Desalination and Water Treatment
www.deswater.com

doi:10.5004/dwt.2018.22836

120 (2018) 88–108
July

Removal of micropollutants and nutrients in household wastewater using organic and inorganic sorbents

W. Zhang[a,*], K. Blum[b], M. Gros[c], L. Ahrens[c], H. Jernstedt[c], K. Wiberg[c], P.L. Andersson[b], B. Björlenius[d], G. Renman[a]

[a]*Department of Sustainable Development, Environmental Science and Engineering, KTH Royal Institute of Technology, Teknikringen 10B, SE-10044 Stockholm, Sweden, email: zhangw@kth.se (W. Zhang), gunno@kth.se (G. Renman)*
[b]*Department of Chemistry, Umeå University, Linnaeus väg 6, SE-90187 Umeå, Sweden, email: kristinblum89@gmail.com (K. Blum), patrik.andersson@umu.se (P.L. Andersson)*
[c]*Department of Aquatic Sciences and Assessment, Swedish University of Agricultural Sciences, Box 7050, SE-75007 Uppsala, Sweden, email: mgros@icra.cat (M. Gros), lutz.ahrens@slu.se (L. Ahrens), henrik.jernstedt@slu.se (H. Jernstedt), karin.wiberg@slu.se (K. Wiberg)*
[d]*Department of Biotechnology, KTH Royal Institute of Technology, AlbaNova University Centre, SE-10691 Stockholm, Sweden, email: berndtb@kth.se (B. Björlenius)*

Received 28 April 2018; Accepted 22 July 2018

ABSTRACT

The efficiency of five organic and five inorganic sorbents in removing 19 organic micropollutants (MPs), phosphorus, nitrogen, and dissolved organic carbon (DOC) was tested in a two-week column experiment using household wastewater spiked with pharmaceuticals (n = 6), biocides/pesticides (n = 4), organophosphates (n = 3), a fragrance, a UV-stablizer, a food additive,a rubber additive, a plasticizer and a surfactant. Two types of granular activated carbon (GAC), two types of lignite, a pine bark product, and five mineral-based sorbents were tested. All the organic sorbents except pine bark achieved better removal efficiencies of DOC (on average, 70 ± 27%) and MPs (93 ± 11%) than the inorganic materials (DOC: 44 ± 7% and MPs: 66 ± 38%). However, the organic sorbents (i.e. GAC and xyloid lignite) removed less phosphorus (46 ± 18%), while sorbents with a high calcium or iron content (i.e. Polonite® and lignite) generally removed phosphorus more efficiently (93 ± 3%). Ammonium-nitrogen was well removed by sorbents with a pH between 7 and 9, with an average removal of 87%, whereas lignite (pH 4) showed the lowest removal efficiency (50%). Some MPs were well removed by all sorbents (≥97%) including biocides (hexachlorobenzene, triclosan and terbutryn), organophosphates (tributylphosphate, tris-(1,3-dichloro-2-propyl)phosphate and triphenylphosphate) and one fragrance (galaxolide). The pesticide 2,6-dichlorobenzamide and the pharmaceutical diclofenac were poorly removed by the pine bark and inorganic sorbents (on average, 4%), while organic sorbents achieved high removal of these chemicals (87%).

Keywords: Micropollutants (MPs); Synthetic substances; Sorbents; On-site sewage facilities (OSSFs)

*Corresponding author.