Motivation

Biological Activated Carbon (BAC) is a water purification process that combines physical adsorption onto granular activated carbon (AC) and biodegradation to remove pollutants (Fig 1). The technology is eco-friendly and cost-effective, since the biodegradation helps to prevent the saturation and replacement of the AC. BAC is an established process in drinking water treatment\[1\], however, BAC also has potential for wastewater reclamation\[2,3\]. At the Puurwaterfabriek (Emmen, the Netherlands), ultrafiltration (UF), BAC Pre-filter (O2BAC PrF) and BAC Polishing Filter (O2BAC PoF), and Reserve Osmosis (RO) are subsequently applied to produce ultrapure water from the effluent of a wastewater treatment plant\[4\]. This ultrapure water plant has been in operation for over 9 years without the need to replace the AC and RO membranes, although in literature, BAC is associated with downstream fouling\[5\]. This research aims to understand how UF and BAC can prevent downstream fouling.

Technological challenge

The BAC filters at the Puurwaterfabriek are unique as they are oxygenated and periodically back-flushed. The challenge is to investigate possible synergy between the biotic and abiotic processes contributing to the removal of fouling precursors, and to establish how these processes depend on the BAC operation and design.

Research goals

- Analysing the fouling precursors removal by mass balances over the UF unit and BAC filters
- Improve the operation and design of UF and BAC filters for fouling prevention
- Assessing the effect of pure oxygen on the AC surface, growth, and biotic and abiotic oxidation of organic matter
- Describing the processes in a simple mathematical model
- Obtaining the interdependency of the removal processes and their dependency on the operational parameters

Fig 1. Activated carbon granule covered by a microbial biofilm[6].