UDC: 628.316.12:546.48]:633-157.64
Professional paper

THE IMPACT OF THE ENVIRONMENT ON THE REMOVAL OF CD IONS FROM POLLUTED WATERS USING UNMODIFIED RICE HUSK AS A BIOSORBENT

Fjolla LATIFI [1], Mahi LATIFI [2], Ejup LATIFI[3], Nazif JASHARI[4], Albin RUFATI[5]

[1]*Universitet of Tetova*
[2] *Max Zeller Söhne AG pflanzliche Heilmittel Romanshorn*
[3] *Public Enterprise for State Roads - Universitet ofi Tetova*
[4] *PUC "Tetova" Tetovo -Universitet of Tetova*
[5]*Universitet of Tetova*
Contact: f.latifi96@gmail.com

Abstract

Water is a resource that is decreasing every day, which is why urgent measures are needed to preserve resources or even purify water and return it to use for drinking and in the food industry. The first option is to use water more rationally, but this is not enough, since heavy industries are the ones that cause the greatest pollution by discharging impurities into surface or groundwater, which in a chain way pass into the human body and cause the death of living organisms. It is precisely the ions of toxic metals discharged from various industries that create ecological disasters and cause the death of organisms as well as harm human health. Depending on the degree of pollution, adequate methods are also applied for their treatment. In the best case, the waters are only subjected to the filtration process and the removal of mechanical pollutants, and the same water is used in households or even in the food industry. For highly polluted waters with toxic and carcinogenic metal ions, a more specialized treatment is required by applying different methods, which are often not so efficient. Methods of cleaning using chemical adsorbents belong to the past, and today natural adsorbents are required which have high adsorption capacity, have affinity towards toxic metal ions, and maintain ecological balance. Biosorption is the most advanced method for ecological cleaning of waters using various mosses with high adsorption affinity, biomass deposited as bottoms after extraction or bottoms of various products, among them is rice husk, which has a very high affinity for adsorption of toxic metal ions. The removal of Cd ions has been proven for different pH values.

Keywords: Adsorption, biosorption, rice husk

1. Introduction

Wastewater treatment can be carried out in several ways: Preliminary treatment – this wastewater treatment includes the elimination of sand, oil, and solid insoluble substances. Primary treatment – the purpose of this treatment is to purify the waste materials that are suspended in them or to bring them to the surface. The process takes place in pools in which water flows for a longer period of time in order to remove or bring to the surface suspended organic substances. A large part of these particles has a density close to that of water, so a longer period of time is required for their separation. These treatments use tanks in the form of rectangles or cylinders. Secondary treatment – this treatment involves the separation of insoluble organic and secondary substances. Tertiary treatment – wastewater is purified from pathogenic microorganisms, nitrogen, and phosphorus components that cannot be eliminated in previous treatments, and finally, disinfection with chlorine is performed. (Mahi Latifi 2015)
The methods used for wastewater treatment are divided into: Mechanical methods – methods used to eliminate larger solids from water. Physical methods – these methods remove suspended particles that pollute water. These methods include the processes of flotation, flocculation, filtration (ultrafiltration and normal), reverse osmosis, aeration, and adsorption. The flotation

