e-ISSN: 2582-5208
International Research Journal of Modernization in Engineering Technology and Science
(Peer-Reviewed, Open Access, Fully Refereed International Journal)
Volume:04/Issue:04/April-2022 Impact Factor- 6.752 www.irjmets.com

REMOVAL OF TOXIC SUBSTANCES FROM WATER/WASTE WATER TREATMENT PLANT USING SUITABLE ADSORBENT

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ABSTRACT

Various businesses release heavy metals into water bodies, either completely or partially untreated. These heavy metals are potentially hazardous and pose a severe environmental threat. Biosorption is a new technology for heavy metal removal that can replace traditional methods that have specific limitations, according to the literature review. Rice husk has the potential to operate as a bioadsorbent for heavy metal removal. Furthermore, several parameters influence the adsorption process, and the maximum percentage removal was found under ideal conditions. More study is needed in the subject of adsorption to make it commercially successful and apply it in the field of water and wastewater treatment, but if proven to be effective and efficient, it could be a promising technology in the future.

Keywords: Bioadsorbent, Water Treatment, Adsorption And Heavy Metal.

I. INTRODUCTION

Metals that are toxic are released into the environment in large quantities due to industrial activity. In recent years, heavy metal contamination has emerged as one of the most pressing environmental concerns. Many sectors, such as electroplating, mining, and the steel industry, discharge wastewater containing heavy metals straight into water bodies, either partially treated or untreated. The removal of harmful pollutants such as phenol, ammonia, and toxic metals from sewage and industrial waste water has attracted a lot of attention as the number of health problems linked to environmental contamination continues to climb. (**Munaf E.&Zein R 2010**.)

The application of the biosorption for removal of heavy metal is gaining momentum due to following reasons :

- The total chemical need for the treatment procedure is lowered.
- Affordable operational costs.
- An environmentally friendly and cost-effective alternative to traditional ways.
- Efficient at lower levels of contamination

Metals having density greater than 5gm/cm^3 are considered to be heavy metals. Metals like mercury, lead, and arsenic can be harmful to the kidneys and induce weakness, headaches, stomach cramps, diarrhoea, and anaemia, among other symptoms (USEPA,2004). Chronic exposure to these contaminants can result in kidney and brain damage that is irreversible (USEPA,2004).

The Conventional techniques like Chemical precipitation, lime coagulation, ion exchange, reverse osmosis, and solvent extraction are all methods for extracting metal ions from aqueous streams.due to limitations and drawbacks of conventional methods,a search for some alternative techniques has directed attention to biosorption.

Toxic Heavy metals

- Metals and metalloids with an atomic density greater than 5 grammes per cubic centimetre are referred to as "heavy metals.". These heavy metals are of concern because of their impact on the environment, particularly on the biota. The fact that these metals are persistent and non-biodegradable is one of their significant drawbacks.
- The bulk of heavy metals are known to be harmful and carcinogenic, providing a significant risk to both humans and the fauna and flora of receiving water bodies.

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- Heavy metals have a high proclivity for bioaccumulation, resulting in irreversible contamination of the environment. gold, cadmium, zinc, silver, copper, nickel, iron, chromium,lead, mercury, aluminium, manganese, cobalt ,molybdenum, selenium, tin, arsenic are all heavy metals.
- The removal of heavy metals from waste water has recently become a focus of research due to tight legislation. Filtration, electro coagulation, and other procedures for removing heavy metals from wastewater exist, but they all have limitations, such as extensive treatment times. Heavy metals sources, effects, and acceptable limits are shown in Table 1.

TABLE 1

Pollutants	Major Sources	Effect on human health	Permissible limit mg/L
Arsenic	Pesticides, fungicides, metal smelters	Bronchitis, dermatitis, Poisoning	0.02
Cadmium	Welding, Electroplating, Pesticides, fertilizer, Cd-Ni batteries, Nuclear fission plant	Renal dysfunction, lung disease, lung cancer, bone defect(osteomalacia, osteoporosis). Increased blood pressure, Kidney damage, bronchitis, bone marrow, cancer, gastrointestinal disorder	2.0
Lead	Paint, pesticides, Smoking, Automobile Emission, mining, Burning of coal	Mental retardation in children, development delay, fatal infant encephalopathy, congenital Paralysis, sensor neural deafness and acute or chronic damage to Nervous system, liver, kidney, Gastrointestinal Damage	0.1
Manganese	Welding fuel addition, Ferromanganese Production	Inhalation or contact causes Damage to central nervous System	2.0
Mercury	Pesticides, batteries And paper industries	Tremor, gingivitis, minor Psychological change, acrodynia Characterized by pink hand and feet, spontaneous abortion, damage to nervous system	0.01
Zinc	Refineries, brass Manufacture, metal Plating, plumbing	Zinc fumes has corrosive effect on Skin, cause damage to nervous Membrane	5.0
Chromium	Mines, minerals Sources	Damage to nervous system, fatigue, irritability	2.0

II. LITERATURE REVIEW

Beer Singh et al(1995)

- According to this study, active carbon 90CTC can be employed in water filtration systems to remove impurities such as SM (sulphur mustard) and other poisons.
- Physical adsorption was used to retain SM (sulphur mustard) and its hydrolyzed derivatives on activated carbon.
- Phenol cannot be utilised to replicate SM (sulphur mustard) adsorption on carbon in water.
- Because the two molecules are physically similar, the adsorption of sulphur mustard on carbon may resemble that of OA (oxygen analogue of Sulphur mustard).

