ECP 2025 Conference

The 4th International Electronic Conference on Processes

20–22 October 2025 | Online

MDPI

Investigation of the effectiveness of waste coffee grounds in nickel removal from aqueous solution-a green chemistry perspective

Gamze Özçakır

Department of Chemical Engineering, Faculty of Engineering, Bilecik Şeyh Edebali University, TR 11100, Bilecik, Türkiye;
gamze.ozcakir@bilecik.edu.tr

INTRODUCTION & AIM

Heavy metal pollution originating from industrial processes such as battery production is a threat to the environment.

Heavy metals such as Nickel do not degrade in the wastewater directly.

Among the methods, adsorption is a cost-effective process to clean wastewater.

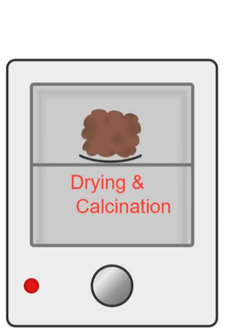
Cheap and easily achievable agricultural wastes such as rice, coffee, maize, and corn are preferred for adsorption.

Figure 1. The importance of removing heavy metal by using a waste [1]

This study aimed to remove Nickel from the aqueous solution by adsorption with Turkish Coffee Waste (TCW). Adsorbent amounts (0.05 and 0.07 g), adsorption time (15-60 min), and adsorbent calcination temperature (300-700˚C) were the tested parameters in the adsorption.

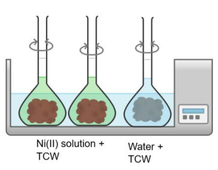
METHOD

Figure 2. Photos represented the TCW preparation

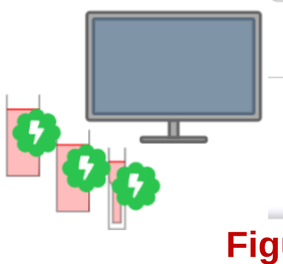


The coffee grounds were dried at 100˚C.

Then, they calcinated to 300-700˚C under static air during 5 h (5˚C/min).



Adsorption conducted in a water bath at a 200 rpm shaking rate with 0.4 g/L initial Ni(II) solution concentration at room temperature.



UV-VIS was used to analyze the Ni(II) concentration against time at a 400 nm wavelength.

Figure 3. The details for the method used in the study

RESULTS & DISCUSSION

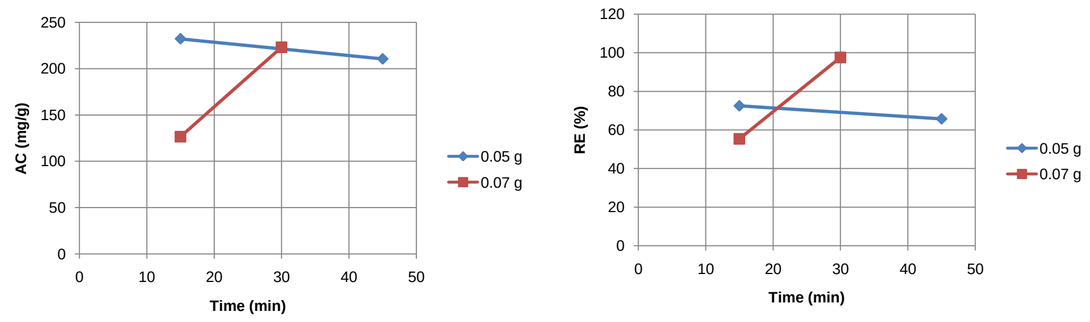


Figure 4. Removal Efficiency (RE, %) and Adsorption Capacity (AC, mg/g) values for different adsorbent amounts (TCW calcination temperature: 300 ˚C)

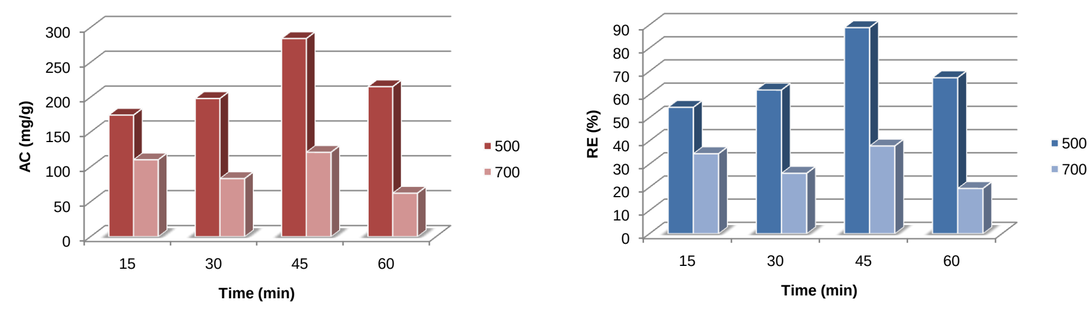


Figure 5. Effect of different adsorbent calcination temperatures on the Removal Efficiency (RE, %) and Adsorption Capacity (AC, mg/g) values (TCW amount: 0.05 g)

Table 1. Comparison of the data with the literature [2]

AC_{max} (mg/g)	Adsorbent
284.00 (This Study)	Calcinated Turkish Coffee Waste
0.13	Palm shell activated carbon
60.20	Activated sludge
11.40	Baker's yeast

In literature, maximum adsorption capacity values were in the range of 0.13-60.20 mg/g for several biomass-based adsorbents for Ni (II) removal (Table 1). Therefore, it was believed that the biomass calcination procedure could be effective for removing Ni (II) from water.

CONCLUSION & FUTURE WORK

- It is thought that this study creates an alternative green way for cleaning wastewater via biomass wastes.
- The adsorbent calcinated at 500˚C can be utilized to remove other pollutants from water in the future.

REFERENCES

[1] Rodiguez et al. (2018). *Journal of Environmental Chemical Engineering*, *6*(1), 1161-1170.
[2] Shroff & Vaidya (2011). *Chemical Engineering Journal*, 171(3), 1234-1245.