Journal of Materials and Environmental Sciences
ISSN : 2028-2508

JMES, 2017 Volume 8, Issue 10, Page 3740-3746

http://www.jmaterenvironsci.com/

Effect of Activated Carbon in Polysufone-Polyethyleneimine-Silver Composite Membrane Towards Adsorption of Chromium (Cr), Lead (Pb), Silver (Ag) and Cadmium (Cd) in Synthetic Wastewater

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Received 11July2017,
Revised 17Apr 2017,
Accepted 20Apr 2017

Keywords

- ✓ Membrane;
- ✓ Adsorption;
- ✓ Activated carbon;
- ✓ Polyethyleneimine;
- ✓ Flux

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Abstract

Adsorption of heavy metal has been monopoly by activated carbon either in solid or powder form and the introduction of membrane consist of activated carbon could therefore increase the capacity of adsorption. The objective of this work was to investigate the effect of adding activated carbon in a Polysufone-Polyethyleneimine-Silver (Psf-PEI-Ag) composite membrane in terms of the heavy metal adsorption in synthetic wastewater. The membrane was developed by phase inversion at different composition of activated carbon (from 0 to 0.9%) while the other components were kept constant at 15% Psf, 0.5% Ag and 0.3% PEI. The SEM image showed a symmetrical membrane matrix with sponge-like structure. The composite membrane with 0.9wt% AC has the highest water flux and removal of heavy metal (chromium, lead, silver and cadmium). The percentage of heavy metal reduction by the composite membrane was 35% cadmium, 19% chromium, 16% silver and 2% lead. The result indicated that the introduction of activated carbon indeed plays an important role towards enhancing the adsorption of heavy metal. This work is expected to provide better understanding of activated carbon in PEI-Ag membrane and to inspire new approaches in designing membrane with higherheavy metal removal.

1. Introduction

In Malaysia, water resources can be obtained from rainfall, surface runoff, groundwater recharge, dams, aquifers and evapotranspiration. On top of that, streams and rivers also contribute 98 % of the total water used in Malaysia. Malaysia received 2,000 to 3,000 mm rainfall a year, recorded as the seventh highest in the world but most of it is lost to the surface run-off, evaporation and groundwater recharge that is often used for drinking water.

Problem arises when the heavy metals from the industry and domestic enter into the streams, lakes, rivers and groundwater. In the end, water is polluted with heavy metal residues and poses danger to the aquatic organism. Heavy metals are categorized as metallic elements having atomic weights between 63.5 and 200.6, and a specific gravity greater than 5.0. Unlike other organic contaminants, heavy metals are not biodegradable.

A major concern involving heavy metal such as chromium, cadmium, lead, zinc, and copper is the carcinogenic effect [1]. In addition, these heavy metals are usually found in the industrial wastewater and at large amount of discharge, a significant effect to the aquatic life would either be acute or chronic toxicity [2]. Therefore, it is vital to treat and process the effluent before discharged.

There are several proposed methods available for the treatment of heavy metals in wastewater including microbial system, electrochemical process, chemical precipitation, coagulation, adsorption, and membrane filtration [3]. These are divided into three categories mainly chemical, physical and biological treatment where