History of Medicine, 2023, 9(2): 248–251
DOI: 10.17720/2409-5834.v9.2.2023.035

Efficiency of Resin and Zeolite filters in removing heavy metal Cd and Pb pollutants water

Abid Ahmad Erdeni[1]

[1]*Department of Biology/ College Of Education for Women/University of Tikrit/Tikrit/Iraq*
Email: bioerdene@tu.edu.iq

Received: 11 May 2023 **Accepted:** 10 June 2023

Citation: Erdeni AA (2023) Efficiency of Resin and Zeolite filters in removing heavy metal Cd and Pb pollutants water. History of Medicine 9(2): 248–251. https://doi.org/10.17720/2409-5834.v9.2.2023.035

Abstract

The research aims to find a low-cost and easy-to-use technique to remove heavy metals polluting water. The two filters designed and manufactured by the researcher demonstrated high efficiency in removing Lead and Cadmium polluting the water, as the results showed that the resin filter was efficient in removing lead and cadmium for all contaminated concentrations, the removal rates ranged between (99.8-88.36)% for lead and (87.682-93.309)% for Cadmium. The zeolite filter is efficient in removing lead and cadmium, and the removal rates ranged between (99.8-94.91)% for lead and (57.76-83.75)% for Cadmium.

Keywords:

Filter, Resin, Zeolite, Pollution, Pollution treatment, Lead, Cadmium.

dangerous and toxic element that may enter the organism's body through both the digestive system and the respiratory system, and it has the property of accumulating in human tissues, and it may lead to damage to the genetic material (You, 2004).

There are many methods for removing heavy metal that pollute water, including the Reverse Osmosis (R.O.) method, which works to separate water from ions under pressure through a membrane (Mohsen etal., 2010). And the techniques of separation Membranes by electrophoresis through the attraction of anions towards the positive pole and cations towards the negative pole in the electric cell, and thus the water becomes free of ions (Burose, 2000), but it may be expensive and may not be commensurate with pollution at high concentrations (Al-Karaghouli et al. , 2010), as well as the method of absorption, as the sorbent materials are classified into three classes: inorganic such as Graphene, Activated carbon, Zeolite, Silica, as well as organic absorbent materials, and Biological materials, and among the methods for removing water-contaminated ions is also the Ion

Water is necessary for the life of living organisms, especially for drinking purposes, but it may be contaminated with toxic compounds and heavy metals, which negatively affects its quality and thus affects the life of living organisms, including humans (Montana et al., 2013).

Heavy metals are ions with a density of more than 5 g / cm3,heavy metals are used in various industries, including building materials, dyes, water pipes, furniture, the automotive industry, the oil industry and extraction (ECDG, 2002; Lars Järup, 2003; Santos et al., 2005), pollution of the aquatic environment with heavy metals negatively affects the life of aquatic organisms, which may lead to their inclusion in the food chain of aquatic organisms as lead and cadmium, even at low concentrations (Mason, 2002). Thus, it affects the growth and physiological composition of animal organisms and aquatic plants (Vitaly et al, 2007), and may affect human health (Pantic et al, 2019), but if its harmful concentrations are not properly treated and removed, it causes health risks to the environment (Cong et al, 2020). As lead is a

Preparation of pollutant concentrations

Three concentrations of lead were prepared with concentrations of (2.5, 5.0, 10.0) ppm after dissolving them with distilled water, And also in three concentrations (5.0, 10.0, 20.0) ppm of Cadmium element.

Treatment filters test:

The water contaminated with lead was passed through the resin filter, as the polluted water was entered through the inlet hole at the top of the filter, and then the treated water was collected from the outlet hole at the bottom of the filter, the same steps were repeated when testing each of the aforementioned prepared concentrations, and the process was repeated in the zeolite filter as well. The same previous steps were also performed when treating the cadmium element and for both filters, noting that the filter was replaced when Filter each focus separately.

