An Experimental Study Of Improving Quality Of Industrial Waste Water With Low Cost Adsorbents

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Abstract- *Rapid industrialization has not only brought development and prosperity but eventually disturbed the ecosystem. One of the visible impact is in the form of water pollution.Effluents from large number of industries viz., electroplating, leather, tannery, textile, pigment & dyes, paint, wood processing, petroleum refining, photographic film production etc., contains significant amount of heavy metals in their wastewater.*

The aim of the study is to investigate the suitability of orange peel as low Adsorbents for that vertical flow with brick bat aggregate and varying quantity of orange peel is made. In this model, waste water with varying retention time is passed and quantity of lead is check and compared.

After study it is found that orange peel .

Keywords- Heavy metal removal, lead, Industrial wastewater

I. INTRODUCTION

Water pollution caused due to addition of heavy metals resulting from the industrial activities is increasing tremendously and is a matter of global concern**.** Heavy metals contaminations could exist in wastes of many industries, such as metal plating, mining operations, tanneries, chloralkali, radiator manufacturing, smelting and alloy industries, wood processing industries, petroleum refining industries, storage battery industries.The heavy metals present in the wastewater is persistent and non degradable in nature. Moreover, they are soluble in aquatic environment and thus can be easily absorbed by living cells. Thus, by entering the food chain, they can be bio accumulated and biomagnified in higher trophic levels also. The heavy metals, if absorbed above the permissible labels, could lead to serious health disorders. Therefore, it is obligatory to treat metal contaminated wastewater before discharging into the environment.

Lead is a heavy, soft, malleable, bluish grey metal. Because of high toxicity of Lead and its widespread presence in the environment it is considered as a priority pollutant.It is an industrial pollutant, which enters the ecosystem through soil, air and water. Lead is a systemic poison causing anaemia, kidney malfunction, tissue damage of brain and even death in extreme poisoning situation.

Theconventional methods for lead removal from wastewater includes chemical precipitation, chemical oxidation, ion exchange, membrane separation, reverse osmosis, electro dialysis etc. These methods are not very effective, are costly and require high energy input. They are associated with generation of toxic sludge, disposal of which is expensive and non ecofriendly in nature. Adsorption has emerged out to be better alternative treatment methods. It is said to be effective and economical because of its relatively low cost.

II. INDUSTRIAL WASTEWATER AND LEAD

Lead pollution, spreading over earth and ground water, comes from natural sources and industrial effluents. Natural sources are: seepage from rocks Into water, volcanic activity, forest fires etc. Processing industries, such as acid battery manufacturing, metal plating and finishing, ammunition, tetraethyl lead manufacturing, ceramic and glass industries and environmental clean-up services treat and disposal of lead contaminated water are the major sources of lead pollution.

Lead is the most significant toxin of the heavy metalsThe presence of high levels of lead in the environment may cause long-term health risks to humans and ecosystems. The inorganic forms of lead are absorbed through ingestion by food and water, and inhalation. A notably serious effect of lead toxicity is its teratogenic effect. Lead poisoning also causes inhibition of the synthesis of haemoglobin; dysfunctions in thekidneys, joints and reproductive systems, cardiovascular system and acute and chronic damage to the central nervous system.

