International Journal of
Environmental Sciences & Natural Resources
ISSN: 2572-1119

Juniper Publishers
key to the Researchers

Research Article
Volume 34 Issue 5 - February 2025
DOI: 10.19080/IJESNR.2025.34.556399

Int J Environ Sci Nat Res
Copyright © All rights are reserved by Manisha Kulkarni

Using different Types of Recyclable, Eco-friendly, Cost-effective Resins for the Removal of Heavy Metals from Wastewater

Manisha Patil and Manisha Kulkarni*

Department of Environmental Science, Dr. Homi Bhabha State University, Institute of Science Fort, India

Submission: February 13, 2025; **Published:** February 25, 2025

***Corresponding author:** Prof (Dr.) Manisha Kulkarni, Department of Environmental Science, Dr. Homi Bhabha State University, Institute of Science Fort, Mumbai- 40032, India

Abstract

Removal of heavy metals from wastewater is of most importance for human health and fresh environment. It is also a task in terms of cost effectiveness and eco-friendlyness. Various methods were reported for heavy metal ions removal from various wastewater sources. In this paper we used commercially available resins as adsorbent for removal of heavy metals such as iron (Fe), chromium (Cr), copper (Cu), cadmium (Cd), nickel (Ni), lead (Pb) and Zinc (Zn). For this study we used recyclable, eco-friendly, cost-effective, and sustainable materials, and method for waste water treatment for industrial effluents/wastewater. The main features of these Resins are that those are low toxic, recyclable, renewable sourcing, and low cost.

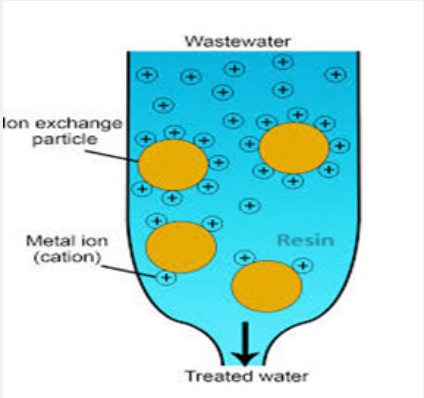
Keywords: Recyclable; Heavy metal; Resin; Purified water; Wastewater

Highlights

Recyclable, eco-friendly, cost-effective resins used for waste water treatment, Simple method for treatment of waste water.

Graphical Abstract

Figure



Introduction

Resins have developed as an Environment friendly choice absorbent in the current years. A very high concentration of heavy metals in industrial wastewater like water purification companies, pharmaceuticals, pesticides, organic chemicals, rubber and Plastics. Lumber have been reported, and it has been reused or discharged into water bodies without process [1,2].

The removal of heavy metals from wastewater using cost effective, eco-friendly, and easily available techniques is to be a challenge in today's wastewater treatment technologies. In the literature, numerous methods have been projected for the removal of heavy metal from wastewater. These treatment methods include chemical precipitation, Extraction of using ionic liquid,

Carbon beds, ion-exchange, adsorption, membrane filtration, and electrochemical methods [3,4].

Their some techniques however limited, due to some cost effectiveness, critical process in current study extraction of heavy metal using ILs and resin are progressively used as an alternative method for wastewater treatment [5]. As recent many research is available using in resign extraction techniques. In study the resins for the removal of chromium from wastewater of leather industry. [6] also, in many cases resins used for the purification of acidic waste streams containing heavy metals such as Cu(ii), Zn(ii), and Ni(ii) [7]. A trial study intensive on mercury elimination using combined ultrafiltration–ion exchange method. [8] In many studies have measured basic limits such as kinetics and were carried out in the laboratory scale. [9-11] it is strong from the literature waste water treatment using resin are important method. The main source of common heavy metal are Lead-based batteries, solder, alloys, glass production, electrical and cable industry, rubber industry, steel industry and agriculture [12-14].

In this study a pilot-scale experiments the removal of heavy metals from typical aqueous solutions, for wastewater treatment different resin are to be used and check their efficiency.

Instrumentation

Methods

Resins For this study five types of resin used KE 47, AD 20, AD 50, AES OH and KE20H

The trials were conducted using the resins KE 47, AD 20, AD 50, AES OH and KE20H and standard stock of the heavy metal ions (Fe, Cd, Cr, Cu, Ni, Pb and Zn). The stock standard solution of known concentration of the metal ions.

Adsorption test with real wastewater samples

To measure absorption of heavy metal into resins using different wastewater, the experiments conducted using wastewater samples from textile industry, sewage treatment plant, chemical industry, and lake water.

a) Heavy Metal Removal process using different Resin: In the experiments using 50ml of waste water sample passing through the 5gm of resin bed for the time of 2hrs, both the as such and after treatment samples were tested for heavy metal content after digestion.

b) Reusability of Resin: Used resin charge in beaker add acidic water stir well and filter it and finally washed with purified water and use this resin further for waste water treatment.

Table 1: Comparison of heavy metal removal capacity of Different waste water by using different types of Resin.

