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Review Article

A Review on Studies and Research on Manganese Removal

Sunil J. Kulkarni

Datta Meghe College of Engineering, Airoli, Navi Mumbai, Maharashtra, India.

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ABSTRACT

Water treatment is one of the key areas in the pollution engineering. Removal of organic and inorganic matter is essential for environmental conservation. Various conventional treatment techniques include physical, chemical and advanced treatment processes. The removal of metal ions from wastewater is widely investigated research area. Manganese and iron are two such heavy metals. Manganese removal is difficult because of its high solubility. Various chemical and biological methods can be used for manganese removal. These methods include biosorption, adsorption, biological methods, chemical methods and precipitation. Current review summarizes research and studies on manganese removal.

Key words: microfiltration, optimum dose, pH, nanoparticles, concentration.

INTRODUCTION

Sustainable development calls for effective removal of various metals from wastewater by using environmental friendly techniques. Conventional treatment plant includes primary, secondary and tertiary treatments. Removal of various metal ions is important aspect of these treatment methods. Removal of organic matter is also widely investigated area of research. Organic matter is expressed as chemical oxygen demand (COD). Various biological methods are investigated for COD removal with satisfactory results. [1-3] For COD removal, adsorption by low cost adsorbent is also effective alternative. [4-6] Heavy metal removal also can be carried out by using various adsorbents. [7-9] For heavy metals also, biological and membrane techniques were found to be effective. [10,11] Manganese is one of the metals with high solubility in water. Various investigators have studied various physical, chemical and biological treatments for its removal. Current review summarizes research and studies for manganese removal from water.

RESEARCH AND STUDIES ON MANGANESE REMOVAL

Kan et. al. carried out an investigation on removal of iron and manganese by aeration, chlorine oxidation and microfiltration (MF). [12] They studied the factors such as oxidant doses, pH and reaction. They observed that the pH value greater than 7 has positive effect on the removal. The optimum dose of 3 mg/l of NaOCl was required for 90 percent removal of manganese.

Pires et.al. carried out an investigation on chlorine oxidation for manganese removal from wastewater. [13] They used chlorine oxidation followed by clarification. They investigated the simultaneous removal of arsenic [As (V) or As (III)] and manganese [Mn (II)] from natural waters. By using clarification it was possible to remove up to 27 percent of manganese. Manganese removal reached 77 percent when they used chlorination. Beh et. al. carried out an investigation aimed at studying characteristic and behavior of manganese removal by using Electric Arc Furnace(EAF) slag for efficient metal removal. [14] They investigated removal characteristics in terms of sorption kinetics and isotherm. They observed that second order rate equation describes the removal kinetics for manganese. Also it obeyed the Langmuir kinetics. For initial concentration of 20-120 mg/l, the contact time required was 3-4 hours.

Sinha and Khare discussed various technical aspects associated with manganese as pollutant and microbial mitigation. [15] According to them, the use of natural sources like microbes seems promising for the removal of manganese from the environment. According to this review, immobilized microbes have an advantage of easy handling and large-scale applications.

Annisa et. al. carried out research aimed at determining the influence of flow rate variance in removal of Fe and Mn from groundwater used in activated sand filtration technique. [16] They treated variance of flow rate as independent variable and removal of Fe and Mn as dependent variable. They observed that efficiency of removal decreased with increase in flow rate. Their research was aimed at determining the influence of flow rate variance in removal of Fe and Mn from groundwater using activated sand filtration technique. They analyzed the data by descriptive analysis using canberra matrix and group average clustering methods. Higher discharge and shorter height reduced the removal capacity of the column. They found that average concentration for Mn removal efficiency was 94 percent.

Agarwal and Patel used modified zero valent iron (ZVI) nanoparticles for removal of manganese from water. [17] They characterized nanoparticles by scanning Electron Microscopy (SEM), Energy dispersive X-ray spectrometry (EDS), X-ray diffraction (XRD) and Fourier transform infrared spectra (FTIR). They studied the effects of contact time, adsorbent dose, Mn (II) initial concentration, pH and temperature. They were able to achieve maximum 92.45 percent Mn removal by using nanoparticles. The maximum removal occurred at pH value of 9. With increase in initial concentration from 2 percent to 9 percent, the removal percent decreased from 93.11 percent to 68.82 percent. They also observed that the adsorption followed pseudo first order kinetics. Also Langmuir isotherm fitted the data.

Vidovic et. al. carried out an investigation on removal of Mn and Fe in presence of hydrogen sulfide and ammonia. [18] According to them the presence of these two components makes the treatment more difficult. It was observed that decrease in hydrogen sulfide increases the removal. A study carried out by Lumiste et.al. was focused on the optimization of the groundwater pilot plant treatment scheme for the removal of iron, manganese, ammonia, and sulphides. [19] They observed that the detention time of water in the oxidation tank played a key role in the chemical reactions implementation and gas (CO2) removal. Limestone and sodium carbonate was used for treatment of water containing high manganese by Silva et.al. [20] They observed that besides the concentrations, pH also plays a key role in the removal. For pH value above 8.5, 99.9 percent manganese removal was possible.

CONCLUSION

The pH value greater than 7 has positive effect on Mn the removal. Manganese removal reached 77 percent when chlorination was used with clarification. Second order rate equation describes the removal kinetics for manganese in most of sorption studies. The use of natural sources like microbes seems to be promising for the removal of manganese from the environment. Immobilized microbes have an advantage of easy handling and large-scale applications. Efficiency of removal decreased with increase in flow rate. pH also play a key role in the removal.

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