WATER WORKS WASTE AS LOW COST ADSORBENT

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ABSTRACT

Treatment of surface water for obtaining water of potable quality is being practiced all over the world. The desludging of water treatment tanks results in discharge of water works waste.On analysis this waste has been found to contain SiO_2, Fe_2O_3,Al_2O_3,CaO ,MgO,SO_4^{2-},Cl^-,F^- and organic matter as major components. A number of anthropogenic toxicants like heavy metals Cu,Co,Ni,Pb,Zn,Mn,Cd,Bi,Cr,Li,Rb,As,Si,Sb,and F^- which were in the raw water at trace level were found to have accumulated in the water works waste in concentration several fold higher than in the raw water. Experiments showed that this waste has asignificant adsorption capacity for removing several toxic ions and shows promise as a good detoxifying material.

KEYWORDS

Sedimented-Sludge, Antropogenic metals, Adsorption, Hazardous , Detoxification.

Introduction

Water pollution due to organic contaminants is a serious issue because of acute toxicities and carcinogenic nature of the pollutants. Among various water treatment methods, adsorption is supposed as the best one due to its inexpensiveness, universal nature and ease of operation. A conventional method for removing metals from industrial effluents includes chemical precipitation, coagulation, solvent extraction, electrolysis, membrane separation, ion-exchange and adsorption. The cost of water purification by these technologies is very high per cubic meter of treated water. Oppositely, the cost of water treatment using activated carbon adsorption ranges Rs 1000 to Rs 15000 per cubic meter of water. Many waste materials used include fruit wastes, coconut shell, scrap tyres, bark and other tannin-rich materials, sawdust and other wood type materials, rice husk, petroleum wastes, fertilizer wastes, fly ash, sugar industry wastes blast furnace slag, chitosan and seafood processing wastes, seaweed and algae, peat moss, clays, red mud, zeolites, sediment and soil, ore minerals etc. These adsorbents have been found to remove various organic pollutants ranging from 80 to 99.9%. The present article describes the conversion of waste products into effective adsorbents and their application for water treatment. The possible mechanism of adsorption on these adsorbents has also been included in this article. Besides, attempts have been made to discuss the future perspectives of low cost adsorbents in water treatment.

Nowadays, water pollution is a serious issue as it affects the all living creatures, household, recreation, fishing, transportation and other commercial activities [1-2]. The growth of world population, industrialization and civilization, domestic and agricultural activities and other environmental and global changes are continuously affecting the quality of water. More than 700 organic and inorganic pollutants have been reported in water. Among these pollutants, heavy metal ions such as lead, chromium, mercury, selenium, zinc, arsenic, cadmium, gold, silver, copper, nickel, etc are most dangerous and toxic in nature. A conventional method for removing metals from industrial effluents includes chemical precipitation, coagulation, solvent extraction, electrolysis, membrane separation, ion-exchange and adsorption. The cost of water purification by these technologies is very high per cubic meter of treated water. Oppositely, the cost of water treatment using activated carbon adsorption ranges Rs 1000 to Rs 15000 per cubic meter of water. Besides, adsorption is supposed to be the best wastewater treatment method, due to its wide range of applications and ease of operation [3]. Many researchers have investigated the potential use of different plant material as adsorbent for heavy metals from water, such as coconut husk, palm fiber, water fern, peat moss, duck weed, wheat bran etc,(4-14). Iin this investigation, adsorption studies for the removal of toxic metal ions is done from low cost adsorbent .(20) was studied by a batch technique. .

MATERIALS AND METHODS

Sample Collection: Three samples (1Kg each) were collected from different storage points of the sedimented sludge discharged by the water works of a township . The samples were composited and then dried in an oven, and thereafter powdered to 100 mesh size.