https://doi.org/10.62792/ut.jnsm.v10.i19-20.p3104

process takes place by washing the suspended substances and bringing them to the surface, which depends on the density of the substances themselves. The primary goal of flocculation is to remove turbidity in the water, another task of the process is to form larger particles that would be easier to remove from the water. Filtration as a final treatment involves the removal of solid substances through porous materials, which can be rigid and fine, depending on the process itself. Depending on the degree of purity required, the filters can be nets, sand, or artificial filters. The filtration flow takes place under the influence of pressure or gravitational forces. Under the influence of pressure, filtration takes place in such a way that a difference in pressure appears between the media. When a difference in pressures or a difference in concentrations occurs, reverse osmosis occurs - a process in which molecules from the solution that has a higher concentration move to the solution with a lower concentration. When the water being purified comes into contact with air that will be introduced into it, a change in the components between the two phases takes place (this process is called aeration). In the adsorption process, dissolved organic and inorganic substances are removed, depending on the need. Chemical methods - include water treatment with chemical agents, alkaline chlorination, and chemical precipitation, which remove heavy metal cations. Biological methods - in these methods, purification is carried out with biological cultures.(Zlokarnik M. 2018.) Various physicochemical and biological processes are typically used to remove contaminants from industrial wastewater before it is discharged into the environment. Biological processes such as standard wastewater and water treatment, as well as additional reed and wetland approaches, have been used for many years due to the remarkable abilities of microorganisms to detoxify organic and inorganic pollutants. Biosorption is one of the most important properties of both living and dead microorganisms (and their components) relevant to pollutant treatment (F. Veglio", F. Beolchini 1996). However, virtually all biological material, including macroalgae (seaweed), plant and animal biomass, and derived products (e.g., chitosan), is capable of biosorption. For several years, biosorption has been identified as a promising biotechnology for the removal and/or recovery of pollutants from solution due to its simplicity, its operation compared to conventional ion exchange technology, its apparent efficiency and the availability of biomass and biowaste products.(Mahi Latifi, Jeton Kuqi, Ejup Latifi, Kiril Lisichkov, Mirko Marinkovski, Stefan Kuvendziev ,2018)

2. Experimental:

In a chemical beaker, solutions of Cd (NO3)2 metal ions were created. With different concentrations of Cd ions Ckp(0.2 gr/dm3), Ckp(0.4 gr/dm3) and Ckp(0.5 gr/dm3) to observe the adsorption capacity for different concentrations of Cd ions. Analyses were made for three environments of pH, 4.5, 6.8 and 9.7. For all three analyses, 2.5 gr of finely ground rice husk biosorbent were weighed. The beaker was equipped with a mixer set at 180 rpm for 180 min. In the first sample, an acidic environment of pH 4.5 was set, for the second sample 6.8, and for the third sample 9.7. During the biosorption process, a sample was taken from the solution at different times to determine the adsorption curves and to determine the residual amount of Cd ions in the solution for different environments. After the biosorption time, the samples were subjected to AAS measurement to determine the remaining amount of Cd ions in the aqueous solution. Before the biosorption process began, the biosorbent was prepared in advance, namely, the rice husk was ground to a certain degree of fineness. 50 g of rice husk was weighed and subjected to grinding with a 1 mm sieve, and in a period of 10 min under vibrations, the different fractions of the biosorbent were created, reflecting the granulometric analysis of the biosorbent Table 1, Figure 1

3. Results and discussion:

From the measurements performed and the results obtained, it can be observed a high affinity of rice husk towards Cd ions, which can be seen from tables 2, 3, and 4, fig. 2, 3, and 4. It is concluded that for different environments, the adsorption abilities also vary. For pH 4.5 environment (acidic environment), it is observed that the adsorption activity is lower due to protonation in the solution, namely, the creation of a solution with excess hydrogen ions, which makes adsorption difficult. For pH 9.7 environment (basic environment), we also have a lower adsorption as a result of excess OH ions, which create sediment and hinder the biosorption process. Based on the results obtained, it is observed that the neutral environment 6.8 is ideal for the continuation of the biosorption process. Regarding the use of the amount of biosorbent, 2.5 gr is sufficient, and for different concentrations of Cd ions in the solution, high activity of rice husk as an adsorbent is observed. It is hoped that this adsorbent can also be used for the removal of other toxic metal ions from aqueous solutions, including the removal of hexavalent Cr ions, which are difficult to remove, but which, through modification, can give very good results. Such research has been done by modifying rice husk by treating it at a temperature of 400°C, and during biosorption, excellent results were achieved (Mahi Latifi 2015)

