REMOVAL OF HEAVY METALS FROM WASTEWATER WITH THE HELP OF ADSORBENT MATERIALS OBTAINED FROM SLAG PRODUCED AS A RESULT OF STEELMAKING ACTIVITIES

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Heavy metals, like lead, cadmium, copper, zinc, are known to be toxic and carcinogenic agents when discharged into the environment, which pose serious health problems and threaten flora and fauna in water bodies and soil.

Human health conditions due to long-term exposure to contact with heavy metals can be damage to nerves, muscles and physical processes.

Heavy metals, unlike organic pollutants, do not break down naturally and tend to accumulate in living organisms once they are introduced into the environment.

One of the most used methods of reducing and eliminating heavy metals from waste water is the adsorption process.

Adsorption is flexible in design and operation, and cost and removal efficiency depend on the choice of adsorbent.

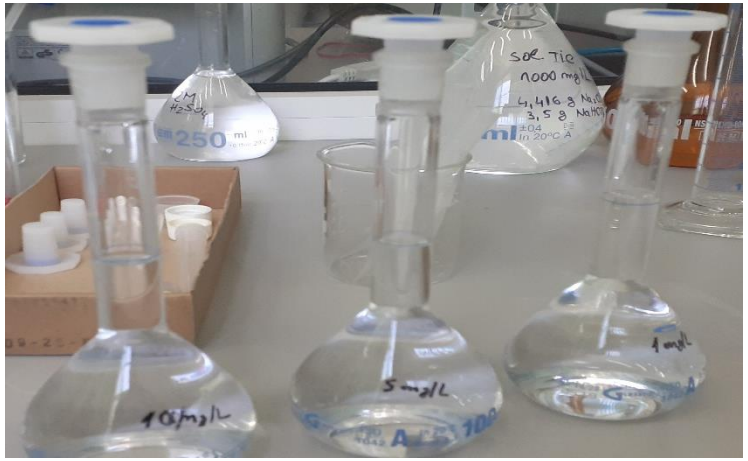
The removal of heavy metals using commercial adsorbent materials such as activated carbon is an expensive process, that's why alternatives to these adsorbents were sought among industrial wastes and by-products.

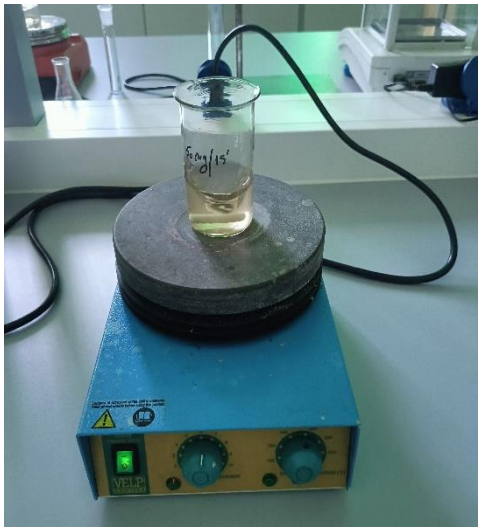
A reliable alternative in the choice of adsorbents is the slag obtained in the production processes of pig iron and steel.

The adsorbent	Pollutants	References
Blast furnace slag	heavy metals: Hg^{2+}, Cr^{6+}, Pb^{2+}, Cu^{2+}	Alsulaili, A. et al., 2023
	heavy metals, phosphate and dyes	Abdelbasir, M. et al., 2022
	heavy metals like nickel, zinc, lead, chromium, copper, cadmium	Anjali M.S. et al., 2019
	Pb(II), Cu(II), Zn(II), Cd(II), Ni(II)	Blahova, L. et al., 2018
	heavy metals like copper, nickel; dyes	De Gisi, S. et al., 2016


1mm
500
125


contrAA
800


250 ml
5 mg/L



The properties of the blast furnace slag sample

	pH, at 25 °C	Electrical conductivity, µS/cm, at 25 °C	Total dissolved solids content, mg/L
The sample of slag in water, 10 %	8,9-10,3	72,4	39,7
The slag sample in the solution mixture containing pollutants	4,8-4,9	1000	531

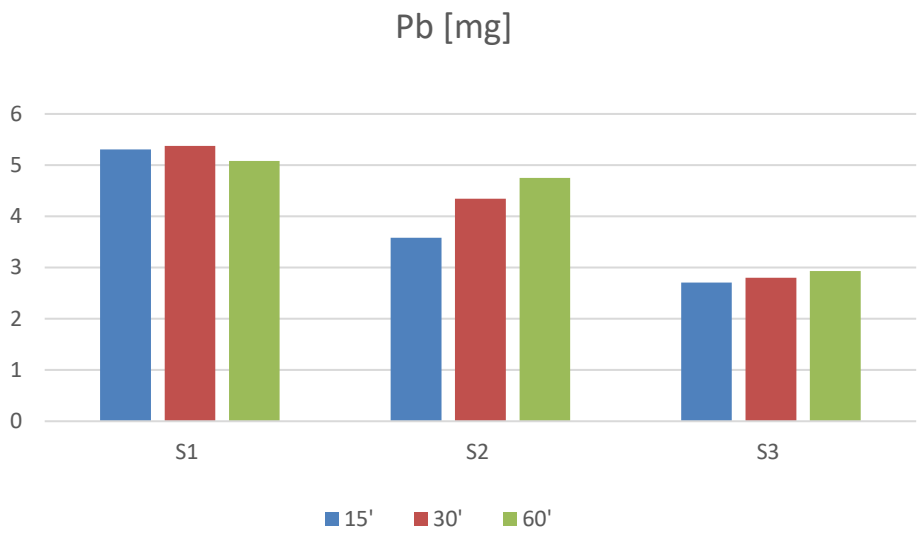
Analytical characteristics of the determination of heavy metals

