Removal of Heavy Metals (Zinc) From Wastewater

S.B.Divate
Department of Chemical Engineering
Pravara Rural Engineering College, Loni

Abstract- *Heavy metals are the most hazardous pollutants present in industrial and domestic waste water. they are rejected directly into the natural main stream and if left untreated they are in most of the time the major causes of nature degradation. Rapid industrialization and urbanization have resulted in the discharge of various toxic pollutants into the water bodies. Heavy metals constitute the major part of toxic waste let out by many industries. These metals are toxic to both human beings and aquatic life when they exceed their permissible limits. There are several methods used for the removal of heavy metals in the wastewater such as chemical precipitation, ion exchange, reverse osmosis, electro dialysis, ultra filtration but these methods are either expensive or inefficient for the removal when the metals are at high concentration. The search for new technologies involving the removal of toxic metals from wastewaters has attracted attention to adsorption.*

Keywords- Heavy metals, wastewater, Zn ion, Industrial effluent, Alloy, Human

I. INTRODUCTION

Zinc is an essential element and it plays an important physiological role in human beings. Zinc is present in many alloys and is also found in a number of pharmaceutical samples and in airborne particulates, causing environmental pollution. Heavy metal releases to the environment have been increasing continuously as a result of industrial activities and technological developments, posing a significant threat to the environment and public health because of their toxicity, accumulation in the food chain and persistence in nature. Metals of immediate concern include copper, zinc, chromium, arsenic, lead, nickel, iron. Living organisms require varying amounts of heavy metals like Iron, cobalt, copper, manganese in small quantities. But excessive levels can be damaging to the organism and their accumulation over time in the bodies of animals can cause serious illness. Acute toxicity of zinc may result in sweet taste, throat dryness, cough, weakness, generalized aching, chills, fever, nausea and vomiting. Eating large amounts of zinc even for a short time .The proposed limit of Zinc in drinking water is 5 ppm as proposed by FDA. Zinc is the 23rd most abundant element in the Earth's crust and its concentrations are rising unnaturally due to addition of zinc through human activities. Most zinc is added during industrial activities such as mining, coal and waste combustion and steel processing. When it is present in less quantity in human's body it affects considerably human's health. Although humans can handle large extent of zinc too much of it can still cause eminent health problems. Zinc is widely used in industries such as galvanization, paint, batteries, smelting, fertilizers and pesticides, fossil fuel combustion, pigment, polymer stabilizers and the wastewater from these industries is polluted with zinc due to its presence in large quantities. This wastewater is not purified satisfactory. One of the consequences is that rivers are depositing zinc-polluted sludge on their banks.

II. MATERIALS AND METHODS

To remove these dissolved metals and zinc in particular numerous downstream physicochemical approaches in addition to biological can be applied to recover heavy metals from aqueous solutions or from aqueous solutions that saturate soils but all of them remediate rather than prevent. most of the possible methods we will have a closer look as said earlier on the methods that use microalgae since microorganisms are considered intrinsically more efficient in the bioaccumulation of heavy metals when exposed to low concentrations in their surrounding aqueous environment.

A. Physicochemical methods

There is a wide range of treatment methods such as membrane filtration, adsorption, ion exchange, reverse osmosis, chemical precipitation, or solvent extraction which have classically been employed for stripping toxic metals from wastewaters .these methods have disadvantages like incomplete metal removal, high reagent or energy requirements and generation of toxic sludge or other heavy metal containing waste products that may sometimes be more toxic than their parent ones. For this reason additional disposal methods are required. In addition they are often expensive especially when the heavy metal concentrations are very low and ineffective since a too large amount reduction of effluents is anticipated so a narrow use in large-scale in situ operations will typically result.

B. Biological methods

Number of advantages for these methods can be enumerated such as reduced requirement for chemicals low operating costs, eco-friendliness and high efficiency at low levels of contamination. They also offer possibilities for metal recovery and biosorbent regeneration afterward. using various kinds of readily available and inexpensive biomass of several microorganisms and microalgae in particular for removal of heavy metals. Microorganisms are in fact considered intrinsically more efficient in the bioaccumulation of heavy metals when exposed to low concentrations in their surrounding aqueous environment.

