Reengineering Biological Oxygen-Dosed Activated Carbon (BODAC) Filters as A New Approach for Micropollutant Removal

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Motivation

Biological Activated Carbon (BAC) is a water treatment process where adsorption onto activated carbon, desorption and biodegradation occur simultaneously (Fig. 1), resulting in longevity of the carbon bed[1,2]. Full-scale BAC filters dosed with oxygen (O_2), referred to as BODAC, are operated in the Puurwaterfabriek (Emmen, the Netherlands). These filters remove foulants before reverse osmosis (RO) membranes, producing ultra-pure water for industrial purposes. These BODAC filters are operated for 10 years without the need for thermal or chemical carbon regeneration and replacement. Recent studies showed that the BODAC filters are also able to remove micropollutants. The Dutch water authorities have recognised that micropollutants, such as medicine residues, are increasing problems in water[3]. However, the underlying mechanisms of micropollutant removal by BODAC filters are not entirely understood. This is essential for the development of a BODAC system optimised for micropollutant removal from WWTP effluent.

Technological challenge

- Different aspects have to be considered in the translation of the BODAC technology for ultrapure water production as a technology optimised for micropollutant removal at WWTPs throughout the Netherlands, such as the different water characters, carbon types and influent microbial.
- Generally, a little is known on the application of BAC filters as a stand-alone tertiary treatment for micropollutant removal[4]. This study will assess the performance of BODAC with or without pre- and post- treatments.
- Analytical challenges associated with the detection and quantification of micropollutants at low concentrations.

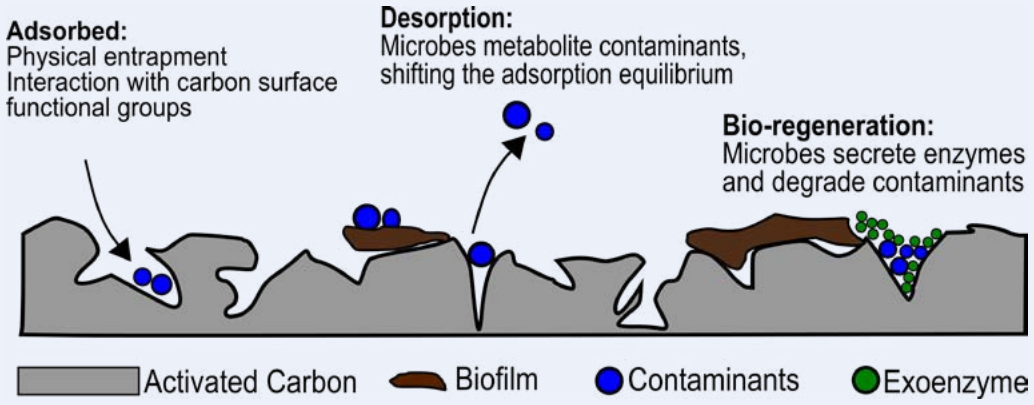

Fig 1. Schematic illustration of micropollutant interactions on BAC.

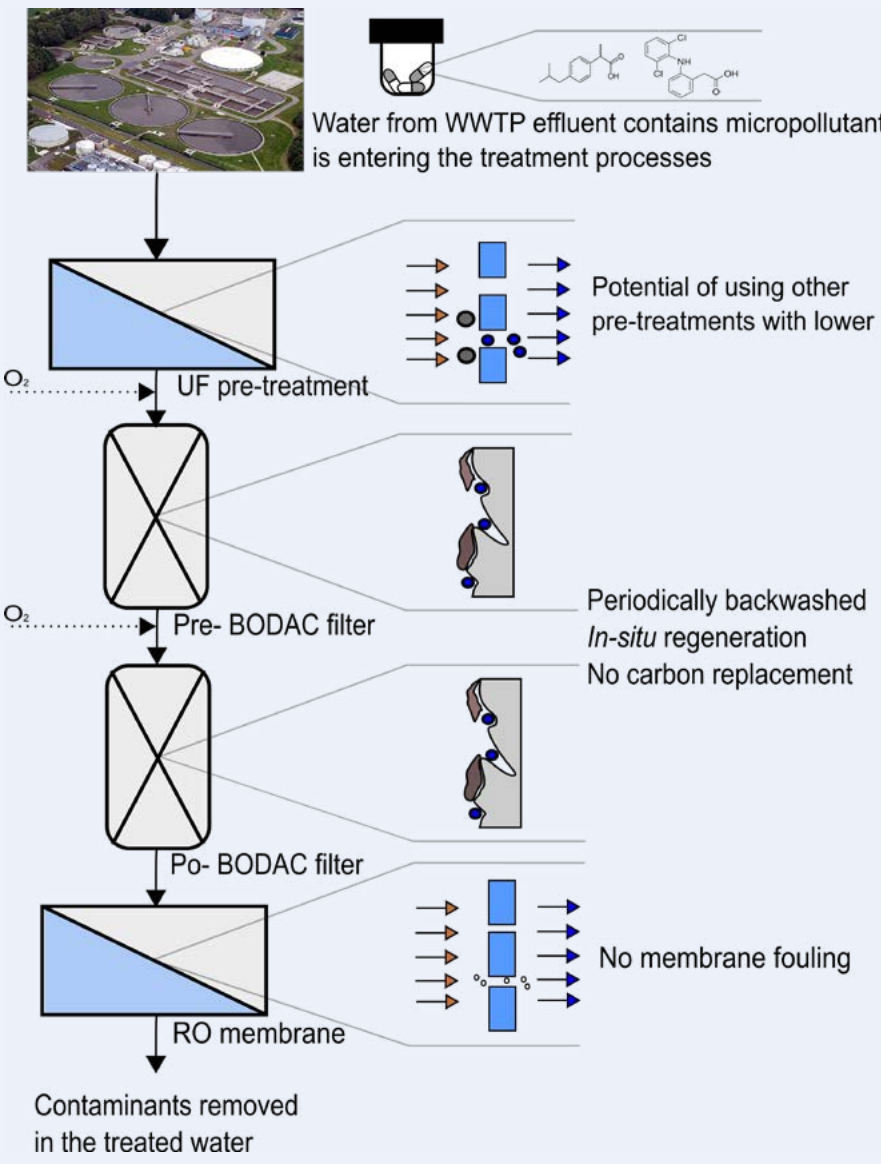

Fig 2. Graphical abstract: diagram of the current treatment processes.

Research goals

Fundamentals of micropollutant removal in BODAC filters

To understand the underlying mechanisms (adsorption, desorption and biodegradation)

Effects of operational parameters

To improve the treatment efficiency (higher loading rate and lower O_2 dosage)

BODAC Filters to Remove Micropollutants

Pre- and post-treatments

To evaluate the roles of additional treatment steps accompanying the BODAC filters

Pilot-scale testing

To assess the cost and environment impact of BODAC for micropollutant removal from WWTP effluent

Fig 3. Research goals.

References

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