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- The removal of phenol from water using two inexpensive carbonaceous adsorbents, WC (wood charcoal) and BA (bagasse ash), has been found to be comparable to commercial grade AC (Activated charcoal).
- When the pH of the adsorption system was reduced, the removal efficiency of phenol increased marginally

V.K. Gupta et al(2009)

- There are two types of low-cost alternative adsorbents.: on their availability (Natural materials for example wood, peat, coal, lignite, and slag, sludge, fly ash, bagasse flyash, red mud, and other industrial/agricultural/domestic wastes or byproducts); or by their composition (agriculture/industrial/domestic wastes or byproducts such as slag, sludge Chitin and chitosan are two types of chitin.
- Both chitosan and chitin are used as adsorbents, particularly in the removal of metals. In a study, Cu (II), Cr (III), and Ni (II) were removed from solutions and recovered.
- Jha et al. discovered that chitosan has an adsorption capacity of 5.93 mg/g at a pH of 6.5 in a study on Cd (II) removal.

Munaf &Zein(2010)

- Because real waste water samples contain other ions, the percentages of chromium, zinc, copper, and cadmium ions removed were 65, 55, 50, and 60%, respectively. This could be due to competition for adsorption sites
- The maximal uptake of chromium, zinc, copper, and cadmium ions by rice husk was 75, 70, 79, and 80 percent, respectively, in the optimal pH range of 4.5 to 6.5 pH.
- Surface activity, or the specific surface area accessible for solute-surface interaction, is a key factor in rice husk adsorption capacity. This suggests that a sorption material having a bigger surface area, or in other words, a small particle size, will be more successful at adsorbing metal ions than one with a smaller particle size.

Hegazi(2013)

- Batch experiments for the removal of lead and copper using tartaric acid modified rice husk as an adsorbent have been undertaken, and the impacts of various parameters such as pH, initial adsorbate concentration, particle size, temperature, and others have been reported. Modified rice husk has been suggested as a possible material for extracting copper and lead from aqueous solutions.
- The results of using real wastewater revealed Rice husk was successful in concurrently removing Fe, Pb, and Ni, but fly ash was successful in removing Cd and Cu.

Bisht et al.(2016)

- This study explains about Graphene.
- It absorbed chromium onto graphene oxide's surface, with a maximum adsorption capacity of 92.65 mg/g at an optimal pH of 5
- S.Gopalakrishnan et.al. (2015) used a modified Hummer's method to oxidise graphene for the addition of COOH and OH functional groups to the surface. Their work is unique in that only 70 mg of graphene oxide was used to effectively remove 100% of chromium from wastewater at an optimal pH of 8.

Mittal et al(2016)

- Guar gum graft copolymers have strong adsorption capabilities for removing diverse hazardous metal cations from aqueous solutions, such as Pb^{2+}, Cu^{2+}, and methylene blue. The removal of Cr^{6+} ions from wastewater was achieved using a graft copolymer of guar gum and PAAM with a significantly high adsorption capacity of 588.24 mg/g-1
- Guar gum graft copolymers have also shown potential as adsorbents for removing cationic and anionic contaminants from wastewater.

Dinesha et al(2017)

- In terms of mass, nanoadsorbents have a far larger surface area than macro particles. They can also benefit from the addition of additional reactor groups to increase their chemical affinity for target molecules.

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- Peng et al., (2005) developed a novel sorbent made of cerium oxide supported on carbon nanotubes (CeO2-CNTs) with a high surface area (189 m^2 /g).
- Deliyanni et al., (2003) created and investigated a novel As (V) sorbent made of akaganeite nanocrystals

Wolowiec et al(2019)

Surface and groundwater heavy metal contamination is a big concern all over the world, demanding the development of appropriate technology to remove heavy metals from aqueous solutions. WTRs (Water Treatment Residuals) have an incredibly high sorption capacity for a wide range of compounds, particularly heavy metals and metalloids. In most studies, however, sorption efficiency was found to be influenced by the pH of the solution, reaction time, temperature, and beginning metal concentration in the solution. Because the specific surface area of the particles increased as the particle size decreased, the sorption characteristics improved

Qasem &Lawal(2021)

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III. FINDINGS

- Negative effect of toxic substances on release on waterstream was analysed how they effect on human, animal and soil was analysed.
- Bioadsorbent emerges as a good conventional technique for removal of heavy metals since conventional techniques uses chemical on large scale.
- Two Categories of bioadsorbent are found after reviewing the papers that are

1.Bioadsorbents(Rice Husk, Guar Beans, flyash, wood charcoal)

2.Artificialy synthesized (AC, garphene, carbon Nanotubes, Mesoporous Silica,Chitosan)

- Removal Efficiency of toxic heavy metals depends on various parameters such as pH, temperature, particle size of adsorbent, contact time, adsorbent dose.
- Out of different bioadsorbent rice husk comes with a great possibility for readily avialable as a bioadsorbent.

IV. CONCLUSION

- Different bioadsorbent research paper have been studied among them rice husk is the best option available for the removal of toxic heavy metals and other impurities.
- Removal of heavy metal from water-stream is important because of its adverse effect on human body and environment.
- Bioadsorbent comes out as a good alternative option for economical and sustainable option for treatment of toxic heavy metal from waterstream.
- Further studies is needed for the large scale use of bioadsorbent in day to day life

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