According to the World Health Organization (WHO), the maximum permissible limit (MPL) of lead in drinking water is 0.05 mg/L. The permissible limit (mg/L) for Pb (II) in wastewater, given by Environmental Protection Agency (EPA), is 0.05 mg/L. In industrial wastewaters, lead-ion concentrations approach 200–500 mg/L; this concentration is very high in relation to water quality standards, and lead-ion concentration of wastewaters must be reduced to a level of 0.05–0.10 mg/L before discharging to water ways or sewage systems. Hence proper treatment of industrial wastewaters which are releasing lead into the aquatic and land systems is very important. Various methods are used to removal of heavy metal from industrial effluents like chemical precipitation ION exchange adsorption, adsorption has emerged out as effective, economical and eco-friendly treatment technique. It is a process potent enough to fulfil water reuse obligation and high effluent standards in the industries. Adsorption is basically a mass transfer process by which a substance is transferred from the liquid phase to the surface of a solid, and becomes bound by physical and/or chemical interaction.It is a partition process in which few components of the liquid phase are relocated to the surface of the solid adsorbents. All adsorption methods are reliant on solid-liquid equilibrium and on mass transfer rates. The adsorption procedure can be batch, semi-batch and continuous. At molecular level, adsorption is mainly due to attractive interfaces between a surface and the group being absorbed. Depending upon the types of intermolecular attractive forces adsorption could be of following types: method Constructed wetland (CW) can be basically considered to be an artificial wetland. This artificial wetland becomes a new habitat for native and migratory wildlife, for anthropogenic discharge such as wastewater or sewage treatment and or other ecological disturbances such as required mitigation for natural areas lost to a development. CW can be considered to be a bio filter, filtering out the sediments and pollutants such as heavy metals, and restoring clean water as a filtrate. It is very efficient and effective.

Low Cost Adsorbents

The removal of heavy metals by using low cost adsorbent is found to be more encouraging in extended terms as there are several materials existing locally and profusely such as natural materials, agricultural wastes or industrial by-products which can be utilized as low-cost adsorbents [6]. To be commercially viable, an adsorbent should have high selectivity to facilitate quick separations, favorable transport and kinetic characteristics, thermal and chemical stability, mechanical strength, resistance to fouling, regeneration capacity and low solubility in the liquid in contact. Adsorption process has several advantages over the conventional methods of heavy metal removal. Some of the gains of adsorption process are: (I) Economical, (II) metal selectivity, (III) Regenerative, (IV) Absence of toxic sludge generation (V) metal recovery and most importantly (VI) effective. Various low cost adsorbent derived from various natural as well as anthropogenic sources have been implemented for treatment of waste water contaminated with heavy metals. The adsorbents mostly used are agricultural waste, industrial by-products, natural materials or modified biopolymers. Some of low cost absorbent are as below

Zeolites

They are naturally occurring crystalline alumino silicates consisting of a skeleton of tetrahedral molecules, connected with each other by mutual oxygen atoms. Ion exchanging capacities of zeolites make them a suitable candidate for removal of heavy metals. Adsorption in zeolites is in fact a choosy and reversible packing of crystal cages, so surface area is not a significant aspect.

Clay

There are three main groups of clays: kaolinite, montmorillonite-smectite, and mica. The montmorillonite has the highest cation exchange capacity and its recent market price is found to be 20 times cheaper as compared to activated carbon. Their heavy metals removal capacity is less as compared to zeolites but their easy availability and economical properties give back their less efficiency.Abundant in nature and has a very high organic content. Its large surface area (≥ 200 m2/g) and high porosity makes it an effective agent for heavy metal removal from wastewater. It was observed that peat moss plays an important role in treatment of metal-bearing industrial effluents such as Cu^{2+} , Cd^{2+} , Zn^{2+} and Ni^{2+} [1].

Adsorption by Agricultural Wastes

Use of agricultural byproducts as adsorbents for heavy metal removal from industrial waste water has been increasing nowadays. Most of the studies were focused on plant wastes such as rice husk and neem bark [2,3], Black gram husk [4],

Adsorption by Industrial Wastes

Various industrial wastes have also got adsorption capacity and can be used for adsorbing heavy metals from wastewater. These industrial wastes are produced as a by-product and are used rarely for any purpose. The by-product nature renders it to be easily available and very economical also. These industrial wastes are found to have good application as adsorbent. Adsorptive capacity of these wastes could be increased followed by slight processing. Industrial by-products such as fly ash [5,6], blast furnace sludge [39,40],

