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Review Article

Research and Studies on Cobalt Removal from Wastewater

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ABSTRACT

Removal of heavy metals from wastewater can be carried out by using methods such as adsorption, biosorption, chemical precipitation, bioconversion, ion exchange and membrane separation. Nickel, cadmium, arsenic, zinc, lead, iron, mercury and cobalt are few heavy metals present in industrial wastewater. These metal ions can have various effects on biological cycle of living organisms. The need for effective method for removal of cobalt calls for studies on various methods and aspects of wastewater treatment for cobalt removal. The current review summarizes research and studies on cobalt removal from waste water.

Key words: Heavy metals, removal, adsorption, pH, concentration, time, isotherm, kinetics.

INTRODUCTION

The industrial waste water needs to be treated for removal of various pollutants present in it. The nature of wastewater plays key role in deciding the treatment method. The pollutants present in wastewater are classified as organic, inorganic, biological and toxic. Other types of pollutants include various coarser materials, oil and grease etc. The most common structure of industrial wastewater treatment includes physical treatment, biological treatment and chemical treatment. The removal of organic matter from the wastewater is major treatment for wastewater. Various methods are studied by investigators for studying various aspects such as affecting parameters, kinetics, isotherms and mechanism. [1-6] Also removal of heavy metals is widely studied topic. The removal of heavy metal can be carried out by using membrane separation, biological methods and adsorption by various low cost adsorbents. [7-13] The presence of these metals in wastewater can cause various acute and chronic diseases. [14,15] Cobalt is one such metal used in industries such as nuclear, medicine, enamels and semiconductors, grinding wheels, painting on glass and porcelain, hygrometers and electroplating. It is also used as a foam stabilizer in beer, in vitamin manufacture, as a drier for lacquers, varnishes, paints. Cobalt can have various adverse effects on health such as asthma, heart damage, heart failure, damage to the thyroid and liver. The removal of cobalt from wastewater can be carried out by various chemical, biological and physical methods. Current review summarizes research and studies on cobalt removal from wastewater.

RESEARCH AND STUDIES ON COBALT REMOVAL FROM WASTE WATER

Dwairi and Al-Rawajfeh carried out an investigation on use of low-cost zeolite and bentonite for removal of cobalt and nickel from wastewater. [16] They observed that bentonite provided better removal than zeolite. Also it was observed that 50-50 mixture of these two yielded best results. They also found that the removal process

followed second order kinetics. Salehzadeh investigated the capacity of Xanthium Pensylvanicum towards metal ions such as Pb^{2+}, Cu^{2+}, Zn^{2+}, Cd^{2+}, Ni^{2+}, Co^{2+} and Fe^{3+}. [17] He performed batch experiments to study effect of these parameters on adsorption. He observed that the optimum parameters for cobalt removal were pH=4, initial concentration of metal ions 10 mg/L, and 90 minutes of shaking time. Waghmare and Chaudhari carried out investigation on removal of cobalt from wastewater using Moringa Oleifera Bark. [18] Their studies were aimed at utilizing the locally available material for removing the heavy metal. They studied effect of various parameters such as such as adsorbent dosages, pH, and contact time on adsorption of cobalt. The equilibrium contact time was observed to be 360 minutes with 85.33 percent efficiency in these studies. Pine sawdust was used for cobalt removal by Musapatika et.al. [19] According to them use of such agricultural waste helps to reduce solid waste problem along with wastewater treatment. They also studied parameters such as adsorbent dose, solution pH and initial concentration. Also adsorption isotherms studies were carried out by them. They observed that low adsorbent dose, high pH and high initial concentration of wastewater favoured nickel removal. Also it was observed that Freundlich isotherm provided better fit than Langmuir isotherm. Hashemian and Saffari used Fe_3O_4/Bentonite Nanocomposite for removal of cobalt from aqueous solutions. [20] They used chemical co-precipitation method for preparation of Fe_3O_4/Bentonite nanocomposite. In their investigations, they observed that spinel structure of Fe_3O_4 and the presence of Fe_3O_4 significantly affect the surface area and pore structure of the bentonite. They also observed that pseudo-second-order kinetics explained adsorption isotherms. Galedar and Younesi used saccharomyces cerevisiae cells for removal of cobalt and other metal ions from waste water. [21] They studied effect of parameters like pH, initial biomass dose and initial metal ion concentration on cobalt removal. They observed that pH value of 8 was optimum for cobalt removal. The optimum biomass concentration was 8 mg/l. Also Langmuir model was found to be a better fit. Prabakaran and Arivoli carried out investigation on wastewater treatment for cobalt removal by using low cost activated carbon. [22] They studied the effects of various parameters like adsorbent dosage, Co (II) concentrations, contact time and pH on cobalt removal. They analyzed the results by using Langmuir, Freundlich isotherms. Pseudo-first-order kinetic model described the adsorption kinetics. Aydin and Yavuz carried out investigation on recovery of copper, cobalt, nickel, cadmium, zinc and bismuth from electrolytic copper solution. [23] They converted cobalt ions to sulphates. Then the sulphates were roasted. Then other ions were separated by fractional distillation.

CONCLUSION

Cobalt removal from wastewater can be carried out by using low cost adsorbents. The research has been reported on use of agricultural waste for removal of cobalt. The main objective of adsorption studies was study on affecting parameters, isotherm and kinetics. The isotherm and kinetics depends on nature of adsorbent and ease of adsorption. The increase in initial concentration, adsorbent dose and pH favours cobalt removal. Methods such as precipitation, ion exchange and electrodialysis were also found to be useful for cobalt removal.

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