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ADSORPTION OF Pb(II) ONTO XANTHATED AND HYDROGEN PEROXIDE MODIFIED RUBBER (*Hevea brasiliensis*) LEAF POWDER

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AUTHOR'S DECLARATION

I declare that the work in this thesis was carried out in accordance with the regulations of Universiti Teknologi MARA. It is original and is the result of my own work, unless otherwise indicated or acknowledged as reference work. This thesis has not been submitted to any other academic institution or non-academic institution for any degree or qualification.

I, hereby, acknowledge that I have been supplied with the Academic Rules and Regulations for Post Graduate, Universiti Teknologi MARA, regulating the conduct of my study and research.

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ABSTRACT

Two types of chemical modifications on rubber leaf powder were performed in order to evaluate the Pb(II) adsorption capacity by xanthation and oxidation processes. Pb(II) adsorption study was investigated under batch and fixed bed column modes. The amount of Pb(II) adsorbed increased with increasing pH, contact time and initial Pb(II) concentration but decreased with increasing adsorbent dosage, ionic strength and temperature for xanthated rubber leaf powder (XRL) and hydrogen peroxide rubber leaf powder (HPRL). The adsorption kinetics of Pb(II) by XRL and HPRL were fitted well with pseudo second order model suggesting that chemisorption could be the rate determining step in Pb(II) adsorption. The equilibrium time was achieved within 60 min for XRL and 90 min for HPRL. Adsorption of Pb(II) followed Langmuir isotherm model with the monolayer adsorption capacities of 166.7 mg/g by XRL and 52.6 mg/g by HPRL, respectively. The optimum adsorption process occurred at pH 4, shaking rate of 120 stroke/min and temperature of 303 K. The adsorption process was found to be exothermic for both adsorbents. The amount of Pb(II) adsorbed decreased in the presence of Cu(II) ions. Pb(II) ions showed higher selectivity compared to Cu(II) ions in the binary systems. EDTA was more effective in releasing Pb(II) from XRL surface than HCl but HPRL desorbed well in HCl. Possible mechanisms involved in the Pb(II) adsorption by XRL and HPRL were ion exchange, complexation and physical adsorption as supported by FTIR spectra, thermodynamic, ion exchange and desorption studies. Fixed bed column data was fitted well with the Thomas and Yoon-Nelson models with correlation coefficients of (R^2) > 0.96 for both adsorbents.

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CHAPTER ONE
INTRODUCTION

1.1 HEAVY METALS POLLUTION

The presence of heavy metals in the environment due to the technology development and industrial activities are becoming one of the most important sources of water pollution throughout the world (Nasir *et al.*, 2007). The use of metals and chemicals in industrial processes generated a large volume of wastewater effluent that contains high level of toxic heavy metals. These pollutants pose major environmental and human health problems. Mercury, arsenic, lead, cadmium, copper, zinc, nickel, chromium and cobalt are heavy metals frequently detected in industrial wastewaters, which originate from battery manufacturing, tanneries, metal plating, electrical equipment manufacturing, mining activities, smelting, textile industries, ceramic, glass, printing, paint and pigment manufacturing, pesticides, sludge disposal and photographic industries (Wang *et al.*, 2011; Nourbakhsh *et al.*, 1994). Among these heavy metals, mercury, arsenic and lead are classified as the most toxic heavy metals in the environment and cause great concerns to the public due to their toxicity effects.

Heavy metal ions have been classified as priority pollutants, due to their toxicity, carcinogenic and mobility in natural water bodies (Guangyu and Viraraghavan, 2003; Volesky, 2007; Fu and Wang, 2011). High solubility of these heavy metals means they can be easily absorbed by living organisms and accumulated in the human body (Barakat, 2011). They are also the stable and persistent water pollutants since they cannot be degraded and destroyed. The toxic properties of metal ions can affect the aquatic lives and remains a serious public health problem for human health (Demirbas, 2008).

The tragic tragedy due to the heavy metals pollution in the environment occurred in Japan. The diseases suffered by the people in Japan are called the Minamata diseases (1932-1968) and Niigata diseases (1965) (Nurchi *et al.*, 2010). The Minamata diseases caused the human and animal death for more than 30 years by releasing methyl mercury into wastewater before being discharged into the rivers (Nurchi *et al.*, 2010). This highly toxic mercury concentration was accumulated in the aquatic organisms in Minamata Bay and Shiranui Sea and absorbed by the human body after consuming these aquatic organisms such as fish and shellfish. These diseases are related to the neurological diseases and people suffered from muscle