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Minimization of the Heavy Metals Discharge from the Industries into the Water Bodies by Marsh Plants, Rice Husks and Algae

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Abstract: ***Heavy metals like Hg, Zn, Cd, Pb when discharged from the industries harms the aquatic flora and fauna. It results into bio-magnification and affects their metabolism too. The organic pollutants, the majority of which biologically degrade, heavy metal ions do not degrade into harmless end products. A treatment body is to be made for sedimentation and screening of the industrial wastewater. It is to be surrounded by the marshes in an artificial pond. Marsh plants absorb the heavy metals through their roots. Later, an adsorption tank is to be made consisting of trays made of bagasse, rice husk and algae. Agricultural and industrial waste by-products such as rice husk and bagasse have been used for the elimination of heavy metals from wastewater. Rice husks traps the heavy metals and further decreases their concentrations due to adsorption. After it, wastewater was treated with the algae which is a more economical method and costs less for the removal of heavy metals. It showed that low cost adsorbents can be easily used for the removal of heavy metals with a concentration range of 10–50 mg/l, using real wastewater showed that rice husk was effective in the simultaneous removal of Pb and Ni. Algae culture plays significant role for wastewater treatments, because they provide a tertiary treatment. This method is an effective way to minimise the heavy metals as well as some toxic organic compounds, therefore, it does not lead to further secondary pollution.***
Keywords: biomagnification, marsh, rice husk, adsorption, sedimentation.

I. INTRODUCTION

In the contemporary world, various types of industrial wastes are produced every year by different industries which are composed a huge amount of heavy metal discharge like Pb, Ni, As and many more. These heavy metals are too much harmful causing severe health related issues which are long lasting and its effects are inherited too. Moreover, they are also responsible for the contaminations in the land, air and water[5] causing the disturbance in the ecology. It also hinders the sustainable development of a country by increasing the pollutions levels because of its huge impact. Industries comprising of tanneries also produce heavy metals like Cr, Cu, Fe, Cd, Ni, Pb and Zn these metals are drained directly into the rivers and affects the aquatic animals resulting into bio-magnification. Later on, consuming those animals, by irrigating the crops these metals are passed on to humans resulting into mental retardness and other adverse effects which are passed to the future generations. Removal of heavy metals from aqueous solution involves different physical, chemical and biological processes. Several techniques have been adopted to minimize the effects involving chemical precipitation, lime coagulation, solvent extraction, reverse osmosis, evaporation, ion-exchange, membrane processes and many more but they have their own demerits (incomplete metal removal, high reagent and energy requirements, generation of toxic sludge or other waste products).Above mentioned Conventional technologies are highly cost effective. In recent years, microbial biomass has emerged as an option for developing economic and eco-friendly wastewater treatment process., therefore, applying biotechnology in controlling and removing metal pollution has been paid much attention, and gradually becomes hot topic in the field of metal pollution control because of its potential application. Alternative process is a biosorption, which utilizes various certain natural materials of biological origin, including bacteria, fungi, yeast, algae, etc. Biosorption can be defined as the ability of biological materials to accumulate heavy metals from wastewater through metabolically mediated or physico-chemical pathways of uptake.“Biosorption“ has been defined as the property of certain biomolecules (or types of biomass) to bind and concentrate selected ions or other molecules from aqueous solutions. So, using the natural phenomenon and simple procedure the level of heavy metal contents can be lowered to a much extent. Using biocoagulant for effective sedimentation. Using Plants like marshes have the property to absorb the heavy metal content and later on passing the heavy metal wastewater to adsorption tower consisting of algae, rice husk and bagasse trays. They have proven capability to take up heavy metals from aqueous solutions, especially when the metal concentrations in the effluent range from less than 1 to about 20 mg/L. By these techniques we are able to get rid of the heavy metals to a greater extent.

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II. MATERIAL AND METHODS

A. *pH*

PH is the expression of hydrogen ion concentration. It is an important parameter for biological treatment of water. The acidity or the alkalinity of any solution can be indicated by the term of PH which stands for the power of the hydrogen ions H+. PH is related to the concentration (or more strictly the activity) of hydrogen ions by the following equation:

pH = - Log10 [H+] …(1) Also, alkalinity indication relates with hydroxide ion as:

POH = - Log10 [OH-] …(2)

Generally the pH of waste water is in the range 5.5 to 8.0. Biocoagulant, Algae, Marsh Plant each work effective in particular pH range. Thus for higher efficiency of performance pH must be maintained.

B. *Chemicals Used*

For acidic wastes (low pH): NaOH, Na2CO3, CaCO3or Ca(OH)2.

For alkali wastes (high pH): H2SO4, HCl.