The concentration of heavy metals before and after treatment was determined by a SHIMADZU AA-6200 atomic absorption spectrophotometer, According to the method used by (Erdeni,2014).

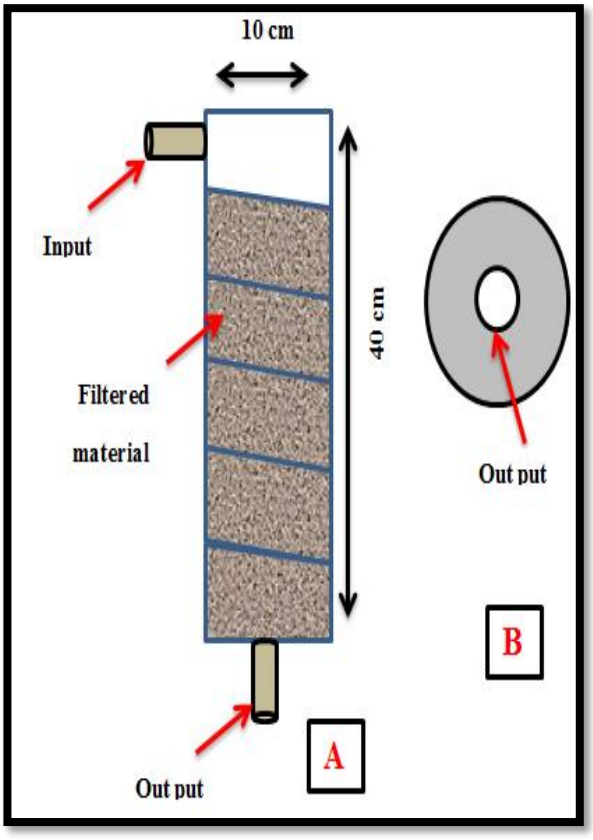

Figure (1) is a diagram showing the filter. (A: Side

exchange method such as Resins and Zeolites, which are One of the methods for treating pollution with ions polluting water, as in the exchange of heavy metal ions polluting water (Yi etal, 2019;Zhen etal, 2020).

Low-cost natural zeolite, which is aluminum silicate, hydrated crystalline with a skeletal structure containing pores occupied by cations and has a high capacity for cation exchange and is also used as adsorbents in separation and purification processes in water pollution with heavy metals (Yuelian and Shaobin, 2010) It is high in ion exchange and is used to remove pollution with ions such as lead polluting water (Nevin and Singh, 2016), as zeolite has proven efficient in removing lead compared to bentonite, as confirmed by both Mohsen etal.(2010), and both (Hua etal, 2009) proved The zeolite was efficient in removing lead. The resin is used to remove heavy metals polluting the water, as it was proven (Mudeer, 2015) that the resin removed lead by 80%. And also between (Gharbi et al, 2014) that the resin proved efficient in removing lead polluting water.

Material and Methods

The study was conducted at the University of Tikrit, College of Education for Women, and aims to remove contamination with lead and cadmium, which pollute the water by low-cost and easy-to-use technique.

Processing unit design and manufacture:

The treatment unit was designed and manufactured by the researcher, as the treatment unit included only one stage, which is a filter designed in a cylindrical shape from the outside and made of polyethylene, with a height of (40) cm and a diameter of (10) cm. And a hole at the bottom to remove the treated water with a diameter of (1.5) cm. Figure(1 A&B).

Inside the filter, there is a plate-shaped spiral made of polyethylene with the same diameter as the filter from the inside and extending from the top of the filter to the bottom. Figure(1 A&B).

Two types of treatment materials were added to the inside of the filter weight(15 grs), one of which was Cationic Resin and the other Zeolite, and each was added separately from the other, thus two separate filters were prepared.

percentage was 83.75%, while the lowest removal percentage was 57.76%.

Table (2) Efficiency of Resin and Zeolite filters in removing Cadmium element from water.