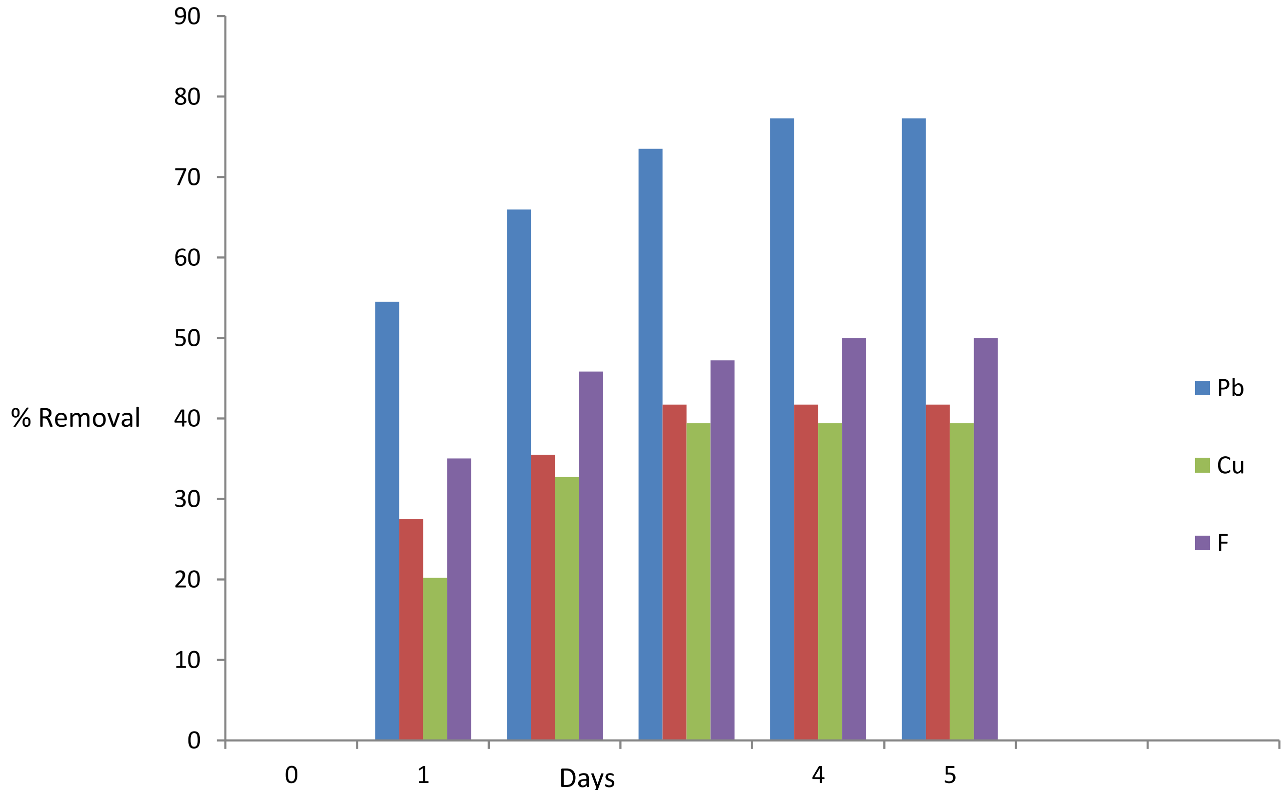
Procedure: Five treatment mixtures , in separate beakers, were prepared by taking weighed quantities(5 g each) of the dried sediment and then adding separately 100 ml aliquots of solutions of Pb^{2+} ,Cd^{2+},Cu^{2+} and F^- ions, each containing known quantities of the respective ions (Nitrates of the metallic elements, and NaF for F were used). Aliquots (5 ml) of the filtered liquids were drawn from each vessel at intervals of one day and the concentrations of the ions were determined volumetrically. Pb^{2+} ,and Cd^{2+} were determined using EDTA(disodium salt) solution (0.01 M), hexamine powder and xylenol orange indicator (1). Cu^{2+} ions were determined idometrically using standardized sodium thiosulphate solution(N/30),(1,2) F^- was determined spectrophotometrically using alizarin red S reagent, measuring absorbance at 532 nm (3,4). The estimations were continued in each case till constant values were obtained. The results obtained have been shown in Table-1.

Table-1 Removal of Toxic ions by water works Sediments

S.No	Toxic ions	Amt added (g/100ml)	Duration (days)	Amt Found (g/100ml)	% Removal
1.	Pb	1.098 (pH-5.5)	1	0.4662	57.5
			2	0.3729	66.0
			3	0.2900	73.5
			4	0.2486	77.3
			5	0.2486	**77.3**
3	Cd	0.3372 pH-(5.6)	1	0.2445	27.5
			2	0.1967	41.7
			3	0.1967	**41.7**
4	Cu	0.5292 pH-(5.3)	1	0.3687	30.3
			2	0.559	32.7
			3	0.3178	39.4
			4	0.3178	**39.4**
5	F	0.3000 pH-(10.5)	1	0.1800	40.0
			2	0.1625	45.8
			3	0.1625	45.8
			4	0.1500	50.0
			5	0.1500	**50.0**

The extent of removal of the toxic ions in known durations have been shown in the Fig-1.

FIGURE -1 Removal of Toxic ions by water works Sediments



RESULTS AND DISCUSSION

Results obtained show that Pb^{2+} ions were removed by the sedimented-sludge to a large extent (over 77%) the percentage of removal of F^-, Cd^{2+}, Cu^{2+}, and Ni^{2+} ions were 50%,41.7%,39.9% and 15.8% respectively ,while the removal of F Cd and Cu ions is at significant level, but adsorbtion t of Ni ions is low.

All these ions have hazardous effects which have been extensively reported. Pb- poisoning is reported to be associated with anemia and reduced cell life.(5,6) Copper toxicity is found to be the fundamental cause of Wilson's disease.(7) Cadmium compounds are toxic substanceproducing acute or chronic symptoms varying in intensity from irritation to extensive disturbance (8,9). Nickel contact dermatitis has been reported .(10) Symptoms that follow ingestion of soluble fluorides are vomiting, abdominal pain,diarrhea,muscular weakness, collapse,weakness of the pulse,disturbed color vision and motor unrest.(11,12) The effects of fluorides on human health have been extensively reviewed by the World Health Organization.Fluorides have been quoted to have adverse effects on agriculture.(13)

The studies have shown that the sedimented sludge discharged by water works can be economically used in the treatment of industrial waste waters contaminated with toxic ions such as Pb, Cu, Cd, Ni, and F for the partial or complete removal of these ions. The applications shall be particularly useful for minimizing the contamination of thesoil by these toxic elements where the contaminated waters are discharged to open land.

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