TREATMENT OF WASTE WATER USING BIOSORPTION

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ABSTRACT

Wastewater from metal smelting and refining industries has a inimical effect on environment. The toxic sludge from these industries has an adverse effect on aquatic life. Now days use of metabolically inactive dead biomass of microorganisms, plant are used as an alternative technology for sorption of pollutants from aqueous solution. The removal of heavy metals like Pb, Zn, Cd, Cr, Cu and Ni can be done. This method had gain attention now days due to cost-effective, efficiency of this process and Sources are easily available so they are readily available. Aseptic conditions are not required in such type of treatment. Conventional treatment (ion exchange, reverse osmosis) of wastewater is not so much effective and economical compare to biosorption for aqueous solution. In this study a ordinary biosorbents (Banana peels, Orange peels, egg shell, Jackfruit, Corn cobs, Fungi, yeast) were used. The potential of biosorbents depend on pH, Contact time, Temperature, biosorbent dose, agitation speed, absorbent size, and agitation time was analyzed. The objective of this paper is to available the use of different biosorbents for different heavy metals at different conditions..

Keywords*: Metabolically, Sorption, Aseptic.*

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1. INTRODUCTION

Effluent from industries containing heavy metals is now become concern to environmentalist. Many chemical and metallurgical industries release their effluent without any proper treatment into water bodies. Toxic effluent contains lead, Zinc, Cadmium, Chromium, Copper, Nickel, etc. like heavy metals, Due to which both aquatic life and human beings has negative effect on health. Diseases to human beings can be heart problem, skin rashes, cancer, nausea, kidney damage[1]. The non-biodegradable nature of this type of effluents is a problem for chemical engineers. Conventional methods like, ion exchange, filtration, chemical precipitation, electrochemical treatment, chemical reduction or oxidation, reverse osmosis, membrane technology, evaporation recovery is costly when the metal are in less range. The sludge cannot be dispose directly due to toxicity. So proper treatment to the effluent is necessary. Biosorption of heavy metals using inactive biomass is an effective method for treatment of effluents from industries. Biomass of plant and microorganisms are good absorbents for heavy metals. Availability and choosing the appropriate biomass is important. As the biomass is readily available this method is less costly and eco-friendly for treatment. In this paper the potential of banana peels, orange peels, Jackfruits, corncobs, egg shells, Fungi and yeasts are lighted.

1.1 Heavy Metals in Effluents

Metals having density more than 5 g/cm^3 are called heavy metals [2]. There are large numbers of heavy metals, which are harmful for the living organisms. Heavy metals cause many diseases to human beings like Nausea, cancer, Fatigue, headache, vomiting, etc. Mercury, lead, chromium (VI), Cadmium are pernicious for human beings. The frequently used metals are Cr(III),Cu, Ni and are less toxic. Electric Industries mostly use Cu, and brass. For production of alloy and galvanization Zn is used[3]. Cd accumulate in human body and causes cancer it affects bone, kidney as many industries use it in electro-plating and producing batteries and pigments. Chromium compounds are carcinogenic in nature. Country should be concern having large production of dyes.

2. Methods for Treatment

To remove the heavy metals from the effluent there are many conventional methods for treatment like Chemical precipitation, ion exchange, reverse osmosis, electro dialysis. Chemical precipitation it is common method for removing dissolved metals from wastewater solution containing harmful metals. A precipitation reagent is added to the mixture. A chemical reaction takes place within the mixture, which causes the dissolved metals to form solid particles. After it filtration is done. Ion Exchange in this method one or more undesirable contaminants are removed from water by exchange with another non-objectionable substance. This is an effective method for removal of heavy metals but this is a expensive method as compared to other methods. This method is capable to achieve ppb level of clean water. An ion exchanger exchanges either cations or anions from the liquid. Ion exchanger is made of organic ion exchange resins. Problem with this type of treatment is it cannot handle concentrated metal solution as matrix will foul by organic and other solids of effluent. Reverse osmosis it is a semi permeable membrane method to remove ions, molecules and larger particles. This process can remove bacteria and suspended species from both industrial and portable water. This is also a expensive method due to the use of semi permeable membrane.

2.1 Biosorption

It is a process in which inactive biomass is used for the treatment of effluents. Biomass exhibits same property just like chemical substance, as in ion exchange of biological origin [4]. The adsorption of the metals at the surface of the absorbent is due to the cell wall structure. This method is an emerging technology for treatment of effluents. Removal of dyes through adsorption technique is already investigated using activated carbon, corncobs, rice husk [5].

2.1.1Advantages

Requirement of costly food is not require for the growth of cells. Non-living biomass is available in good quantity. As the inactive biomass behaves like a ion exchanger the process is rapid. Good quantity of adsorption take place at the surface of the absorbents to it is efficient. Cells are inactive so processing conditions are not so much complicated. Aseptic conditions are not required. If the metal is valuable then it can be easily desorbed.

2.1.2 Factors Affecting Biosorption and equilibrium model

The major factors that affect the biosorption are pH, Contact time, Temperature, biosorbent dose, agitation speed, absorbent size, and agitation time. Testing of solid liquid absorption is of two types:
Equilibrium batch sorption test.
Dynamic continuous flow sorption studies.
Widely accepted and linearized equilibrium adsorption isotherm models for single solute system are (a) Langmuir (b) Freundlich.

Langmuir: $q = q_{max}bC_{eq}/1+bC_{eq}$

Where q is milligram of metal accumulated per gram of biosorbent material. C_{eq} is the metal residual concentration in solution. q_{max} is the maximum specific uptake corresponding to the site saturation and b is the ratio of adsorption and desorption rate. The theoretical model for monolayer adsorption.

Second model for monolayer adsorption is

Freundlich $q = K_F C_{eq}^{1/n}$
Where, k_F and n are constants.
The use of inactive biomaterial for binding compound is gaining advantage because toxic ions do not affect them. Care is not required so much and biomass could be easily regenerated and reused.

2.1.3 Optimum conditions for each biosorbents

Banana peels

The absorption of Sn(II) from aqueous solution using acid treated banana peels increase the capability. Using 2.0 g of biosorbent at 0^0C for 15 min having stirring speed 300rpm and 2.0 pH are the optimum condition for treatment [6].

Corn Cobs

The optimum condition in case of corncobs is 3g Corncobs at 2.0 pH [7]. The absorption of cadmium and copper by corncobs increase with temperature till a point and after it starts decreasing.

Jackfruit

The maximum sorption of Ni (II) is at 6.0pH having contact time 40 min[8]. The jackfruit leaf powder can be a potential for the treatment of Ni (II) in aqueous solution.

Orange Peels

The maximum absorption on Cu^{2+}, Zn^{2+}, Co^{2+}, Ni^{2+}, $Pb^{2+++}$was is at high pH [9]. Acid treated orange peels are better absorbent then without treated.

3. CONCLUSIONS

The different process for adsorbents gives us idea about the potential of low cost treatment of aqueous solution of heavy metals. The factors mentioned above should be taking into consideration for effective treatment. Strategies and equipment should be design to make this method commercially more useable.

4. REFRENCES

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