Type of filter Conce. Co		Resin	Removal %	Zeolite	Removal %
ppm	5.0	0.6159	87.682	2.112	57.76
	10.0	0.7310	92.690	2.855	71.45
	20.0	1.3381	93.309	3.250	83.75

Tables (1 and 2) show that the resin filter is efficient in removing lead and cadmium, and that the highest removal is for lead element 99.9%, while the lowest removal is 87.682%, while the zeolite filter is less efficient in removing cadmium, and the lowest removal is 57.76%, while the highest removal rate is 99.8%. These results indicate the possibility of using the two materials filters in water treatment units contaminated with heavy elements, including lead and cadmium. This is consistent with what was confirmed by (Dawoodi, 2019) that zeolite is efficient in removing lead and cadmium polluting water. And also with (Ahmed, 2018) that the resin is efficient in removing lead.

References

Ahmed, Ahmed Salim Atea (2018). Removal of Salinity from the water of some wells in Al-Alam / Salah El-Din Governorate by safe Methods. M.Sc. thesis- Biology department,Tiktit university-Iraq.

Al-karaghouli , Ali ; David, Ranne ; lawvence, L, and Kazmers,k.(2010).Technical and Economic Assessment of photovoltaic – driven Desalination system.

Buros, O.K .(2000).The ABC of Desalting , second Edition . International Desalination Association , toppsfield, Massachusetts.

Dawoodi, Mariam Adnan Ibrahim(2019).The possibility of treating wastewater from Salah El Din General hospital and the medical Rehabilitation hospital with environmentally friendly materials in Tikrit, Ph.D. thesis, Biology department, Tikrit university,Iraq.

ECDG.(2002). European Commission DG ENV. E3 Project ENV. E.3/ETU/0058. Heavy metals in waste. Final report.

Erdeni, Abd Ahmad (2014).Study of the Chemical pollutants in the wastewater of Baiji refineries and removed it physically towerds safe use in irrigation of the plant. Ph.D. thesis, Tikrit university, Iraq.

Gharbi, Soumaya; Jamel eddine Khiari and Bassem Jamouss(2014). studies synthesis and characterization

perspective, B: lower perspective).

Results and Discussion

Table (1) shows the low concentrations of lead in polluted water, filtered through a resin filter and a zeolite filter, and for all prepared concentrations of lead, as the prepared filters proved highly efficient in removing lead from polluted water and for all contaminated concentrations, as the remaining concentrations of lead upon filtration through a filter The resin is (0.005, 0.005, 1.164) compared to the prepared concentrations (2.5, 5.0, 10.0), respectively, with a removal percentage of (99.8, 99.9, 88.36)%, respectively. The zeolite filter also proved efficient in removing lead, as the remaining concentrations after filtration were (0.005, 0.454, 0.509) while the prepared concentrations were (2.5, 5.0, 10.0), respectively, with a removal rate of (99.8, 90.92, 94.91)%, respectively.

Table (1) Efficiency of Resin and Zeolite filters in removing lead polluting water.

Type of filter Pb		Resin	Removal %	Zeolite	Removal %
Ppm	2.5	0.005	99.8	0.005	99.8
	5.0	0.005	99.9	0.454	90.92
	10.0	1.164	88.36	0.509	94.91

Table (2) shows the efficiency of each of the resin and zeolite filters in removing the cadmium element polluting the water at different concentrations, and that the resin filter is more efficient in removing the cadmium element.

As the table shows that the remaining concentrations after filtration with the resin filter are (0.6159, 0.7310, 1.3381) ppm for each of the concentrations (5.0, 10.0, 20.0) ppm, respectively, and the removal rates are (87.682, 92.690, 93.309)%, respectively. While the remaining concentrations of the cadmium element filtered by the zeolite filter were (2.112, 2.855, 3.25) ppm for both concentrations (5.0, 10.0, 20.0) ppm, respectively, and the highest removal

applied to heavy metal ions absorption: A review. Nanotechnology Reviews, 9: 800–819.

of chelation Ion – exchange properties of copolymer resin derived from (8- hydroxyl), American chemical science journal 4(6):874-889.

