WWW.IJRPR.COM

International Journal of Research Publication and Reviews

Journal homepage: www.ijrpr.com ISSN 2582-7421

Heavy Metal Ions and Adsorption Technique: A Review

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ABSTRACT:

This study reviews, metals occur in water, harmful heavy metals, necessity to remove heavy metals from water. Important techniques which are suitable for removing heavy metals from water. Adsorption a very convenient technique for treatment of water particularly for removing these harmful heavy metals. Cheap adsorbents, harmful effects of heavy metals. Factors affecting adsorption, Applications of adsorption.

KEYWORDS: Adsorbents, adsorption, wastewater, harmful heavy metals.

INTRODUCTION:

Sources of water include mainly lake, sea, river, well, borewell, rain etc. Out of this rain is the major source of water. Rainwater is the purest form of water. But during its downward journey towards the earth, it gets contaminated with certain impurities. These impurities may be suspended impurities, biological impurities, colloidal impurities or dissolved impurities. Dissolved impurities are either in the form of dissolved gases like oxygen, carbon dioxide, ammonia etc. or dissolved salts like nitrates, sulphates, chlorides, bicarbonates of calcium and magnesium mainly.

Water also gets contaminated or polluted due to dissolution of metal ions present in soil or rocks. Most of the small-scale industries like electroplating, battery, paint, pesticides, glass, insecticides, printing, dyeing, paper, fertilizer, cement, pharmaceutical, food etc, release water without treatment called as industrial wastewater. This industrial wastewater contains various heavy metals along with other pollutants. These heavy metals are chromium, cobalt, mercury, iron, arsenic, manganese, nickel, lead, copper, titanium, zinc, cadmium [1] etc .

Table no.1 gives us more information about the major heavy metals and their major sources.

Table no.1: Major heavy metals and their major sources

Name of heavy metal	**Source: name of industry**
Cadmium	Plating, fertilizers
Zinc	Fertilizers, plating, paper
Nickel	Plating, paper, battery, electroplating
Copper	Pesticides & insecticides, plating, paper, fertilizers, electroplating
Lead	Dyeing & printing, plating, paper, fertilizers, paint, battery
Chromium	Dyeing & printing, paper, fertilizers, paint
Mercury	Pesticides & insecticides, paper, fertilizers [2]
Lead	Dyeing & printing, plating, paper, battery, paint [3], fertilizers,
Manganese	Fertilizers
Iron	Fertilizers
Titanium	Paint

Most of these heavy metals are very harmful to ecosystem, mankind and aquatic living things. So, it is very essential to remove them from the water before the use of water for any purpose.

Table no.2. gives us information about Maximum permissible limit of few heavy metals (MPL) in (mg L^{-1}) in water. This MPL is very important because heavy metals become harmful beyond this limit.

Table no.2: MPL of heavy metals

Name of heavy metal	**MPL in (mg L^{-1})**
Lead	0.05
Mercury	0.1
Chromium	0.05
Arsenic	0.06
Nickel	0.1
Copper	2.0

If consumed more than MPL these heavy metals may cause certain ill effects as follows,

1. Lead: May causes anemia, headache, kidney problem, brain damage, bone damage, etc.

2. Mercury: May causes chest problem, genetic damage, dermatitis, bone damage, nervous system problem, brain damage, mutations, etc.

3. Chromium: May causes lowering immunity power, ulcer [4] , liver damage, lung cancer, kidney damage, rashes on skin, etc,

4. Arsenic: May causes arsenicosis, vomiting, cancer etc.

5. Nickel: May causes nose cancer, lung cancer, vomiting, anemia , Headache, vomiting, bone cancer, etc,

6. Copper: May causes nausea, brain damage, bone damage, cancer, kidney problem etc.

7.Iron: May causes haemochromatosis, stains laundry [3] etc.

Above ill effects indicates that heavy metal removal is very important before use of water for any purpose like industrial, domestic, irrigation etc.

Membrane separation, ion exchange [5] , chemical precipitation, adsorption, solvent extraction, coagulation etc. are some techniques to remove heavy metals from industrial wastewater.

Ion exchange, reverse osmosis [6] and adsorption are the techniques which are mainly used for dilute metal solutions. Out of these ion exchange[5] and reverse osmosis techniques are less preferred due to high operating cost. So, among Membrane separation, ion exchange, chemical precipitation, adsorption, solvent extraction, coagulation etc. only adsorption technique is economical and may be used by small scale industries.

For adsorption technique different adsorbents have been used by different researchers as below,

1.Plant materials: Jambhool , watermelon , cashew nut shells , bengal gram husk, seaweed, peanut hull, tamarind husk, teak leaves, bidi leaves, peels of banana, grape bagasse, ratrani leaf, cotton, jute stick, algae, maize, tea waste, green peas shell , amla dust, Jute and Sunnhemp , neem leaves, coffee [7] , pine cone, tur dal husk, green tea etc.

2.Other materials: Activated carbon [8,9] , fly ash, clay [10] , brick kiln ash, wool, biopolymer, lignin, humus, building waste materials like Kota and granite etc.

3. Pre-treated adsorbents: Nitric acid treated Prosopis Juliflora Leaf Powder (11)

Advantages of adsorption technique:

1.All Adsorbents used are naturally available

2. Capital cost is low

3. Environment friendly byproducts

4. The equipments are portable

5. The equipments are very small

6. Some adsorbents are available free of cost.

7. The equipment occupies small space

8. All adsorbents are user friendly

9. All adsorbents are environment friendly

10. As byproducts are environment friendly so no waste disposal cost.

11.Recovery of some precious metals is possible

12. No advanced equipments are required

Factors affecting adsorption [(11)] :

1. Effect of Contact Time
2. Effect of Adsorbent Dose
3. Effect of Initial Concentration of Adsorbate
4. Effect of Temperature
5. Effect of pH

Applications of adsorption:

1.Heavy metals removal from wastewater

2. Recovery of dyes from dilute solution [(12)]

3.Dyes removal from industrial wastewater

4.Enzymes purification

5. Impurities removal from petroleum oils

CONCLUSION:

From the above study it shows that adsorption technique is the good alternative for the removal of heavy metals from wastewater. It is the cheapest technique. It is environment friendly.

REFERENCES:

1. Naef A.A. Qasem, npj clean water, 2021, 4, 75- 80.

2. C. Namasivayam, K. Periasamy, Water Res., 1993, 27, 1663-1668.

3. Sureshkumar Halnor, IJAIEM, October 2015, Volume 4, Issue 10,19-22.

4.P.C. Mane, *J. Nat.Prod. Plant Resour*., 2011, 1(1), 75- 80.

5.Khai M. Nguyen, Bien Q. Nguyen, Hai T. Nguyen, Ha T.H. Nguyen, App. Sc., 2019; 9: 619.

6.Vercus Lumami Kapepula, Front. Chem. Eng., 2024, 6, 580-584.

7. Ghadah M. Al-Senani, Foziah F. Al-Fawzan, Hindawi-Bioino. Chem. and Appl., 2018,8

8. Shelke R S, DCS, 2011, 2 (4), 6-11.

9. V. C. Renge, Sci. Revs. Chem. Commun., 2012, 2(4), 580-584.

10.R.R. Merchant, Int. Journal of Applied Engineering Research, 2019, Vol. 14, No.1, 63-68.

11. Sureshkumar Halnor, Che Sci Rev Lett, 2013, 1(4), 239-244.

12. Sureshkumar Halnor, J. of Applicable Chem., 2013,2(3), 475-485.

13. Naeema H. Yarkandi, Int.J. Curr. Microbiol. App. Sci, 2014, 3(4), 207-228.