

Polishing of pharmaceuticals in conventionally treated wastewater with intermittently fed Moving Bed Biofilm Reactors (MBBR)

Kai Tang

Department of Environmental Engineering, Technical University of Denmark, Denmark

Objectives As conventional wastewater treatment plants (WWTPs) are not able to remove many recalcitrant organic compounds (i.e. many pharmaceuticals), these compounds are found in effluents, which thus might cause damage to aquatic ecosystems.

Moving bed biofilm reactor (MBBR) is an approach that has been developed with focus on nitrogen removal since the 1980s and consists of a tank filled with plastic carriers attached by biofilm, which move freely and utilize the whole tank volume for biomass growth. Previous studies have demonstrated that MBBR has the ability of higher removals of pharmaceuticals than activated sludge (Falås et al. (2012); Escola-Casas et al. (2015)).

In this study, a MBBR system was used to treat the effluent of an activated sludge WWTP for pharmaceuticals. The biofilm would have little organic matter to sustain growth. To increase the amount of biomass the MBBR reactors were rotated between polishing effluent and intermittently being fed with a very low flow of raw wastewater. The approach is described in the Swedish patent application 1650321-1.

Methods For estimating the capacity of pharmaceuticals degradation each reactor was spiked with a mixture of pharmaceuticals in a batch experiment without water flow. Samples were taken from reactors over time. For actual removal of pharmaceuticals, samples were taken from in and outlet of reactors without spiking following the hydraulic retention time.

Main results The performance of intermittent loaded MBBR reactors led to more effective biofilm for degradation of pharmaceuticals. Removals of the majority of pharmaceuticals were enhanced through intermittent feeding of MBBR reactors intermittently. Rate constants normalized with biomass of pharmaceuticals were significantly higher compared to other studies on activated sludge and suspended biofilm. Especially for Diclofenac, Metoprolol and Atenolol. The effect of increasing of HRT on removal of pharmaceuticals was compound specific.

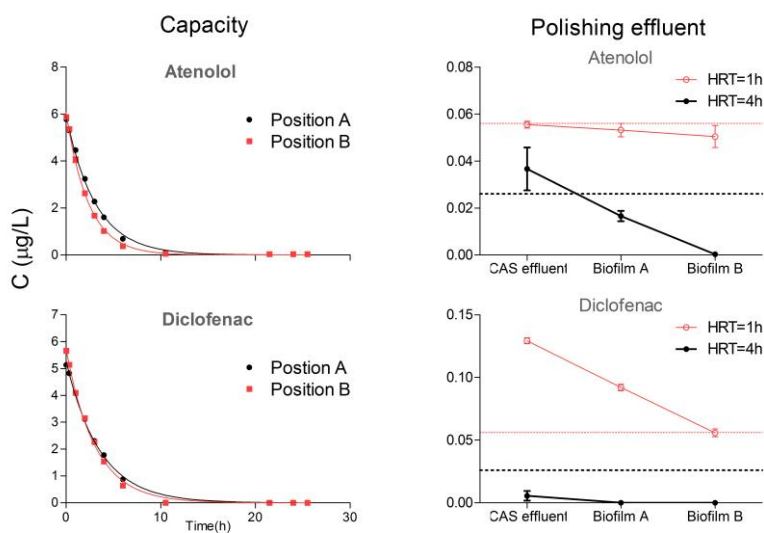


Figure 1. First-order kinetics fitting of concentration plots of pharmaceuticals in batch experiment (at left) and Comparison of pharmaceuticals in continuous experiments with different Hydraulic retention time (at right).

References:

- Escola-Casas, M., Chhetri, R.K., Ooi, G., Hansen, K.M.S., Litty, K., Christensson, M., Kragelund, C., Andersen, H.R., Bester, K., (2015), Biodegradation of pharmaceuticals in hospital wastewater by staged Moving Bed Biofilm Reactors (MBBR). *Water Research*, **83**, 293-302.
- Falås, P., Baillon-Dhumez, A., Andersen, H.R., Ledin, A., la Cour Jansen, J., (2012), Suspended biofilm carrier and activated sludge removal of acidic pharmaceuticals. *Water Research*, **46**(4), 1167–1175.)