Hua, Li ; Wei-yu Shi ; Hong-bo Shao and Ming-an Shao(2009). The remediation of the lead-polluted garden soil by natural zeolite. Journal of Hazardous Materials, Volume 169, Issues 1–3, 30:1106-1111. https://doi.org/10.1016/j.jhazmat.2009.04.067

Koshy, Nevin and Singh, D.N. (2016). Fly ash zeolites for water treatment applications. Journal of Environmental Chemical Engineering, Volume 4, Issue 2:1460-1472. https://doi.org/10.1016/j.jece.2016.02.002.

Lars, Järup (2003). Hazards of heavy metal contamination. British Medical Bulletin 2003; 68: 167–182.

Mason, C. F.(2002). Biology of freshwater pollution. 4rd ed. Essex Univ. England. 387 pp.

Mohsen, Hamidpour ; Majid Afyuni; Mahmoud Kalbasi; Amir H. Khosh goftarmanes and Vassilis J. Inglezakis (2010). Mobility and plant-availability of Cd(II) and Pb(II) adsorbed on zeolite and bentonite. Applied Clay Science, Volume 48, Issue 3, April 2010, Pages 342-348. https://doi.org/10.1016/j.clay.2010.01.004.

Montana, M.; Camacho, A.; Serrano, I.; Devesa, R.; Matia, L. and Valles, I.,(2013). Removal of radionuclides in drinking water by membrane treatment using ultrafltration reveres osmosis and EDR , ELSEVER, Desalination Vol.125:86-92 .

Mudeer, Mubarak Merza(2015). Kinetic and thermodynamics study of heavy metal ions adsorption from aqueous solution using new resin 8-hydroxyquinoline-furfural-hydroquinone (HQFH). Journal of the College of Basic Education, vol(21),No(88):169-188.

Pantic S, Skodric SR, Loncar Z, Pantic I. Neurotoxocity,nephrotoxicity, and hepatotoxicity of copper-based nanoparticles:potential implications in molecular medicine and neurosciences. Rev Adv Mater Sci. 2019;58(1):201–5.

Santos, I. R., E. V. Silva-Filho, C. E. Schaefer, M. R. Albuquerque- Filho and L. S.Campos. 2005. Heavy metals contamination in coastal sediments and soils near the Brazilian Antarctic Station, King George Island. Mar. Poll. Bull., 50: 85-194.

Vitali D, Dragojevic IV, Sebecic B, Validzic K.(2007). Assesment of toxic and potentially toxic elements in potato and cabbage grown in different locations in Croatia. Dtsch Lebensmittel-Rundschau.103(9):424–30.

Yi Z, Tang Q, Jiang T, Cheng Y.(2019). Adsorption performance of hydrophobic/hydrophilic silica aerogel for low concentration organic pollutant in aqueous solution. Nanotechnol Rev. 8(1):266–74.

You, X.H.(2004).A Study on the effect of soil aggregate on organic matter in mixed forests of Chinese Fir and Phyllostachys heterocycla cv pubescen .Acta Agric. Univ. Jiangxiensis.

Yuelian, Peng and Shaobin, Wang(2010).Natural zeolites as effective adsorbents in water and wastewater treatment, Chemical Engineering Journal, Volume 156, Issue 1, 1 January 2010, Pages 11-24. https://doi.org/10.1016/j.cej.2009.10.029.

Zhao, H., Li, X., Wang, X.(2011). Heavy metal contents of road-deposited sediment along the urban-rural gradient around Beijing and its potential contribution to runoff pollution.Environ. Sci. Technol. 45, 7120–7127.

Zhen Tang, Zedong Qiu, Shuang Lu, and Xianming Shi(2020). Functionalized layered double hydroxide