Microalgae are used in bioremediation of metal-contaminated sites due to

- their ability to tolerate those metals
- their high yields of recovery per unit mass
- Their high specific outer area coupled with a cell wall loaded with ionisable groups.

They furnish an extensive collection of helpful mechanisms which in natural environments contribute to the global cycling of inorganic matter and in particular lead to the formation of deposits of various minerals and ores such as gypsum, limonite within geological periods of time. Thompson hypothesized that such "bio mineralization" processes proceed according to the following sequence:

1. Formation of microbial biofilm
2. Biosorption of soluble metals to microbial cells and exopolymers
3. Formation of metal hydroxides, oxides, carbonates and their maturation to amorphous mineral precursors
4. Stabilization of the precipitates forming a demineralization nucleation crystal template for further mineralization in the microenvironment generated by the metabolic activity of microorganisms. pH and the cell's wall play by themselves one of the most important functions in the adsorption of heavy metals by micro-algal cells. The micro algal cell wall has indeed the capacity to bind with these ions its negatively charged moieties.

III. RESULTS AND DISCUSSIONS

Different investigations are being conducted aiming to reduce considerably the amount of dissolved heavy metals. Most of these methods which were applied on a lab scale can still be used to reduce the amount of Zn in wastewater streams. designed algal and duckweed based stabilization pond system during cold weather it was seen that the BOD was lowered considerably in fact the first pond of the system in place in which the micro algae were consuming nutrient from the wastewater for their growth. In order to reach target the COD of the system was partially modified to allow the oxidation of organic nutrients to happen. Analysis of the water leaving the second pond revealed a huge potential for this treatment since for example the pH of the wastewater was increased as well as the DO. as per all experiments a certain number of parameters have to be clearly set in order to give a good efficiency of the pollutant removal.

The growth of microalgae was hindered seriously as the concentration of Zn went increasing. Although the growth was inhibited seriously a huge increase in the metal removal was reported when the cells were in highly concentrated environments rather than in less concentrated ones. These living cells first showed an immediate high adsorption of Zn ions at the very beginning of the experiment and the slowly the adsorption went on decreasing as the Zn concentration decreased. same micro algal specie can act differently according to the fact that it is isolated from contaminated environments or grown artificially. Indeed the micro alga specie which was collected from contaminated environments showed an important removal capacity than the one artificially grown.

In case of pH, it was reported that cationsbiosorption and pH were directly proportional. smallest Biosorption capacity was recorded at lower pH values when the highest was reached at higher pH values approaching neutrality result obtained that high algal diversity results in efficient nutrient removal from primary settled wastewater.

When performing the same experiment with inactivated cells the same observation of sudden removal increase and an equilibrium reached after some time of the experiment was made. This lead to the statement that the fast removal of Zn ions was done by the ionic adsorption by the micro algal cell reason why the equilibrium was remarked at a certain time since no cells were growing.Cold climate is normally not favorable for bioremediation of wastewater in pond system due to poor light availability and low temperature however Gronlund successfully demonstrated the feasibility of using certain micro algae with particular attributes to treat wastewater. Algae are known for their capacity to accumulate heavy metals from wastewater since heavy metals such as Zn, Cu, Fe, Mn, Co and Mo are required as essential nutrients.

IV. CONCLUSION

Throughout this paper the importance of removing heavy metals in general and zinc in particular from industrial or domestic wastewater was highlighted. Many methods with different aims are already available. But the most useful method is microorganism to recycle wastewater due to the fact that the treatment using algae is more efficient and faster since bacteriological treatment is a process of decay whereas algae treatment is one of conversion of organic matter to live healthy plant life. Algae can metabolize sewage far more rapidly than bacterial treatment.

However we are confronted to the development of cheaper methods since in most countries wastewater treatment has to be a low-cost plan for its majority approval. More work by scientists and technologists is required in order to accomplish this objective.

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