

Arsenic and sulfadiazine adsorption by a Fe-hydrochar produced from olive pomace

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Arsenic (As) is a toxic metalloid naturally occurring in groundwaters and, if ingested, can severely harm human health. While the As concentration limit recommended for drinking water is 10 µg/L, concentrations above this limit are found over wide areas, making it necessary the recourse to As removal technologies. The technology commonly adopted to remove As is the adsorption onto granulated ferric oxide or hydroxide (GFO or GFH). However, the costs of these adsorbents (5–10 €/kg) hinder the application of As treatment plants, especially in rural and marginal areas. The use of composite adsorbents produced by thermal treatment of inexpensive biomasses and functionalization with Fe oxides/hydroxides has been proposed to overcome this limitation. Here, an effective technological alternative is represented by hydrothermal carbonization (HTC) (Khan et al., 2021). HTC can convert biomass into a solid carbonaceous material called hydrochar (HC) in the presence of water at high pressure (1-10 MPa) and relatively low temperatures (170-250 °C). A major advantage of the HC, compared to GFH and GFO, is the ability of adsorbing both As and organic pollutants. In this work, the adsorption of As and sulfadiazine (SDZ) onto a Fe-hydrochar produced from olive pomace is analysed. SDZ was selected as a representative emerging organic pollutant. The employed Fe-hydrochar was produced by pilot scale implementation of a process including an HTC stage at acidic pH, followed by the precipitation of Fe oxides/hydroxides at alkaline pH (Di Caprio et al., 2022). The optimization of the pilot scale production and the analysis of As and SDZ adsorption were conducted under the European project LIFE BioAS.

Batch adsorption tests (i.e., hydrochar suspended in SDZ solution) were performed, allowing to derive the equilibrium isotherm for SDZ at pH=6.9 (Fig. 1a). Maximum adsorption capacity q_{max} and affinity coefficient b for SDZ equal to 2.3 mg/g and 0.09 L/mg, respectively, were estimated by fitting the Langmuir model to equilibrium data. The adsorption kinetics of SDZ were analysed by separate tests and satisfactorily fitted by a first-order model.

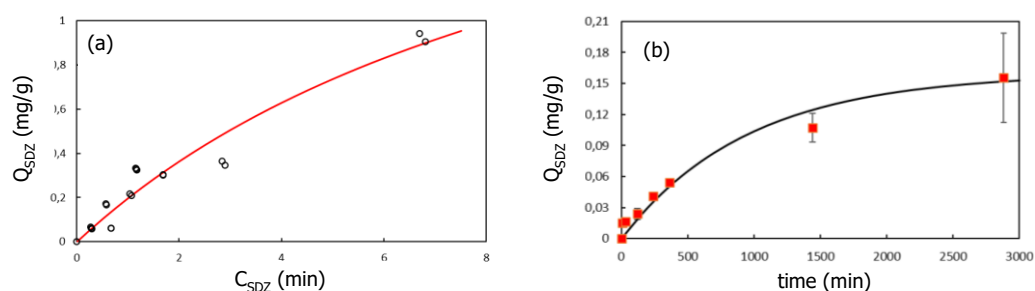


Figure 1 – SDZ adsorption isotherm (a) and temporal evolution of adsorbed SDZ (b) (red solid line in (a) is the curved predicted by Langmuir model; black solid line in (b) is the prediction of first-order model).

Finally, the simultaneous adsorption of As and SDZ onto the HC was investigated. To this purpose, adsorption tests were performed at varying initial concentrations of SDZ and As. This analysis showed that the adsorption of SDZ at concentrations larger than 600 mg/L decreases with increasing the As concentration to 2.5 mg/L.

References

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