INTRODUCTION

1.0 INTRODUCTION

Population explosion, haphazard rapid urbanization, industrial and technological expansion, energy utilization and waste generation from domestic and industrial sources have rendered many waters unwholesome and hazardous to man and other living resources (Amuda and Ibrahim, 2006).

Toxic metals are often discharged by a number of industrial processes and this can lead in turn to the contamination of freshwater and marine environment (Low *et al.*, 2004). Heavy metals are major pollutants in marine, ground, industrial and even treated wastewaters (Valdman *et al.*, 2001).

The presence of heavy metal ions is a major concern due to their toxicity to many life forms. Heavy metal contamination exists in aqueous wastes of many industries, such as metal plating, mining operations, tanneries, chloralkali, radiator manufacturing, smelting, alloy industries and storage battery industries etc (Kadirvelu *et al.*, 2001).

Pollution from heavy metals is common in developing countries. The discharge of heavy metals into watercourses is a serious pollution problem, which may affect the quality of water supply. Increasing concentrations of these metals in the water constitute a severe health hazard mainly due to their non-degradability and toxicity. Numerous metals such as chromium, copper, lead, manganese, mercury and cadmium are known to be significantly toxic (Tumin *et al.*, 2008).

Water pollution due to toxic heavy metals has been a major cause of concern for environmental engineers. The industrial and domestic wastewater is responsible for causing several damages to the environment and adversely affects the health of the people. Several episodes due to heavy metal contamination in aquatic environment had increased the awareness about the heavy metal toxicity. Among these, Minamata tragedy due to mercury poisoning and 'itai-itai' disease in Japan due to cadmium toxicity are well known (Kumar, 2006).

Metal pollution constitutes a danger to health. Indeed, heavy metals are not generally biodegradable and finally are accumulated in nature. These toxic metals can also be found in the humans by means of the food chain, involving chronic and acute effects (Gueu *et al.*, 2006).

Copper is a widely used material. There are many actual or potential sources of copper pollution. Copper may be found as a contaminant in food especially shellfish, liver, mushrooms, nuts and chocolate. Copper is essential to human life and health, but, like all heavy metals, is potentially toxic as well. For example, continued inhalation of copper containing spray is linked with an increase in lung cancer among exposed workers (Shukla *et al.*, 2002; Khraisheh *et al.*, 2004; Yu *et al.*, 2000).

Copper is found in the industrial wastewater mainly due to the printed circuit board manufacturing, electroplating, plating, wire drawing, copper polishing, paint manufacturing, wood preservatives and printing operations (Rahel *et al.*, 2008).

Copper present in industrial wastewater is primarily in the form of bivalent Cu (II) ions as a hydrolytic product, $CuCO_3$ aqueous and/or organic complexes. Several mining and metal industries, for example dye, paper, petroleum, copper and brass plating and copper ammonium rayon industries release undesired amounts of Cu (II) ions. For example in copper cleaning, plating and metal processing, copper ion concentrations must be reduced below the regulated value of 1.0-1.5mg/l (Rao *et al.*, 2007).

Various methods to remediate heavy metal contaminated soils and wastes exist including thermal, biological and physical/chemical treatments. However most current treatment technologies are either too costly or only partially effective (Chirenje *et al.*, 2005).

The removal of heavy metal in an effective manner from water and wastewater is, thus ecologically very important. There are many reported and established technologies for the recovery of metals from wastewater which include chemical precipitation (Esalah *et al.*, 2000), floatation (Zouboulis *et al.*, 1997), biosorption (Sag *et al.*, 2002), electrolytic recovery, membrane separation (Canet *et al.*, 2002) removal by adsorption on minerals (Ahmed *et al.*, 2002; Weirich *et al.*, 2002) and activated carbon adsorption (Toles and Marshall, 2002). In spite of its prolific use, activated carbon remains an expensive material since higher the quality of activated carbon, the greater is its cost. Activated carbon also requires complexing agents to improve its removal performance for inorganic matters (Babel and Kurniawan, 2003).

Adsorption techniques for waste water treatment has become more popular in recent years with regard to their efficiency in the removal of pollutants especially heavy ions, colour, odour and organic pollution (Ganji *et al.*, 2005; Steinhauser, 2008).

At present, there is growing interest in using, low cost, commercially available materials for the adsorption of heavy metals (Saravanane *et al.*, 2002). A wide variety of materials are being used as low cost alternatives to expensive adsorbents. The use of large quantities of wastes from agricultural products for the treatment of polluted water is an attractive and promising option with a double benefit for the environment (Larous *et al.*, 2005).

Agricultural by-products have been widely studied for metal removal from water. These include peat, wood, pine bark, banana pith, soybean and cotton seed hulls, peanut shells, hazelnut shell, rice husk, saw dust, wool, orange peel, compost and leaves (Pino *et al.*, 2005).

An attempt was made in the present study to assess the efficiency of selected agrowastes namely orange peel, rice husk and sugarcane bagasse in the removal of copper from synthetic copper solution.

The objectives of the present study include:

- Characterization of the three selected agrowastes namely orange peel, rice husk and sugarcane bagasse.
- Assessment of the adsorption capacity of these agrowastes at different experimental conditions by batch studies.
- Adsorption kinetic studies using Freundlich and Langmuir isotherms.

The experiments were conducted by batch scale process. The investigations were focused with reference to sorption of copper so as to provide an understanding of metal ion sorption mechanisms and mobility of heavy metal ions into the selected agrowastes under varying experimental conditions, namely different pH, temperature, adsorbent dose, contact time and initial concentration of metal ions. Adsorption kinetics data might prove the suitability of the selected adsorbents in the efficient removal of the metal ions.