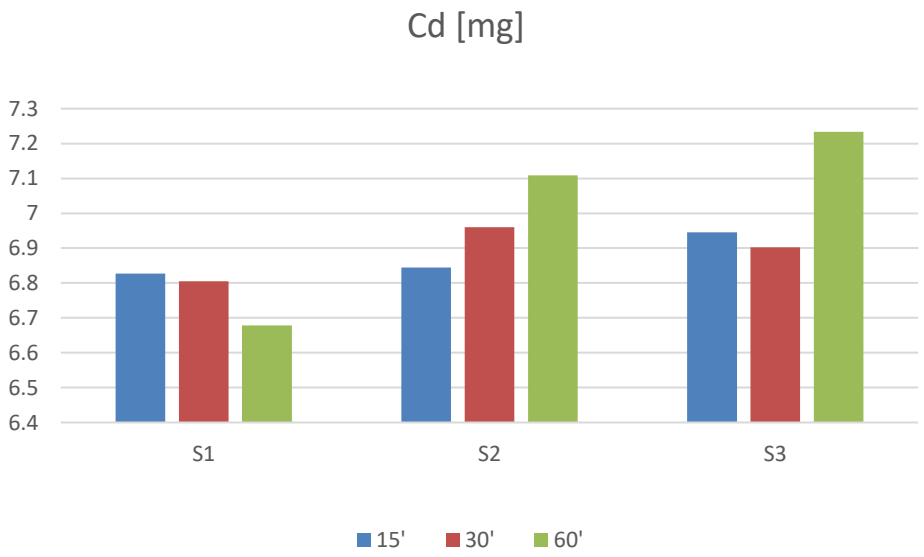
Analytical characteristic Heavy metals	Wavelength [nm]	Linearity of the curve, R^2	Limit of detection [mg/L]	Sensitivity of the method [mg/L/1%A]	Type of flame
Pb	217.0005	0.947614	2.081	0.059125	acetylene - air
Cd	228.8018	0.998584	0.3392	0.121037	
Cu	324.7540	0.994043	0.6963	0.023723	
Zn	213.8570	0.852891	3.545	0.027533	

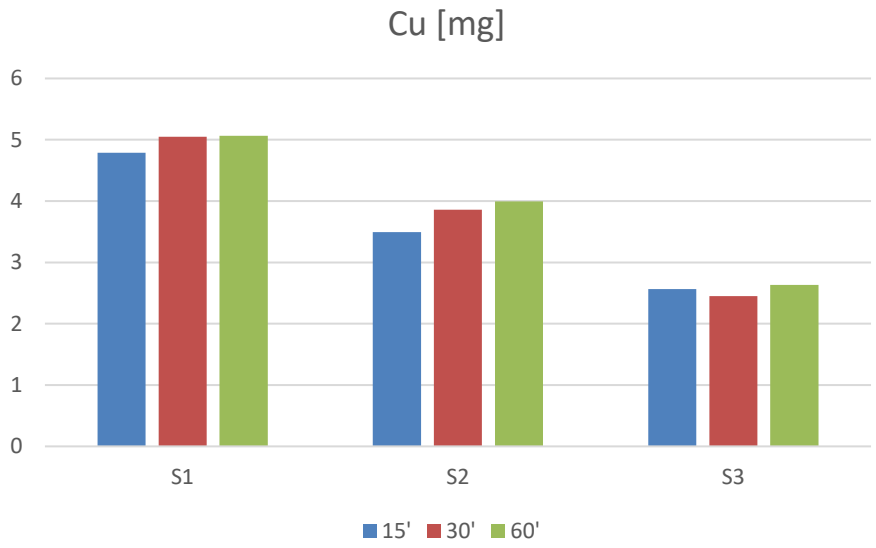
The amounts of heavy metals found in the analyzed samples

