EGU25-9942, updated on 25 Nov 2025
https://doi.org/10.5194/egusphere-egu25-9942
EGU General Assembly 2025
© Author(s) 2025. This work is distributed under
the Creative Commons Attribution 4.0 License.

Arsenic removal from drinking water with magnetite (Fe_3O_4) reduced graphene oxide (MRGO) nanocomposite material: Evaluations on process chemistry, system design and engineering applications

Sarp Çelebi[1], Omar A. I. M. Elkawefi[1], Acar Şenol[1], S. Sevinç Şengör[1], Gülay Ertaş[2], and Kahraman Ünlü[1]

[1]Middle East Technical University, Department of Environmental Engineering, Ankara, Türkiye
[2]Middle East Technical University, Department of Chemistry, Ankara, Türkiye

As surface waters become more polluted, many communities around the world need to turn to groundwater resources for their drinking water needs. Groundwaters on the other hand, carry the risk of having geogenic arsenic (As) that is at hazardous levels for human health. As is legislated by many governments in more recent years to a maximum concentration of 10 ppb in drinking waters as recommended by the World Health Organization since 1991. This has caused a surge in research related to removal of arsenic from drinking waters.

Using adsorptive materials, among other alternatives stand out, for adsorption itself being the major mechanism that determines the fate of dissolved arsenic; and relevant methods being generally easy to operate, cost effective, and having the potential of regeneration. Interest has grown in the 2010's for graphene-based nanocomposites due to their 2-D single layer structure, large surface area and pore volumes, high mechanical stability, flexibility of surface chemistry and abundant production from natural sources. Magnetite reduced graphene oxide (MRGO) among others have an additional benefit of implementing the adsorptive capacities of iron oxides towards arsenic, and is also studied in batch for its adsorption capacity, kinetic and isotherm models under extremely high initial arsenic concentrations to demonstrate its capabilities at laboratory scale.

This study aims to build on the available literature and contribute further by assessing optimal reactor design and operational conditions for arsenic removal from water by column experiments. A custom-designed adsorption column with three sampling ports is implemented to collect data including pH, dissolved oxygen, iron concentration, and As^{+3} and As^{+5} concentrations with time, to evaluate the impact of different conditions such as initial arsenic species (As^{+3} or As^{+5}), flowrate, and ionic composition on arsenic removal efficiency. Speciation analysis data is expected to yield novel insights about adsorption mechanisms as well. The collected data will be later used to model the column with hydrogeochemical and reactive transport models to make assessments about larger-scaled systems.

Acknowledgement: This study is supported by TUBITAK (The Scientific and Technological

Research Council of Turkey) 1001 Project with Grant Number 123Y025 and Research Fund of the Middle East Technical University, Research Universities Support Program (ADEP) with Grant Number ADEP-311-2022-11172