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A Review on Materials, Method and Results for Metal Removal from Liquid Effluent

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ABSTRACT

Removal of heavy metals from industrial effluent is major part of research carried out by researchers to improve the environment and protect human population from adverse effects of industrialization. Zinc, Copper, Manganese and Lead are few of the major heavy metal which finds application in pharmaceutical, paint, catalyst, piping, battery, insecticides and many other industries. Various physical, chemical and biological methods can be used for their removal. Selection of suitable treatment method depends on the concentration of effluent, composition of effluent, available resources, desired final concentration and end use of effluent, disposal method and economic viability. Groundnut husk (GH) and Rice husk (RH) were used as adsorbents to remove Mn2+, Zn2+, Cu (II), Ni and Pb2+ ions from industrial wastewater. Continuous adsorption experiment was conducted to examine the effect of adsorbent mass, pH, temperature and adsorbent combination on adsorption of Mn2+, Zn2+, Cu (II), Ni and Pb2+ from industrial wastewater. The results showed that the adsorption of the metal ions was adsorbent mass, pH, and temperature dependent. The present review is aimed at summarizing various methods used for the removal of these metal ions with respect to methodology, effectiveness and affecting parameters.

Keywords : Adsorption; Isotherm; Adsorbents; pH; concentration.

I. INTRODUCTION

Waste water from numerous industries such as paints and pigments, glass production, mining operations, metal plating, fertilizer and battery manufacturing processes are known to contain contaminants such as heavy metal [1]. Industrial waste water contains heavy metals such as Pb, Cd, Cr, Ni, Zn, Cu and Fe, these heavy metals are not biodegradable and their existence in receiving lakes and streams causes bioaccumulation in living organisms, which leads to several health problems in animals, plants and human beings such as cancer, kidney failure, metabolic acidosis, oral ulcer, renal failure. As a result of the degree of the problems caused by heavy metals pollution, removal of heavy metals from wastewater is important [2]. Investigation into new and cheap methods of metal ions removal has been on the increase lately. Recently efforts have been made to use cheap and available agricultural wastes such as coconut shell, orange peel, rice husk, peanut husk and sawdust as adsorbents to remove heavy metals from wastewater [1]. There are various techniques available for the removal of heavy metals, such as precipitation, membrane filtration, ion exchange, sorptive flotation and adsorption [2]. Biosorption is a physiochemical process that occurs naturally in certain biomass which allows it to passively concentrate and bind contaminants onto its cellular structure [3]. Though using biomass in environmental cleanup has been in practice for a while, scientists and engineers are hoping this phenomenon will provide an economical alternative for removing toxic heavy metals from industrial wastewater and aid in environmental remediation. Rice hulls are the coatings of seeds, or grains of rice to protect the seed during the growing season, the husk is formed from hard materials, including opaline silica and lignin. Groundnut husk is an agricultural based waste material commonly called groundnut husk, peanut hulls, groundnut shells, peanut shells. Belongs to the specie *Arachishypogaea*L. and these materials have the potential to sequester metals from solutions [4,5]. The study has been done on the research that was carried out from January 2015-April

2015 at the Department of Biochemistry, Ahmadu Bello University, Zaria, Kaduna State and focused on investigating the potential of rice husk and groundnut husk agro waste in biosorption of heavy metals from fertilizer industrial wastewater.

II. MATERIALS & RELATED WORK

The waste water contains various organic and inorganic pollutants which need to be treated [6, 7, 8, 9]. There are various health problems caused to human being and environment due to organic matter, heavy metal and biological material [10, 11, 12]. Various methods are available for removal of organic matter from wastewater [13,14, 15]. These methods include biological treatment, adsorption, membrane separation, chemical treatments etc [16, 17, 18]. Both short term and long term deceases are caused to human beings due to these heavy metals. Various biological methods were used successfully by investigators for removal of heavy metals [19, 20]. Adsorption was also investigated by using various low cost adsorbents [21, 22].To prepare bio adsorbent for experiment.The biosorbents used were rice husk and groundnut husk. also prepare packed bed bioreactor for adsorption process. The reactor system used in this study consists of industrial waste water & packed with a known amount of powdered rice husk .then study different effects of various factors like physical and chemical variables, the influence of adsorbent mass, pH, temperature and adsorbent combination.The present review summarizes the studies carried out on the removal of various heavy metals.

III. RESULTS AND DISCUSSION

Nzelibe and Ibrahim [23] attained maximum removal of Mn2+ at 30 g with 92.09% removal using rice husk powder as adsorbent.They [23] observed that increase in adsorbent dosage also increased the percentage removal of Pb2+ for both adsorbents. According to them [23] Lead attained maximum removal at 60 g with 97.35% removal using rice husk powder as adsorbent. Maximum removal of Zinc (Zn) was at 60 g with 96.03% removal using groundnut husk powder. In their study [23] they observed. The percentage removal of Mn(II), Zn(II) and Pb(II) ions , increased with increasing dosage due mainly to an increase in the number of available exchangeable active sites for metal ion sorption [24]. The observed that with increase in the pH of wastewater, the percentage removal of metal ions increased and attained maximum removal for manganese at pH 6 with 75.62% and pH 5 with 98.82% using rice husk powder and groundnut husk powder respectively. Lead had maximum removal at pH 6 with 94.54% removal with groundnut husk powder as adsorbent. They [23] found that the removal of Manganese, Zinc and Lead was favored at higher temperature. Kanawade and Gaikwad used cork powder as Adsorbent for removal of zinc from the wastewater [25]. According to them adsorption is one of the cost effective and efficient way to remove zinc from wastewater. They used electroplating effluent cellulose(Na-CMC). They observed that the removal process was characterized by less energy, high selectivity and fast rate for the treatment with cork powder. According to them At low pH values, a large number of the H_3O+ groups occupy the positions, which prevent the target zinc ions from form complexes with Sodium carboxymethyl. Ghorbani et.al.sed polyanilinenano composite coated on rice husk for removal of zinc ions from aqueous solution[26]. They found that the optimum conditions for zinc removal by this methods were pH value of 3, adsorbent dosage of 10 g/L and equilibrium time of 20 minutes. Also it was observed that the equilibrium adsorption isotherm was better described by Langmuir adsorption isotherm model.

IV. CONCLUSION

There are various factors on which removal of Mn(II), Zn(II), Cu(II), Zn and Pb(II) ions from aqueous solutions are dependent. These factors are Biosorption process like pH, Temperature and biosorbent dose. The equilibrium data collected were analysed using the Freundlich and Langmuir isotherms. RH and GH can be treated as an alternative adsorbent for treatment of waste water containing Mn(II), Zn(II), Cu(II), Zn and Pb(II) ions because of the fact that these are easily available and has an considerable high biosorption capacity. The increase in removal can be done by chemical treatments like coagulation and flocculation along with primary treatments. It can be concluded that adsorption and biosorption techniques are most widely investigated methods because of cost, efficiency, flexibility and simplicity.

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