Fabrication and Effective Sorption Behavior of Electrospun *Cystoseira barbata*/PAN fibers

Fatma Rabia Karaduman
Saniye Türk Çulha, Nesrin Horzum
Izmir Katip Çelebi University, Izmir, Turkey
frkaraduman@hotmail.com
trksanye@gmail.com
nesrin.horzum.polat@ikc.edu.tr

Abstract

With the recent rapid development of cities and industries, toxic heavy metal ions release into groundwater and critically pollute the aquatic environment. Heavy metal ions are a serious threat to human health because they cannot be degraded in the aquatic environment [1] Lead (Pb(II)) ions are one of them that are difficult to remove from waters. Among the numerous methods (biological, chemical precipitation, ion exchange, and sorption) used for the sequestration of Pb(II) ions from wastewater, sorption has clear benefits such as ease of use, high efficiency, and reusability [2]. Therefore, it is crucial to develop low-cost and high-performance sorbents. Algae are biological sorbents with high metal retention potential due to their functional groups such as carboxyl, hydroxyl, amine, and sulfonyl [3]. Nanomaterials are well known for metal ion sorption as they have a high surface area/volume ratio, high strength/weight ratio, and interconnected porosity [4, 5].

In this study, polyacrylonitrile (PAN) fibers containing *C. barbata* were used for the first time to remove Pb(II) ions from the aqueous media. For this purpose, *C. barbata*/PAN fibers were fabricated by electrospinning, and their morphological, structural, and mechanical properties were determined. Then, the sorption of Pb (II) metal ions was studied using *C. barbata*/PAN sorbent. The effect of shaking time, percentage of algae, sorbent amount, pH, temperature, and initial metal ion concentration on the sorption behavior was investigated by batch method. Accordingly, 5 mg of 5% doped *C. barbata*/PAN has a high sorption percentage (88.89%) for Pb (II) metal at 60 min, pH 4.0, 100 µg L^{-1} initial ion concentration. Furthermore, the nature of the sorption process was described using thermodynamic parameters, kinetic and isotherm models. After sorption, the presence of lead ions in the EDX analysis of the nanofibers confirmed the sorption behavior. According to FTIR analysis, carboxyl, and sulfonyl groups presented by algae and polymer played an active role in metal sorption.

References

[1] Horzum, N., Boyacı, E., Eroglu, A. E., Shahwan, T., Demir, M. M., Biomacromolecules, 11(12) (2010), 3301-3308.
[2] Aliabadi, M., Irani, M., Ismaeili, J., Piri, H., Parnian, M. J., Chemical Engineering Journal, 220 (2013) 237-243.
[3] Karaduman, F. R., Çulha, S. T., Horzum, N. Materials Today Communications, 104248 (2022), 1-24.
[4] Shooto, N. D., Dikio, C. W., Wankasi, D., Sikhwivhilu, L. M., Mtunzi, F. M., Dikio, E. D., Nanoscale Research Letters, 11 (2016) 1-13.
[5] Wang, X., Hsiao, B. S., Current Opinion in Chemical Engineering, 12 (2016), 62-81.