4. Table and Figures

Table 1: Granulometric analysis of rice husk

Size of strainer	Measuring vessel gr	Vessel + raw material gr	Netto]
8.00 mm	448.1	448.1	0
4.00 mm	430.82	432.32	1.5
2.00 mm	399.7	401.3	1.6
1.00 mm	362.8	365.93	3.13
0.50 mm	322.5	328.91	6.41
0.25 mm	290.1	302.31	12.21
0.125 mm	279.48	294.93	15.45
Sludge	400.88	423.44	12.56

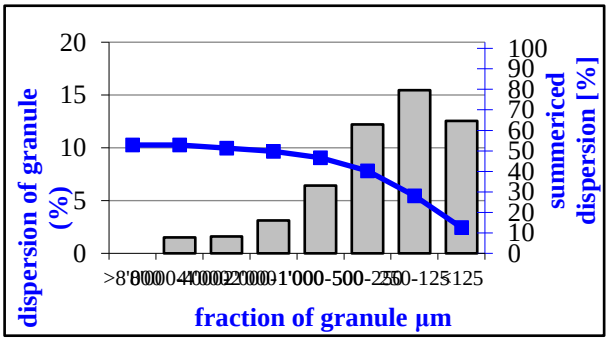

Figure 1: Fraction of granule rice husk

Table 2 Alteration of ion concentration at Cd depending on the time of biosorption for different amounts of concentration Ckp(0.2 gr/dm3) Ckp(0.4 gr/dm3) Ckp(0.5 gr/dm3) pH=4.5

min)	Ckp(0.2 gr/dm3)	Ckp(0.4 gr/dm3)	Ckp(0.5 gr/dm3)
0	0.2	0.4	0.5
20	0.15	0.35	0.45
40	0.11	0.3	0.39
60	0.09	0.27	0.31
90	0.08	0.22	0.26
120	0.05	0.11	0.21
160	0.05	0.08	0.11

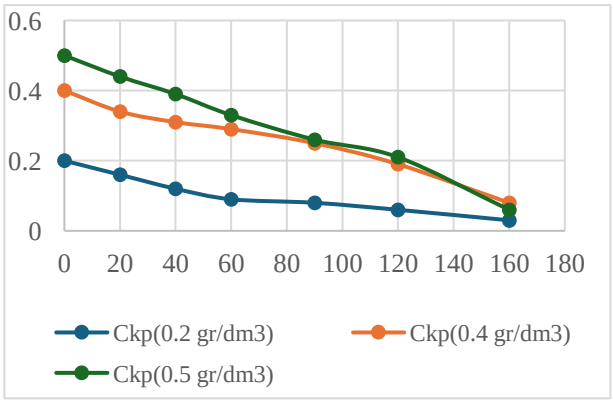

Figure 2: Outline of biosorption Cd ions pH=4.5

Table 3: Alteration of ion concentration at Cd depending on the time of biosorption for different amounts of concentration Ckp(0.2 gr/dm3) Ckp(0.4 gr/dm3) Ckp(0.5 gr/dm3) pH=9.7

T(min)	Ckp(0.2 gr/dm3)	Ckp(0.4 gr/dm3)	Ckp(0.5 gr/dm3)
0	0.2	0.4	0.5
20	0.17	0.35	0.44
40	0.12	0.27	0.37
60	0.09	0.21	0.31
90	0.07	0.15	0.23
120	0.06	0.13	0.19
160	0.05	0.1	0.14

