UNIVERSITI TEKNOLOGI MARA

REMOVAL OF CHROMIUM AND COPPER IONS BY USING PUMPKIN SEEDS AS ADSORBENT

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ABSTRACT

Rapid industrial development in Malaysia is causing large and uncontrollable industrial discharge. Usually, heavy metals are commonly found in the industrial effluent. There are many convincing treatments to remove heavy metals such as chromium and zinc from the wastewater. Among all, the most promising treatment for removal of heavy metals is adsorption due to its high removal efficiency. However, the cost for conventional adsorbent that is widely used nowadays is expensive. Researchers are finding an alternative to conventional adsorbent such as using agricultural waste which is abundant and low cost as adsorbent. Thus, this study aimed to prepare adsorbent by using pumpkin seeds and to investigate the effectiveness between calcined and uncalcined pumpkin seeds that were physically and chemically treated to remove chromium and copper ions in aqueous solution. The uncalcined pumpkin seeds were prepared by physical (P-UC) and chemical (C-UC) treatments. In chemical treatment, the pumpkin seeds were impregnated with local vinegar to activate its active site. In both treatments, part of the pumpkin seeds was calcined at temperature 350^{o}C (PC-350, CC-350), 450^{o}C (PC-450, CC-450) and 550^{o}C (PC-550, CC-550). The adsorbents were characterized by using Fourier Transform Infrared (FT-IR). Batch adsorption experiments were carried out in order to determine the effectiveness of the adsorbents in removing chromium and copper ions. The effect of adsorbent dosage, contact time and initial concentration on the adsorption process were evaluated. The final concentration of the chromium and copper ions was determined by using Atomic Absorption Spectrophotometer (AAS). The most effective pumpkin seeds as adsorbent in removing chromium ions was discovered to be C-UC at optimum condition such as 1.5g adsorbent dosage, 50mL of 50ppm initial chromium ions concentration, 700rpm speed with 30 minutes contact time since the result showed that it can remove the maximum amount of chromium ions, 68.12% compared to other types of adsorbents. Meanwhile, the most effective pumpkin seeds as adsorbent in adsorbing copper ions were revealed to be PC-550 at an optimum condition such as 1.5g dose of adsorbent, 50mL of 50ppm initial copper ions concentration, stirred for 30 minutes at 700rpm speed to remove 85.95% copper ions. The changes in FT-IR spectra of uncalcined to calcine adsorbent treatment suggested that the sorption of chromium and copper ions was consistent with the findings.

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CHAPTER ONE
INTRODUCTION

1.1 Research Background

Industrialization is vital to the global economic growth. The industrial development also has a significant contribution to human welfare. Unfortunately, with rapid increasing in the industrial development nowadays, it led to large and uncontrollable industrial wastewater discharge. Most of the industrial activities such as fertilizer, chemicals, metal plating, mining and many more, discharge the industrial effluent which contains heavy metals either directly or indirectly into the environment without any treatment (Fu & Wang, 2011a). This can cause water pollution as the industrial wastewater generally contains inorganic contaminants and organic toxicants (Lee & Choi, 2018).

Heavy metals are defined as chemical components with a specific gravity greater than 5.0 from specific gravity of water (Noor et al., 2016). Heavy metals are non-biodegradable like organic contaminants. Many heavy metals are known to be toxic, carcinogenic and can cause chemical and physical changes in the environment by altering the water quality and cause water contamination even at high or low level concentrations. Heavy metal such as copper, zinc, mercury, cadmium, lead, iron, manganese, chromium, nickel, arsenic, aluminium are considered as the most widespread contaminants found in soil and water system (Burakov et al., 2018).

Chromium, Cr is mined as chromite ($FeCr_2O_4$) ore (Stoll, 2017). It is a heavy metal that is mainly use in chrome plating, metal ceramics and in alloys industry. Health hazards from chromium associate with level of exposure. Consuming high levels of chromium in polluted water or inhaling fumes from heated chromium can cause health problems such as upset stomachs and ulcers, kidney and liver damage, respiratory problems, cancer and death (National Institutes of Health, 2018).

Copper, Cu is widely used in manufacture of electrical wire. Copper is an essential nutrient needed that can be found in water, foods and dietary supplement. Human body requires sufficient amount of copper to prevent anaemia and keep the skeletal, reproductive and nervous system healthy. Overexposure of copper can cause chronic diseases such as liver failure, hepatic, renal disease and haemolytic anaemia