Experiment Site	Fe	Cr	Cd	Cu	Pb	Zn	Ni
Papad khind lake	0.2	0.4	ND	0.2	ND	0.3	ND
KE 47	ND	0.12	ND	ND	ND	0.1	ND
AD 20	0.05	0.1	ND	0.02	ND	0.05	ND
AD 50	0.05	0.08	ND	0.05	ND	0.07	ND
AES OH	0.1	0.15	ND	0.1	ND	0.15	ND
KE20H	0.09	0.24	ND	0.15	ND	0.14	ND
Wastewater from Textile industry	ND	0.7	0.5	0.5	0.4	0.4	0.5
KE 47	ND	0.02	0.01	0.02	0.1	ND	ND
AD 20	ND	ND	0.05	0.05	0.02	ND	ND
AD 50	ND	ND	0.04	ND	0.04	0.05	0.02
AES OH	ND	0.04	0.08	0.1	0.04	0.2	0.15
KE20H	ND	0.1	0.18	0.2	0.2	0.24	0.25
Waste water STP	ND	0.4	ND	0.5	ND	0.4	0.3
KE 47	ND	ND	ND	0.01	ND	0.02	ND
AD 20	ND	ND	ND	0.02	ND	0.01	ND
AD 50	ND	0.05	ND	0.15	ND	0.05	ND
AES OH	ND	0.04	ND	0.2	ND	0.1	0.13
KE20H	ND	0.1	ND	0.22	ND	0.15	0.2
Chemical industry	0.1	0.4	0.15	0.05	0.2	0.04	0.3
KE 47	ND	0.04	ND	ND	0.05	ND	0.2
AD 20	ND	ND	ND	ND	0.01	ND	0.02
AD 50	ND	ND	ND	ND	0.02	ND	0.05
AES OH	0.05	0.1	0.1	0.02	0.04	ND	0.04
KE2 OH	0.04	0.08	0.1	0.03	0.04	ND	0.02

How to cite this article: Manisha P, Manisha K. Using different Types of Recyclable, Eco-friendly, Cost-effective Resins for the Removal of Heavy Metals from Wastewater. Int J Environ Sci Nat Res. 2025; 34(5): 556399. DOI: 10.19080/IJESNR.2025.34.556399

An Inductively Coupled Plasma-Mass Spectrometer (ICPMS), Columns, Acid (HNO_3), H_2O_2

In this work five different Resin: KE 47, AD 20, AD 50, AES OH and KE2 OH use and confirm the removal efficiency from waste water from different sources like Papad khind, Textile industry waste water, STP water and chemical industry water for target metal ions Zinc (Zn), Ferrous (Fe), Chromium (Cr), Cadmium (Cd), Copper (Cu), Lead (Pb), and Nickel (Ni), shown in (Table 1).

The initial level of metal concentration in waste water in Papad khind is Fe: Cr: Cd: Cu: Pb: Zn: Ni 0.2:0.4: ND: 0.2: ND: 0.3: NDmg/l. As per the study by using KE47, AD 20 and AD 50 resin the removal rate for Fe: Cr: Cd: Cu: Pb: Zn: Ni is ranging from 70% to 100% and for metal like Fe Cu, Pd having more removal capacity, and b using AES OH and KE2 OH also have good capacity of removing all the targeted metals.

The initial level of metal concentration in Textile industry waste water is Fe: Cr: Cd: Cu: Pb: Zn: Ni ND: 0.7: 0.5: 0.5: 0.4: 0.4: 0.5mg/l the metal concentration is high in textile industry waste water as per the study using KE47, AD 20, AD 50, AES OH and KE2 OH metal removal capacity for all the resin is maximum out KE47, AD 20 and AD 50 is almost 100% removal capacity of all the metals. Also, almost same results for STP water and chemical industry waste water.

The AES OH and KE2 OH confirmed by the relatively good removal capacity of the mentioned heavy metals and as per the study by using KE 47, AD 20 and AD 50 have the maximum capacity for the removal of mentioned heavy metal.

Conclusion

In conclusion, we have developed a simple efficient technique for removal of heavy metal from different waste water using different types of Resins and investigate the removal efficiency of heavy metal for different Resins, The Resin used for wastewater treatment process is the big achievements Resins have many advantages like easy Low cost, low toxicity, easy recycling and reuse. The process in mark with the green chemistry principles, compared to conventional heating with respect to time and easy workup are the major advantages of this method. While, there is a limitation about the important role in green technology of these catalyst, on this basis future works should focus on this topic.

