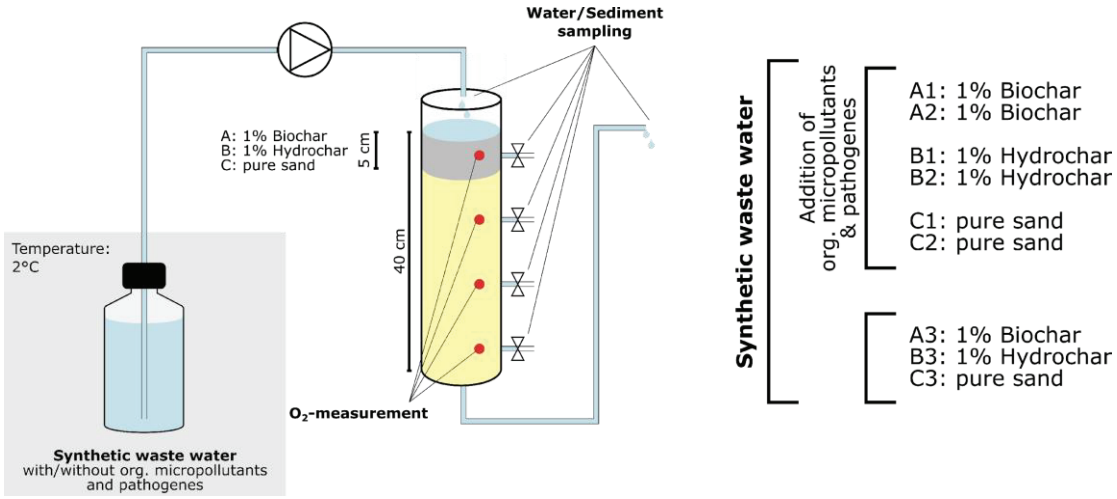
Hydrochar or Biochar Amendments to Increase the Retention of Organic Micropollutants and Pathogens in Managed Aquifer Recharge Systems (MAR)

U. E. Bollmann[1*], T. B. Bech[1], N. Vermaak[2], A. Magingi[3], S. Clarke[4], A. M. Smith[5], M. Gambino[6], and J. Aamand[1]

[1]Geological Survey of Denmark and Greenland (GEUS), Dep. of Geochemistry, Copenhagen, DK
[2]University of the Free State, Centre for Environmental Management, Bloemfontein, ZA
[3]Department for Water and Sanitation, Pretoria, ZA
[4]University of the Western Cape, Earth Science Dep., Bellville, ZA
[5]Aarhus University, Dep. of Biolog. and Chem. Engineering, Aarhus, DK
[6]Copenhagen University, Dep. of Veterinary and Animal Sciences, Frederiksberg, DK

ueb@geus.dk

Managed Aquifer Recharge (MAR) is a commonly used technique to improve water quality and to store water for later use in areas with precipitation seasonality, and it is a low-energy and low-cost water-recycling technology used worldwide (Dillon et al., 2019). The present study assessed the effects of a reactive barrier with 1% biochar or hydrochar on the leaching of organic micropollutants (22 pesticides and pharmaceuticals) and pathogens (S. Senftenberg, two model bacteriophages infecting E. coli) in laboratory column experiments (see figure below). The columns were run continuously for 4 months, and samples were analysed by HPLC-MS/MS and plate counting.
Biochar has a higher sorption capacity for most tested organic micropollutants than hydrochar and considerably higher than pure sand. Thus, the leaching of micropollutants was delayed in the amended columns compared to pure sand (biochar > hydrochar > sand). Degradation seemed slightly increased when hydrochar was used as a barrier compared to pure sand, while biochar did not affect the degradation efficiency. This is in accordance with a higher biological activity detected in the hydrochar amended columns compared to the biochar and sand columns.
Pathogen adhesion revealed strong adhesion of S. Senftenberg to all three materials, while the bacteriophages adhered most to biochar and limited adhesion was observed to hydrochar or sand. The leaching of the three pathogens was influenced by cell size, while the reactive barrier did not influence the leaching.



Experimental setup - 9 parallel columns with/without amendments and with/without feeding with organic micropollutants and pathogens

References

Dillon, P., et al. (2019). Sixty years of global progress in managed aquifer recharge. Hydrology Journal 27,1-30.