III. METHODOLOGY

Preparation of Synthetic Wastewater

1. 0.1599 g Lead (II) nitrate has been dissolved in 10 ml of diluted nitric acid (1 → 10)
2. Then the solution has been made up to a liter.
3. 1 ml of the solution so obtained contains 0.1 mg of lead (Pb).
4. Synthetic waste water with desired concentration of lead was prepared using lead standard stock solution.
5. Figure 3.2 shows the chemical used for preparation of synthetic waste water sample

Vertical Flow (VF) reactor planted with orange peel

A semi –cylindrical hollow plastic container is used as VF reactor. The VF reactor is provided with supporting media of zhama brick bats(40-55mm size), gravel(10-15mm size), sand (2-3 mm size). The supporting media acts as a natural filter and avoids clogging of collection pipe at the bottom

Figure No.1 Sand filter with low cost adsorbent

Experimental procedure

1. Synthetic waste water prepared with 40 mg/litre standard.25 samples has been created for orange peel adsorbent treatment for retention time 5 min to 60 min.
2. 3 slow sand rapid filter was prepared with 50 gm. peel powder, 100 gm. peel powder and 150gm peel powder. Filter has layer of brick bat, aggregate, crush sand and at top peel powder which act as adsorbent
3. Waste water samples from outlet is collected at regular intervals for 5 min,15 min,20 min,30 min,40 min and 60 min in every filter model and collected accordingly
4. Samples collected at every stage were analyzed by apha standards(American Public Health Association) to determine lead ion concentration at Aqua labrotaries, AkurdiPune

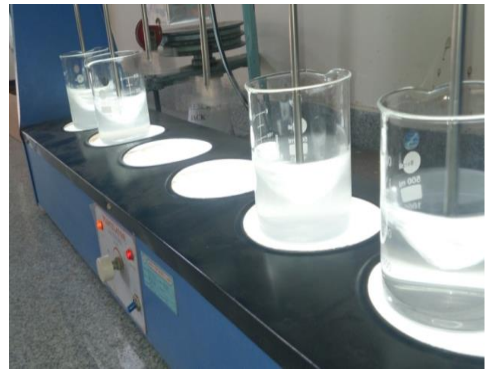


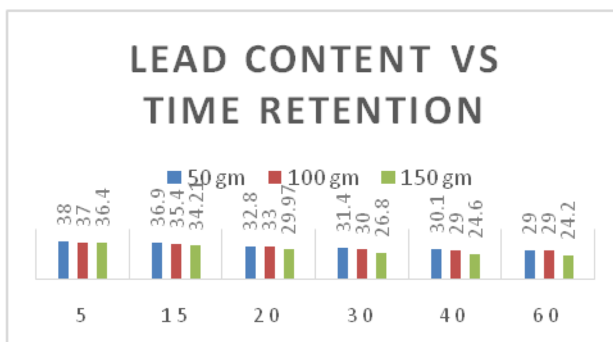
Figure No.2Lead ion identification at AQUA Lab

IV. RESULT AND DISCUSSION

Table no 1 shows change in lead percentage after regular interval when 50 gm of orange peel is put in vertical flow 100 gm of orange peel used and 150 orange peel is used

Time in min.	Lead before treatment	50 gm	100 gm	150 gm
5	40	38	37	36.4
15	40	36.9	35.4	34.21
20	40	32.8	33	29.97
30	40	31.4	30	26.8
40	40	30.1	29	24.6
60	40	29	29	24.2

From above data graph for 50 gm ,100 gm 150 gm orange peel on X axis retention time and y axis concentration after treatment is as below



V. CONCLUSION

After experimental study for various VF with varying quantity of orange some conclusion can draw as below

1. Removal of lead from waste water after vertical flow is directly proportional to retention time.as retention time increased quantity of lead decreases.
2. Removal of lead from waste water after vertical flow is directly proportional to quantity of orange peel.as quantity of orange peel increased quantity of lead decreases.
3. In between 15 -20 min rate of removal lead is more in all 3 cases.

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