ADSORPTION MECHANISM OF REACTIVE DYES ONTO MODIFIED COAL-FIRED BOTTOM ASH: EQUILIBRIUM AND THERMODYNAMICS STUDY

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AUGUST 2012

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5. Report

5.1 Proposed Executive Summary

(Original proposal)

Adsorption has been recognized to be a promising process to remove colours from aqueous solution (Xue, et al., 2009). Utilizing of agricultural and industrial wastes as adsorbents had been explored by many researchers. However, the study of coal-fired bottom ash as adsorbent for dye adsorption is scanty reported by researcher. In fact, the influence of complex properties of coal-fired bottom ash to the adsorption system have not yet been explored in detailed. Therefore, the study on the adsorption mechanism of dye onto coal-fired bottom ash as well as modified coal-fired bottom ash is needed in improving its capability of dyes adsorption process. The physical and chemical properties of an adsorbent serve significant effects to the adsorption process. Chemical properties include the degree of ionization of the adsorbent surface, the types of functional group which are present on the adsorbent and degree to which these properties may changed by contact with the solution (Bernardin, 1985). Some adsorbents have affinity for H^+ and OH' ions, which will directly affect the solution pH, solubility and adsorption capacity. The mechanism might vary from reversible to strong chemical interaction with the presence of active functional groups on the adsorbent surface (Bernardin, 1985). In this study, the equilibrium and thermodynamics studies will be carried out on specific pair of reactive dye-bottom ash and modified coal-fired bottom ash system.

The objectives of the research are to study the equilibrium mechanism and thermodynamic properties of reactive dye adsorption onto modified coal-fired bottom ash. The modified coal-fired bottom ash will be characterized and the main factors (effect of initial concentration, pH, adsorbent's dosage) influence each particular adsorbate-adsorbent system will be studied. Therefore, it is expected that the equilibrium and thermodynamics analysis from this study could provide better understanding on the behaviour of reactive dye-coal-fired bottom ash adsorption system, and improve the efficiency of adsorption process itself.

5.3 Introduction

Wastewater comes from textile industries, agriculture, household, factories and restaurants which have an impact on environmental conditions in rivers and ocean. The discharge of inadequately treated wastewater may cause adverse impacts such as water pollution, creating foul smells and potential health hazard. There are two effluent standards under Environmental Quality (Industrial Effluent) Regulation 2009 which are standard A and Standard B. Standard A is for discharges into any inland waters within catchment area whereas Standard B is for discharges into any other inland water throughout Malaysia. Based on the fifth schedule under Environmental Quality (Industrial Effluent) Regulation 2009, level of colour cannot be discharge more than 100 American Dye Manufacturers Institute (ADMI) units for standard A whereas for Standard B, not more than 200 ADMI units (Environmental Quality Act 1974). If the level of the colour discharge exceeds the standard, then it can cause water pollution. Water pollution includes contamination of streams, lakes, underground water or oceans by harmful substances.

Dyes from dyeing processing wastewaters are found in the wastewater streams of industrial processes, including paint manufacture, dyeing, textiles and papers. Reactive dye is a class of highly coloured organic substances and primarily utilized for tint textiles as compared to other types of dye namely, acid, basic, dispersed and azo dyes. Reactive dyes are used extensively in the textile industry, due to their superior dyeing properties, especially in terms of fastness. Fibre reactive dye is the most permanent of all dye types. Unlike other dyes, it actually forms a covalent bond with the cellulose or protein molecule, as the dye molecule has become an actual part of the cellulose fibre molecule. It is estimated that 10 to 15% of the dye is lost in the effluent during the textile-dyeing process (Lian *et al.,* 2009). The discharge of dyes in the environment focus into water resources even in small amount can affect the aquatic life such as cause depletion of dissolved oxygen resulting in death of aquatic life. Hence the presence of dye in wastewater is one of the major and complex environmental problems (Celekli *et* a*l*., 2009). Therefore, technology has leaded to propose various methods for treating wastewater including adsorption process.

Adsorption has become among the useful methods for decontamination and separation process. The process of adsorption, involves nothing more than the preferential partitioning of substances from the gaseous or liquid phase onto the surface of a solid substrate (Slejko, 1985). The adsorbing phase is called the adsorbent, and the material concentrated or adsorbed at the surface of that phase is the adsorbate. Generally, adsorption is dependent on various factors: adsorbent dosage, initial adsorbate concentration, contact time, temperature, particle size, pH and ionic strength (Santos & Boaventura, 2008).