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Preliminary Study on Zinc Removal from Aqueous Solution by Sago Wastes

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Abstract: In this study, sago wastes were investigated for its potential in removing Zn from aqueous solution. The equilibrium adsorption level has been studied under varying conditions of time, initial metal ion concentration, adsorbent dose, particle size and pH. The adsorption parameters were analyzed using Freundlich and Langmuir models. Kinetics of adsorption of Zn on adsorbents were determined and correlation relationship between kinetics of Zn adsorption and with pseudo first order and pseudo second order rate was determined. The physico-chemical properties such as determination of functional groups, moisture content and ash content were also investigated. The adsorption of Zn increased with increasing treatment time and the equilibrium of the adsorption was attained after 40 minutes The data showed that at initial concentration of 5 mg/l, the percentage of Zn removal based on the particle sizes of 300 µm, 500 µm and 1200 µm are 74 %, 47.6 % and 55.4 % respectively. The percentages of removal increase after the initial concentration of Zn reach 40 mg/l to 100 mg/l and the percentage of Zn removal based on the particle sizes of 300 µm, 500 µm and 1200 µm at 100 mg/l are 6.93%, 7.78% and 10.03% respectively. The study shows that the adsorption gives an optimum value at pH 9, best fitted on Langmuir isotherm model with maximum capacity of adsorption of 10.4 mg/l and obey the pseudo second-order rate equation of adsorption kinetic. However, at pH 7 which represents the normal pH range in wastewater treatment, maximum Zn adsorption is only 0.45 mg/g. It is recommended that further complimentary study should be conducted, for instance the sago wastes should be modified chemically in order to further enhance the removal of heavy metals from solution.

Key words: Sago wastes · Langmuir isotherm model · Zn · Adsorption

INTRODUCTION

Rapid development of the industrial activities that enhance the economic growth of the countries at the same time can lead to environmental pollution. In many cases, industrial wastes were discharged directly into the environment without proper wastewater treatment. The discharge of the heavy metals into the stream is one of the environmental issues that rise due to the toxicological effects of the potentially toxic elements towards the natural resources.

Besides that, other human activities and natural processes such as the weathering changes can also contribute to the increase in contamination of heavy metal in the environment. Heavy metals can pose health hazards if their concentrations exceed the allowable limits. Zinc (Zn) is an essential element for the growth of human, animals and plants. However, higher concentrations of Zn may increase uptake of this metal by plants and subsequently affect humans through the food chains, for instance causing zinc fever and lungs edema [1]. According to Malaysian Environmental Quality Act 1974, the maximum permissible limit of Zn in drinking water is 2.0 mg/l.

Zn can be found in wastewater discharges from acid mine drainage, galvanizing plants and municipal wastewater treatment plant discharges [2]. Conventional methods, for example, ion exchange, chemical precipitation, ultra filtration, or electrochemical deposition does not seem to be economically reasonable for wastewater treatment due to their relatively high costs [3].

As a result, there is a need to investigate low-cost methods, which is effective and economic and can be used by such industries. Adsorption has advantages over other methods. The design is simple and involves low investment in terms of both the initial cost and land. Activated carbon has been recognized as a highly

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