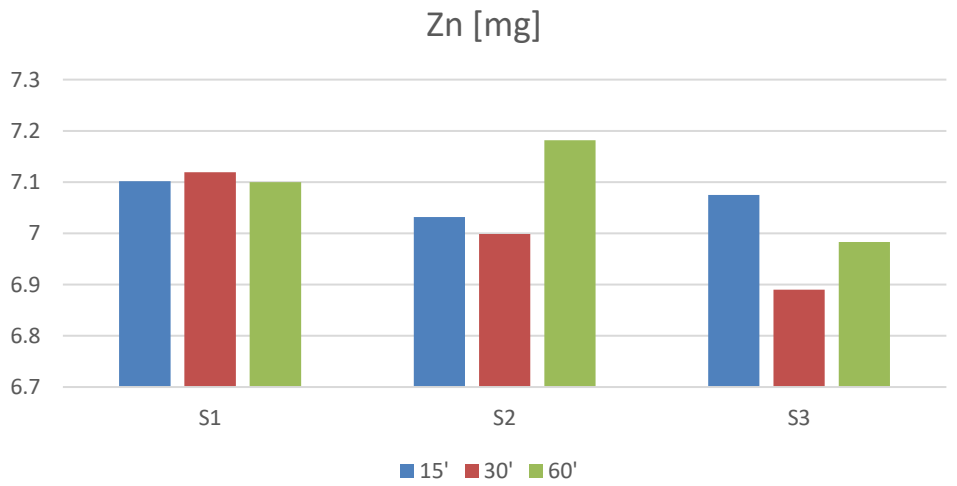
Heavy metals	Sample	S1 [mg]	S2 [mg]	S3 [mg]
Pb	15´	5.305	3.584	2.709
	30´	5.374	4.346	2.799
	60´	5.085	4.754	2.932
Cd	15´	6.827	6.844	6.945
	30´	6.805	6.960	6.902
	60´	6.678	7.109	7.234
Cu	15´	4.789	3.496	2.563
	30´	5.047	3.858	2.450
	60´	5.063	3.994	2.633
Zn	15´	7.102	7.032	7.075
	30´	7.119	6.999	6.890
	60´	7.100	7.182	6.983

- The 10 mg sample was marked with S1, the 25 mg sample with S2, and the 50 mg sample with S3.
- The contact time for each sample was 15 minutes, 30 minutes and 60 minutes.


Pb [mg]
6
5
4
3
2
1
0
S1
S2
S3
15'
30'
60'


Cd [mg]
7.3
7.2
7.1
7
6.9
6.8
6.7
6.6
6.5
6.4
S1
S2
S3
15'
30'
60'


Cu [mg]
6
5
4
3
2
1
0
S1
S2
S3
15'
30'
60'


Zn [mg]
7.3
7.2
7.1
7
6.9
6.8
6.7
S1
S2
S3
15'
30'
60'

CONCLUSIONS

In this work, blast furnace slag, with a diameter of 45 µm, was used to observe its capacity to adsorb heavy metals from wastewater. The influence of the amount of adsorbent and the contact time on the adsorption process was also observed.

Blast furnace slag is an industrial by-product that can be used as an adsorbent in the removal of heavy metals, such as lead, cadmium, copper, zinc, from waste water, even if it is a field in continuous research.

REFERENCES

Abdelbasir, M. Sabah, Khalek, Mohamed A. Abdel. (2022). From waste to waste: iron blast furnace slag for heavy metal ions removal from aqueous system. *Environmental Science and Pollution Research*, 29, 57964–57979.

Ado-Ekiti, Nigeria Mary Aderonke Oguntuase, Abiola Omotayo Oyebamiji, Oluwagbemisola Magret Ayeni, Oluwatoyin Temidayo Adeyanju. (2024). A comprehensive environmental analysis of heavy metal contamination, ecological risks and health impacts in Ilokun area. *Environmental Pollution and Management* 1, 118–127

Alsulaili, Abdalrahman, Elsayed, Khalad, Refaie, Abdelrahman. (2023). Utilization of agriculture waste materials as sustainable adsorbents for heavy metal removal: A comprehensive review. *Journal of Engineering Research*

Ohidul Alam, Xiaojun Zheng, Daolin Du, Xiuchen Qiao, Longyun Dai, Jian Li, Jiaojiao Xia, Jinhui Ye, Shan Zhong. (2024). A critical review on advances in remediation of toxic heavy metals contaminated solids by chemical processes. *Journal of Environmental Chemical Engineering* 12, 113149

J.N. Sahu, Y. Kapelyushin, Devi Prasad Mishra, Prabir Ghosh , B.K. Sahoo, E. Trofimov, B.C. Meikap. (2023). Utilization of ferrous slags as coagulants, filters, adsorbents, neutralizers/ stabilizers, catalysts, additives, and bed materials for water and wastewater treatment: A review. *Chemosphere* 325, 138201

Xiaofang Feng, Runxuan Long, Lingling Wang, Chenchen Liu, Zhongxiang Bai, Xiaobo Liu. (2022). A review on heavy metal ions adsorption from water by layered double hydroxide and its composites. *Separation and Purification Technology* 284 120099

Yared Daniel Retaa, Temesgen Debelo Desissaa, Yiene Molla Desalegn. (2023). Adsorption of heavy metal ions from wastewater: a critical review. *Desalination and Water Treatment* 315, 413–431

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