UNIVERSITI TEKNOLOGI MARA

SORPTION OF ZINC BY HYDROGEL PALM KERNEL SHELL BIOCHAR BLENDED WITH COAL FLY ASH

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ABSTRACT

Zinc is known to be an essential element for human health and its low intake leads to retardation in growth. However, high accumulation of zinc in humans may cause gastro intestinal distress, lung disorders, metal fume fever, abdominal pain and even cancer. The threats that are generated from zinc contaminated water can averted by adsorption technique using low-cost adsorbents. Hydrogel is three-dimension (3D) hydrophilic polymer that is chemical or physical crosslinked which has ability to swell rapidly and retain large volumes of water in their swollen structure. Recently, hydrogel has been a focus of researcher due to the good at absorbing heavy metal from aqueous state. In this research, hydrogel biochar is derived from palm kernel shell biochar (PKSB) blended with coal fly ash (CFA) using ratio of palm kernel shell biochar (PKSB) to CFA (0.2:0.8, 0.5:0.5 and 0.8:0.2). Hydrogel palm kernel shell biochar blended with coal fly ash (HPKSB-CFA) composite is successfully synthesized by embedding the biochar into acrylamide (AAM) as monomer, with N,N'-Methylenebisacrylamide (MBA) as crosslinker and ammonium persulfate (APS) as initiator. While activated carbon (AC) remains an expensive material, HPKSB-CFA is attracting great interest for its use in the absorption of organic contaminants due to its low material cost and importance as renewable source for securing future energy supply in the environmental system. The aim of this study is to characterize HPKSB-CFA by performing several analyses such as the Thermogravimetric Analyzer (TGA), Elemental Analyzer (EA), Brunaeur-Emmett Teller (BET) and Field Emission Scanning Electron Microscopy (FESEM), to investigate the performance of zinc removal by HPKSB-CFA in solution by using several parameters and to adopt the kinetic model from Langmuir and Freundlich isotherm. From the analyses, the results is describe 0.8:0.2 gives the best characteristic as excellent adsorbent. Further results of zinc removal obtained the best adsorbent of HPKSB-CFA is 0.8:0.2 weight ratio for all parameters studied. The percentage removal of zinc for adsorbent dosage, initial concentration and contact time are 95.6% removed by 2 g of HPKSB-CFA, 95.6% remove at 10mg/L initial concentration and 94.9% removed at 30 minutes for contact time. The experimental data was best fitted well to Langmuir isotherm meanwhile, the kinetic data was best described pseudo second order with a correlation coefficient (R^2) 0.9997. Based on the analysis, it was found that the monolayer adsorption capacity was 37.52 mg/g for adsorption of zinc on HPKSB-CFA. Based on the results, HPKSB-CFA has a great potential to be applied as adsorbent to remove heavy metal in wastewater.

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CHAPTER ONE
INTRODUCTION

1.1 Research Background

Water is very important to living things; human, flora and fauna. In Malaysia, 99 % of water is supply from surface water for domestic uses such as drinking, washing and bath. Another 1% of water is supply from ground water [1]. High toxicity level by heavy metals in water can cause brain disorder, insomnia, anemia and heart disease [2]. Therefore, it has to be removed before discharge. Several methods of heavy metal removal has been practice for a decade such as ion exchange, reverse osmosis, membrane separation and so many others are good in removing heavy metal but the cost is expensive.

Many researchers studied of heavy metal removal especially in conventional method such carbon adsorption and ion exchange. Adsorption is a well-known equilibrium separation process and an effective method for water decontamination applications. The ability of adsorption capacity carbon depends on the surface area and pore structure [3]. For example, adsorption process using commercial activated carbon usually produced from natural mineral such coconut shell, wood or coal may be used as raw material for the preparation of activated carbons [4]. The conventional method widely uses in many countries but it is still limited because of high cost, non-renewable and not eco-friendly. Thus, other adsorbent are needed to replace activated carbon to make low cost adsorbent with high efficiency and environmental friendly. Recently, biomass adsorbent attracted a lot of researcher as it has become a replacement for conventional method of removal since it is low cost (agricultural waste), good adsorption capacity, requiring little processing, selective adsorption of heavy metal ions, free availability, and easy regeneration [5].

Biomass has become worldwide attention as it is widely available, cheap, renewable and environmental friendly [6]. It is also found to be an effective source for production of energy and fuel. The world production of biomass per year is estimated at 146 billion tons [7] and Malaysia one of the country that produced many tons of palm kernel shell (PKS). Several adsorbents from biomass or agricultural waste have been studied by other researchers such as oak wood and oak bark [8], sugar beet [9],