

CHAPTER 1

INTRODUCTION

1.1 Background of the Study

Water is the most important source that is essential for all living beings, and a crucial portion of any industrial, agricultural, or other development. It is expected to be the main issue in the 21st century where the water source would increasingly be polluted (Burke et al., 2009). Moreover, Malaysia is categorized as a fast industrial country and a member of Newly Industrialized Country (NIC) (Norzatulakma, 2010). Thus, it has a huge number of industrial areas all over the country. The major industries include petrochemical, chemical, food, manufacturing and other multifarious industries. Due to this, some of the water resources of the area are being polluted caused by the discharge of industrial effluents and wastewater generated from those industries (Hossain, 2014).

Mercury (Hg) is one of the heavy metals that has been traced as a hazardous element in the effluent from industrial wastewater. It could lead to negative effects to humans, animals, and the environment. Mercury is a toxin that has been shown to bioaccumulate which can enter the environment from anthropogenic sources such as chlor-alkali wastewater (Shafeeq et al., 2012). According to Hossain (2014), the average range of mercury was from 0.01 mg/L to 0.074 mg/L. The treatment of mercury-contaminated water remains a challenge, particularly due to the very low regulatory concentrations. Thus, mercury pollution has received many attentions from environmental researchers due to its volatility. Technology such as sorbent injection by using activated carbon has proven as an effective way to reduce the mercury concentration in industrial wastewater (Gu & Zhang, 2015). The activated carbons that are capable of adsorbing the metal include Cr(III,VI), Cd(II), Hg(II), Cu(II), Fe(II,III), Zn(II), Ni(II), V(IV,V), Au(I), and Ag(I) (Santhy & Selvapathy, 2016).

More than 90% removal efficiency of mercury removal in biosorption was recorded in lab and commercial scale when activated carbon was used (Shafeeq et al., 2012). Currently, halogenated activated carbon is the most effective commercially available mercury sorbents. Unfortunately, due the high cost of the sorbent cause a big challenges to apply it for large scale operation (Hwang et al., 2002a). Due to this issue, researchers had been considered the agricultural lignocellulosic by-products as cheaper, eco-friendly and more effective adsorbents. Malaysia is the world's second largest producer and exporter of palm oil and 47 % of the world's supply of palm oil is produced by this country. In addition, it is recorded and it is recorded about 8 million tons/year of palm oil fuel ash (POFA) has been produced as waste from boiler (Sahid et al., n.d.). Previous study shows that POFA was already been used for technology to remove the Cu (II) from aqueous solutions as it is natural low-cost adsorbent for removing the mercury (Aziz et al., 2014). However, the surface of the POFA itself as the activated carbon cause it to be further research on the effectiveness of the POFA to remove heavy metals such as mercury.

1.2 Motivation

Minamata in Japan is well known as the first disaster that inducing by mercury toxicity. Large amounts of methylmercury that was discharged from chemical factory to Minamata Bay during 1950s. Irritability, paralysis insanity, loss weight and other symptom of neurological damage was reported as the main toxicological effects of mercury. The disease was believed existed in local people who consumed the aquatic products (Attari, 2015). Thus, water that has been contaminated must be treated. Treatment of mercury can be done in few alternatives such as biosorption, coagulation, filtration, bio films, reverse osmosis, and chemical precipitation (Shafeeq et al., 2012).

However, biosorption has been focused since biosorption offers an economically feasible technology for efficient removal and recovery of metal(s) from aqueous solution (Bobade & Eshtiagi, 2016). Biosorbent usually can be obtained easily from a by-product from the industry where it can save the cost. Meanwhile, mercury removal by activated carbon (AC) is the technology most widely used to control mercury emissions (Tang et al., 2016). However, most of the ACs was prepared from nonrenewable sources such as coal, that resulting in high costs for the AC preparation.

AC is used as an inert porous carrier material for distributing chemicals on the large internal surface, thus making them accessible to reactants (Shafeeq et al., 2012). Agro-industrial by-products such as coconut shells, almond shells, hazelnut shells, cherry stones, eucalyptus, apricot stones, nuts, grape seeds, olive and peach stones, sugar cane bagasse and palm oil waste are inexpensive materials that abundantly available for which the effective utilization has been desired (Avenue, 1998; Horikawa et al., 2002). Furthermore, palm oil mill is the most important agro-industry in Malaysia (Shahrul, 2010). Hence, Malaysia would face problem in order to manage the agriculture wastes from palm fruits processing wastes. Converting it into valuable product such as activated carbon might significantly reduce the waste (Zarina et al., 2013).