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# A REVIEW ON DESORPTION OF CADMIUM FROM ADSORBENT

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## ABSTRACT

Adsorption is one of the very useful technique for removal of heavy metals. Cadmium is one such heavy metal which is present in the effluent of many chemical and electrochemical industries. Adsorption of cadmium by using various low cost adsorbent is widely studied research area. However the key to application of adsorption is regeneration and recovery of adsorbent and adsorbate respectively. Disposal of heavy metal loaded adsorbent to solid waste facilities or soil is also not very wise option. So desorption becomes important aspect of this treatment facility. Current review aims at summarizing desorption studies for cadmium desorption from used adsorbents for cadmium removal.

## I. INTRODUCTION

Cadmium is one of the important heavy metal pollutant in the waste water from many industries. It affects man and environment adversely if injected, inhaled and exposed to long time [1,2,3]. It can have acute and chronic effects on human beings and animals.[4,5,6]. The removal of cadmium can be carried out by various chemical, biological and physical separation techniques[7,8,9,10,11]. Adsorption is one of the most widely used techniques for heavy metal removal[12,13,14]. Various low cost adsorbents have been used for cadmium removal with different degree of success[15,16,17,18,19,20]. The regeneration of adsorption needs to be studied and investigated to find proper and efficient method for adsorbent regeneration[21,22,23,24,25] . The disposal of used adsorbent should be carried out with minimum loading of pollutant on the adsorbent. The cadmium with adsorbent disposed may enter the living organism through food chain. Thus desorption of the cadmium from used adsorption makes the operation economical and environ friendly. The present review summarizes research carried out for adsorbents used for cadmium adsorption.

## II. RESEARCH ON DESORPTION OF ADSORBENT FOR CADMIUM TREATMENT

In their investigation Maleki et.al. studied desorption of cadmium from barley hull adsorbents[26].They carried out batch desorption experiments using distilled water at fix pH value. The adsorbent time and dosage were 24 hrs and 2 grams respectively. They observed that the desorption of cadmium by batch process was 8 %. Also desorption of cadmium increased with decrease in pH value. V. Jovic and B. Jovic investigated processes of adsorption/desorption of iodides and cadmium cations onto/from Ag(111)[27]. They performed experiments in a two-compartment electrochemical cell at 25±1 °C. They prepared the single crystals by a mechanical polishing procedure followed by chemical polishing in the solution containing NaCN and $H_2O_2$. Hsien and Liu studied desorption of cadmium from porous chitosan beads[28]. They prepared the beads by casting a 5 wt % chitosan solution in the precipitation bath to form chitosan gel beads and then it was cross linked with a 2.5 wt % aqueous glutaric dialdehyde. Remaining humidity was removed by freeze drying. They performed single stage and multiple stage experiments. They added 0.1 N $HNO_3$ solution to the vessel to load the bulk solution for the $H^+$ ions. They observed that cadmium concentration increased sharply during the first 12 hours of desorption. It leveled off after 75 hours of desorption. They also observed that the pH of the cadmium solution also decreased with the addition of nitric acid and then rose to a final value of 2.17. Also it was found by decreasing the equilibrium pH, there was increase in the percentage of cadmium desorbed according to an S-shaped profile. Ugwekar and Lakhawat investigated recovery of heavy metal by adsorption[29].They used peanut hull for preparation of adsorbent. Comans studied the cadmium adsorption desorption by using illite clay[30].They observed initial rapid desorption followed by slow desorption. It increased slightly towards end.

Olowoyo, and Orherhe investigated the feasibility and optimum conditions of removal of lead and cadmium ion from aqueous solution using ion exchange resins obtained from sugarcane bagasse by chemical modification[31].Carsky and Mbhele carried out adsorption and desorption experiments for heavy metal removal by using marine algae[32]. They observed that metal adsorption was found to be rapid within 25 minutes. They observed that the column service time decreased from 25 hrs in the first cycle to 10 hrs for the last cycle. Modified Poly ethylene terephthalate fiber was investigated for cadmium adsorption- desorption studies by Borzou et.al.[33]. By treatment with dilute sodium hydroxide, the desorbed amount was approximately 5 to 8 percent of adsorbed cadmium. By using dilute nitric acid, amount of desorbed cadmium was approximately 97 to 98 percent of adsorbed

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cadmium. Kuczajowska-Zadrożna et.al. investigated cyclic adsorption and desorption of cadmium on activated sludge Immobilized on alginate carriers[34]. In their experiments activated sludge was grown under both, aerobic and anaerobic environment. Solution of sodium alginate with PVA and distilled water was used for immobilization. They observed that the desorption had a two-stage nature. They also observed that equilibrium desorption efficiency was lower in comparison to adsorption efficiency .

Mustafa et.al. investigated desorption of cadmium from goethite in the presence of desferrioxamine B and oxalic acid[35]. Desferrioxamine B (DFOB) siderophore, enhances the availability of iron (III) in Fe deficient soils. Organic acids like oxalic acid (OA), found in the rhizosphere, chelate heavy metals. They conducted experiments with two initial Cd concentrations (i.e. 180 and 300 µM) in the presence of 300 µM DFOB and 200 µM OA and the combination of two. They observed that DFOB and OA enhanced Cd desorption substantially. In their investigation for desorption, they observed 70 to 77 percent cadmium recovery from 180 µM Cd after 15 successive desorptions in the presence of DFOB and OA compared to 46 percent in control sample. Essiett et.al. studied adsorption for removal and recovery of cadmium using coir dust.[36].A series of Cd sorption batch experiments were conducted on different fractions of soils from a long term field experimental site by Hettiarachchi et.al.[37]. Their objective was to evaluate the importance of both the inorganic and organic fractions in biosolids on Cd chemistry. They observed that removal of organic carbon (OC) reduced the slope of the Cd sorption isotherm. In the desorption experiments carried by them, desorption experiments failed to remove from 60 to 90% of sorbed metals in soil systems . The hysteresis was higher for biosolids-amended soil than the control soil. Gupta and Nayak investigated orange peel and $Fe_2O_3$ nanoparticles for cadmium removal and recovery from aqueous solutions $Fe_2O_3$ nanoparticles[38].They used 5 ml of 0.1 M $HNO_3$ in desorption. During desorption studies they observed tht with $Cd^{2+}$laden MNP–OPP in 0.1 M $HNO_3$, approximately 98% of the adsorbed cadmium was desorbed.

## CONCLUSION

Heavy metal removal by adsorption is very effective method of treatment. Low cost adsorbents render economy to this technique. The disposal of the used adsorbent is an environmental problem. Maximum reuse of adsorbent is very important to reduce solid waste disposal in this treatment. Various regenerations methods by using different eluents have been used to explore the possibility of efficient desorption of cadmium from these adsorbents. Desorption by nitric acid was most effective method for desorption cadmium from adsorbents.

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