Unlocking the Remediation Potential of Waste-Derived Biochar: Arsenic Shuttle between Groundwater and Environmentally Friendly Medium

S. Radovic[1,], S. Pap[1,2], J. Prodanovic[3], J. Radonic[1], S. Dmitrasinovic[1], M. Turk Sekulic[1] (1) University of Novi Sad, Faculty of Technical Sciences, Department of Environmental Engineering and Occupational Safety and Health, Trg Dositeja Obradovica 6, 21 000 Novi Sad, Serbia, (2) Environmental Research Institute, UHI North Highland, University of the Highlands and Islands, Thurso, Caithness, Scotland, KW14 7JD, UK; (3) Faculty of Technology in Novi Sad, University of Novi Sad, Bulevar cara Lazara 1, 21 000 Novi Sad, Serbia;*
[*]sanjaradovic@uns.ac.rs

Problem with arsenic contamination (recognised by the International Agency for Research on Cancer (IARC)) of aqueous systems is ubiquitous and alarming due to the various negative effects on human health [1]. Although the problem is widespread, the developing countries and rural areas are the most affected. In order to provide alternative (more affordable) solution, and promote circular economy and cleaner production, novel biochar was developed from abundant waste material from the oil industry – sunflower seed husks (SSH). SSH were iron (Fe)-functionalised and pyrolysed in order to convert into a magnetic biochar (FeBCH).

FeBCH was investigated for the removal of arsenate ((As (V)) from aqueous solutions and groundwater. Influence of solution pH (2-10), initial As (V) concentration (0.1-100 mg/L), contact time (5 min – 24 h) and FeBCH dosage (1-8 g/L) was examined in single model solutions. Effect of competing ions on As (V) removal was investigated in a model solution containing both, As (V) and phosphates which are assumed to be competitive for the active sites on the biochar surface. Finally, groundwater enriched with As (V) underwent adsorption tests indicating the future potential of obtained adsorbent for this purpose.

Results showed that As (V) adsorption was facilitated at pH values between 4 and 8. pH 6 was chosen for further experiments. A contact time of 4 h was sufficient for the removal of 91.6±1.2% of As (V), while a small increase in removal efficiency (up to 5%) was observed after increasing contact time up to 24 h. The optimal biochar dosage was 2 g/L. Almost complete removal of arsenate was achieved for all initial concentrations. However, 20 mg/L was chosen as the initial concentration for further experiments. While As (V) reduction was hindered in the presence of competing phosphate ions (reached 47.2±0.5% under previously determined optimal conditions and after 23 h of contact time), 83.8±1% of As (V) was successfully removed from groundwater, indicating the good potential of synthetised biochar for the application in real systems.

References

[1] X. Hu, Z. Ding, A. R. Zimmerman, S. Wang, and B. Gao, “Batch and column sorption of arsenic onto iron-impregnated biochar synthesized through hydrolysis,” *Water Res.*, vol. 68, pp. 206–216, 2015, doi: 10.1016/j.watres.2014.10.009.

Acknowledgment - *This research was supported by the Science Fund of the Republic of Serbia, grant number 6707, REmote WAter quality monitoRing anD IntelliGence – REWARDING, European Union's Horizon Europe Marie Sklodowska-Curie Actions (MSCA) under Grant Agreement number 101086387and British Scholarship Trust foundation/Environmental Research Institute through grant for short-term research at Universities through the United Kingdom.*