References

1. Liebreich (2023) Clean Hydrogen Ladder, version 5.0.
2. Kovač A, Paranos M, Marciuš D (2021) Hydrogen in energy transition: A review. International Journal of Hydrogen Energy 46(16): 10016-10035.
3. Rosen M, Koohi-Fayegh S (2016) The prospects for hydrogen as an energy carrier: an overview of hydrogen energy and hydrogen energy systems. Energy, Ecology and Environment 1: 10-29.
4. Robles JO, Almaraz SD, Azzaro-Pantel C (2018) Hydrogen as a Pillar of the Energy Transition. Hydrogen Supply Chains, pp. 3-35.
5. Oltra C, Dütschke E, Sala R, Schneider U, Upham P (2017) The public acceptance of hydrogen fuel cell applications in Europe. Revista Internacional De Sociologia 75(4): 076.
6. Zimmer R, Welke J (2012) Let's go green with hydrogen! The general public's perspective. International Journal of Hydrogen Energy 37(22): 17502-17508.
7. Bentsen HL, Skiple JK, Gregersen T, Derempouka E, Skjold T (2023) In the green? Perceptions of hydrogen production methods among the Norwegian public. Energy Res Social Sci 97: 102985.
8. Schmidt A, Donsbach W (2016) Acceptance factors of hydrogen and their use by relevant stakeholders and the media. International Journal of Hydrogen Energy 41(8): 4509-4520.
9. Heinz B, Erdmann G (2008) Dynamic effects on the acceptance of hydrogen technologies—an international comparison. International Journal of Hydrogen Energy 33(12): 3004-3008.
10. Ricci M, Bellaby P, Flynn R (2008) What do we know about public perceptions and acceptance of hydrogen? A critical review and new case study evidence. International Journal of Hydrogen Energy 33(21): 5868-5880.
11. Hienuki S, Hirayama Y, Shibutani T, Sakamoto J, Nakayama J, et al. (2019). How knowledge about or experience with hydrogen fueling stations improves their public acceptance. Sustainability 11(22): 6339.
12. Achterberg P, Houtman D, van Bohemen S,Manevska K (2010) Unknowing but supportive? Predispositions, knowledge, and support for hydrogen technology in the Netherlands. International Journal of Hydrogen Energy 35(12): 6075-6083.
13. Glanz S, Schönauer A (2020) Towards a Low-Carbon Society via Hydrogen and Carbon Capture and Storage: Social Acceptance from a Stakeholder Perspective. Journal of Sustainable Development of Energy, Water and Environment Systems 9(1).
14. Emodi NV, Lovell H, Levitt C, Franklin E (2021) A systematic literature review of societal acceptance and stakeholders' perception of hydrogen technologies. International Journal of Hydrogen Energy 46(60): 30669-30697.
15. Achterberg P (2014) Knowing hydrogen and loving it too? Information provision, cultural predispositions, and support for hydrogen technology among the Dutch. Public Understanding of Sci 23(4): 445-453.
16. Scovell MD (2022) Explaining hydrogen energy technology acceptance: A critical review. International Journal of Hydrogen Energy 47(19): 10441-10459.
17. Ingaldi M, Klimecka-Tatar D (2020) People's Attitude to Energy from Hydrogen—From the Point of View of Modern Energy Technologies and Social Responsibility. Energies 13(24): 6495.
18. Rosenow J (2022) Is heating homes with hydrogen all but a pipe dream? An evidence review. Joule 6(10): 2225-2228.
19. IEA (2022), *World Energy Outlook 2022*, IEA, Paris.
20. IEA (2024), *World Energy Outlook 2024*, IEA, Paris.
21. Central Bureau of Statistics (CBS, 2023). Climate change and energy transition: opinions and behavior of Dutch citizens in 2023 [Klimaatverandering en energietransitie: opvattingen en gedrag van Nederlanders in 2023].

How to cite this article: Manisha P, Manisha K. Using different Types of Recyclable, Eco-friendly, Cost-effective Resins for the Removal of Heavy Metals from Wastewater. Int J Environ Sci Nat Res. 2025; 34(5): 556399. DOI: 10.19080/IJESNR.2025.34.556399

22. Ministerie van Economische Zaken en Klimaat (2024, April 19) *Wet sluiting Groningenveld gaat per 19 april 2024 in*. Rijksoverheid.

23. Sociaal en Cultureel Planbureau (2021). Burgerperspectieven, kwartaal 4.

24. Milieu Centraal (2023) Isolatie.

25. Ladage S, Blumenberg M, Franke D, Bahr A, Lutz R, et al. (2021) On the climate benefit of a coal-to-gas shift in Germany's electric power sector. Scientific Reports 11(1): 11453.

26. Gürsan C, Gooyert V (2020) The systemic impact of a transition fuel: Does natural gas help or hinder the energy transition? Renewable & Sustainable Energy Reviews 138: 110552.

This work is licensed under Creative Commons Attribution 4.0 License
DOI: 10.19080/IJESNR.2025.34.556399

Your next submission with Juniper Publishers will reach you the below assets

- Quality Editorial service
- Swift Peer Review
- Reprints availability
- E-prints Service
- Manuscript Podcast for convenient understanding
- Global attainment for your research
- Manuscript accessibility in different formats
  (Pdf, E-pub, Full Text, Audio)
- Unceasing customer service

Track the below URL for one-step submission
https://juniperpublishers.com/online-submission.php

How to cite this article: Manisha P, Manisha K. Using different Types of Recyclable, Eco-friendly, Cost-effective Resins for the Removal of Heavy Metals from Wastewater. Int J Environ Sci Nat Res. 2025; 34(5): 556399. DOI: 10.19080/IJESNR.2025.34.556399