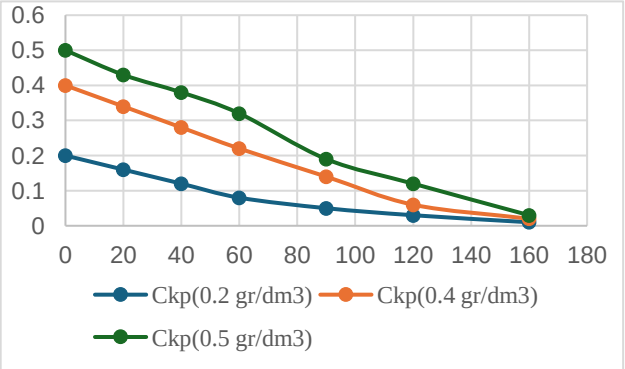

Figure 3: Outline of biosorption Cd ions pH=9.7

Table 4: Alteration of ion concentration at Cd depending on the time of biosorption for different amounts of concentration Ckp(0.2 gr/dm3) Ckp(0.4 gr/dm3) Ckp(0.5 gr/dm3) pH=6.8

T(min)	Ckp(0.2 gr/dm3)	Ckp(0.4 gr/dm3)	Ckp(0.5 gr/dm3)
0	0.2	0.4	0.5
20	0.16	0.34	0.43
40	0.12	0.28	0.38
60	0.08	0.22	0.32
90	0.05	0.14	0.19
120	0.03	0.06	0.12
160	0.01	0.02	0.03

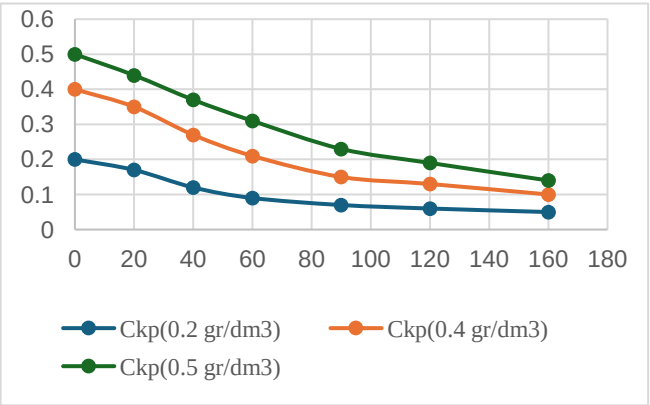

Figure 4 Outline of biosorption Cd ions pH=6.8

5. Conclusion

From the results of the analyses with particular emphasis on the influence of the pH environment, it can be concluded that the pH values must be adjusted in such a way as to create a neutral environment where very good results and almost complete removal of Cd ions are achieved, while rice husk logs as a very advanced biosorbent with very high adsorption activity.

References

[1] Bedell, G. W.; Darnall, D. W. Immobilization of nonviable, biosorbent algal biomass for metal ion recovery in heavy metal biosorption; B. Volesky, ed.; CRC Press: Boca Raton, FL, 1990; pages 313–326.

[2] F. Veglio", F. Beolchini ,Advances in Bioprocess Engineering/Biotechnology Advances in Bioprocess Engineering, Volume 11, pp. 157-180

[3] Mahi Latifi ,Modelling of the process of separation of heavy metals from water resources by application of natural and modified biosorbents 2015, Dissertation,TMF Skopje,MK

[4] Mahi Latifi, Jeton Kuqi, Ejup Latifi, Kiril Lisichkov, Mirko Marinkovski, Stefan Kuvendziev Cleaning of contaminated waters by Mn ions using rice husk as a biosorbent 2nd International Conference of natural sciences and mathematics JNSM ,2018, Volum 3 No.5-6 ,22-23 size: 47 – 53
[5] M Tsezos, E Remoudaki, V Angelatou, Effects of competing ions on the Biosorption of Metals, Volume 38, Issue 1, 1996, pages 19-29
[6] Zlokarnik M. 1979. Advances in Bioprocess Engineering/Biotechnology Advances in Bioprocess Engineering, Volume 11, pp. 157-180
[7] Zlokarnik M. Biosorption: A green approach for the removal of heavy metals from water and wastewater. Journal of Life Sciences Bioinformatics Pharmaceutical and Chemical Sciences · January 2018 DOI: 10.26479/2018.0401.05