C. *Continuous-flow Stirred Tank (Complete – Mixed) reactor*

In this reactors, particles are dispersed immediately throughout the tank as they enter the tank. Thus, the content in the reactor are perfectly homogeneous at all points in the reactor. This can be achieved in square, circular or rectangular tank. The particles leave the tank in proportion to their statistical population. The concentration of the effluent from the reactor is the same as that in the reactor. Waste water after screening is sent to this tank. Chemicals are added to maintain the desired PH.

D. *Screening Process*

Screening is the effective method for removing large solid, biomass, sludge, plastics etc from flowing water. Coarse Screen is used in primary screening which is made of iron rods kept at an angle of 45degree with horizontal. In this process we are using two coarse screen which are 5cm apart each having mess opening of 2cm and 1cm respectively. Screen is driven mechanically with geared down motor. This technique is quite effective as in case of continuous flow of water, easy to clean and avoid clogging.

E. *Mixing tank*

Mixing tank is used for mixing waste water with biocoagulant. Circular mixing tank bottom is kept rounded, to eliminate sharp corners into which fluid would not penetrate. Two Baffles half the height is used for avoiding vertex formation.3 pitched blade turbine are arranged in series of reducing diameter, higher at the bottom.

F. *Biocoagulant*

Biocoagulant are natural coagulant which are used increasing the size of fine particles present in the water for effective sedimentation. They have several advantage over chemical coagulant as they do not generate toxic sludge. In this process we are using the seeds from Moringa Oleifera. Moringa Oleifera is a tropical plant belonging to the family of Moringaceae. Moringa Oleifera is a non toxic and natural organic polymer. The Moringa Oleifera tree is generally known in the developing world as a vegetable, a medicinal plant and a source of vegetable oil.The leaves and young seeds of Moringa Oleifera are rich in calcium, iron and vitamin C, serve as nutritious source for communities. The fruits, which are called ‘‘pods’’ and roots of the tree are used as vegetables. The fruits range usually 20-30 cm long. Each fruit contain ~ 20 seeds. Seeds are globular, on average weight approximately 3.0-4.0 g, 1.0-1.40 cm long and 1.0-1.7 cm wide.Moringa Oleifera was collected from surrounding area of Bhavnagar, India for extracting the coagulant protein. Furthermore, sludge produced by Moringa Oleifera during coagulation is not only safer but also four to five times less in volume than the chemical sludge produced by alum coagulation.

Protein Dosage ppm	Turbidity removal %	pH
0	0	6.83
5	0	7.33
15	0	6.63
25	30	6.53
35	42	6.4
45	58	6.33
55	70	6.19
65	81	6.17
75	89	6.15
85	96	6.14
95	98	6.03

Table 1- efficiency for turbidity removal with pH of biocoagulant active protein

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G. Sedimentation

Water from the Mixing tank is to be discharged into a Sedimentation tank of a height 'h', width 'w' and length 'l' fixed on the ground. The Sedimentation tank is used for the purpose of sedimentation of the suspended impurities in the industrial wastewater. The wastewater is poured into a tank at a controlled flow rate where the sediments are settled at the bottom. To ensure continuous treatment sediments are removed by a removed from bottom with mechanically scrapping device.

Settling of particle depends on flow area, specific gravity, turbulence and size of particle. Greater the flow area, the lesser is the velocity, more settling. Greater the specific gravity more settling. Lesser the turbulence more settling. Greater the size of particle more settling. Velocity of settling of particle is given by Stroke's Law. The is kept in such a way that time taken by suspended particle to travel from one end to another is slightly more than the time required for settlement of that particle. Inlet and outlet are provided with baffle wall arrangements for reducing the turbulence.

H. Packed Bed Reactor

It is filled with some packing medium, such as, dead brown Algae. With respect to flow they can be anaerobic filter, when completely filled and no air is supplied, or aerobic (trickling filter) when flow is intermittent or submerged aerobic filter when compressed air is supplied from the bottom.

I. Algae

Algae are considered one of the most promising types of biosorbents which are interest in search for and development as a new biosorbent[2] materials because of they have high sorption capacity and are readily available in a large quantities in seas and oceans. Algae have low nutrient requirements[6], being autotropic, they produce a large biomass, and unlike other biomass and microbes, such as bacteria and fungi. They generally do not produce toxic substances. Three groups of algae are found:

1) Micro-algal(green algae or fresh water algae);
2) Macro-algal (brown algae or marine algae;
3) Red algae.

Which take more attention in biosorption[7] processes, brown algae distinguished higher uptake capacity compared with red and green, therefore, the metal uptake capacities exhibited by non-living biomass of micro-algal (green algae)[17] and macro-algal species (brown algae) varies from 0.066 to 1.20 mmol/g and 0.65 to 1.21 mmol/g respectively

J. Marsh Plant Treatment

The water is then discharged in the artificial pond where the marsh treatment of the wastewater is done. The marsh plants……..

