate and higher flux recovery rate with and without natural organic matter (humic acid). Besides, it showed a great performance where > 90% copper and ferum ions could be removed from the feed solution at ≥ pH 7. The thin film composite membrane with 3wt% TEOS (M2) exhibits a rejection > 80.0% of copper and ferum ions from industrial wastewater.

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CHAPTER ONE
INTRODUCTION

1.1 Research Background

Water is not only important for our bodies and human life, but it also has become the main source to industries around the world as a cleaning agent, cooling and heating fluid, fabrication, dilution and product transportation [1]. Thus, wastewater treatment is necessary to reuse the water back from domestic, industrial wastewater, and storm water for a beneficial use, especially as the size of cities and population increase [2]. Recently, the presence of heavy metal even at low concentration becoming the main source of water contamination due to their high toxicity [3,4]. The sources of heavy metal pollution can be seen in each stage of production in industries such as electroplating, mining, processing and purification, metal finishing, and even at the end use [3]. A variety of diseases are caused by the accumulation of the heavy metal in the human body throughout the food chain [5,6]. Therefore, these heavy metals are necessary to be removed from industrial discharges by suitable treatments for the benefit of mankind and the environment [7].

Several methods are used for removal of heavy metal from wastewater, which includes chemical precipitation, membrane separation, ion-exchange, flotation and adsorption [8]. However, these conventional heavy metal treatments have several limitations such as cost constraint, ineffective removal at low concentration of heavy metal ions and high generation of sludge [9]. Among all these treatment methods, adsorption using low cost adsorbents and membrane separation have been broadly used in the removal of heavy metal because they are highly efficient and cost effective [5,10]. Membrane separation has received extensive attention in the wastewater treatment due to its convenient operation and its capability to removed suspended solids, organic compounds, and inorganic contaminants [10,3]. Other than that, the main benefits of membrane separation as compared with other processes is related to its unique separation principle, like transport selectivity of the membrane.