K. Adsorption Tower

Then the treated water is sent to the adsorption tower by a motor. The tower has a number of trays. The trays are made by a mixture of bagasse[1] and rice-husk. Algae is cultured over it. As the water is pumped and poured on to the plate through the process of adsorption the heavy metals are adsorbed on to the surface of the plates and heavy contents are removed to a greater extent. The water is then sent to storage tank.

III. CONCLUSIONS

This method is suitable for use as we are able to remove the heavy metals without generation of toxic sludge. This method is also opted as it is more cost effective and economical. We prefer natural method of removal of by-products instead of active charcoal.It reduces the heavy metals to a greater extent and ensures cleaning of water in multiple stages, as the wastewater consisting of solid wastes are eliminated in the screening process itself and heavy metal removal in the later stages.

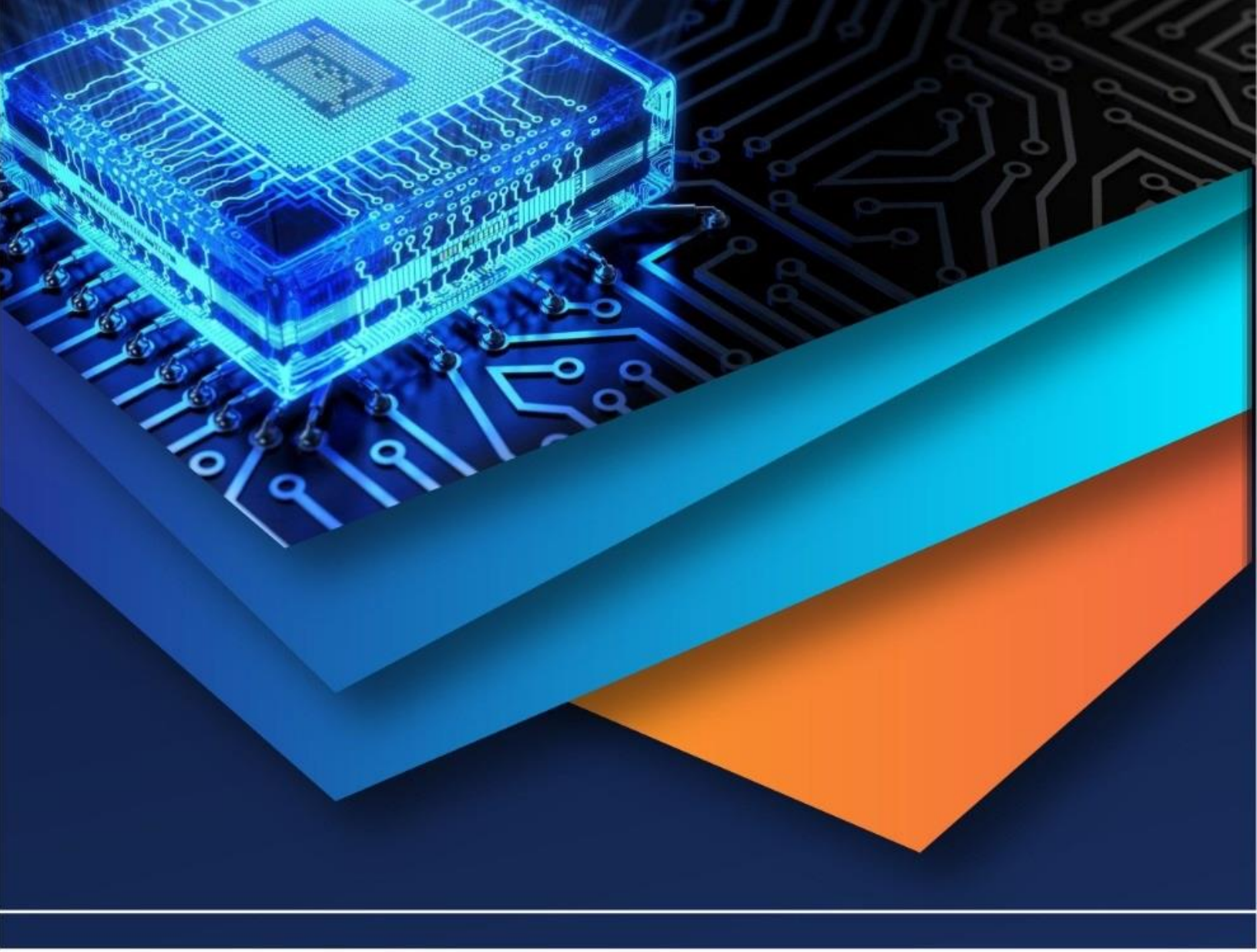
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