AMSTERDAM INTERNATIONAL WATER WEEK

Abstract Title	AdOx – a next-generation adsorption-oxidation process for the removal of organic micropollutants from municipal wastewater
Topic	**X** Improving water quality O Resilient water systems O Circular solutions: Reuse, Recover and Recycle O Transitions in water, agro/food and energy
Challenges and Solutions	How to remove organic micropollutants (OMPS) from municipal wastewater efficiently? These OMPs come in a low concentration (µg/L) and it is expensive to remove them from the mainstream of wastewater effluent. Our solution is to collect and concentrate the OMPs using adsorption and oxidize them in the sidestream. AdOx uses a novel adsorbent, high-silica zeolite granules, which has the similar range of pore sizes as the OMPs, in a reactor. The OMPs attached in the pores of the granules will then be oxidized using gaseous ozone after the reactor is drained and partially dried. This process limits the adsorption and oxidation of natural organic matters (NOMs) and is competitive with other, conventional treatment alternatives.
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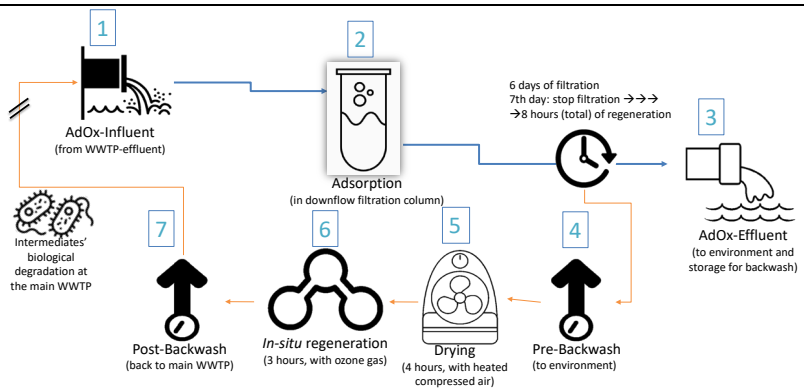
Abstract	Adsorption-Oxidation (AdOx) treatment is a new technology for the removal of organic micropollutants (OMPs), such as traces of pharmaceuticals and hygiene products, from wastewater treatment plant (WWTP-) effluent. These OMPs are present in low concentrations, but the accumulation is harmful for aquatic life in receiving surface water bodies and affects the quality of drinking water intake sources. AdOx uses high-silica zeolite granules as a novel adsorbent to trap and concentrate the OMPs, in a packed-bed down-flow reactor [1]. The frequently-scheduled *in-situ* regeneration is performed by injecting ozone gas into the drained- and partially dried-bed reactor to oxidize the adsorbed OMPs. This process enables long-term adsorbent utilization in a sustainable way, without producing harmful by-products, such as bromate. Figure 1 shows the process steps. The results from the lab adsorption experiments, both in batch and column, have shown that an average removal of OMPs of 80 – 85% were reached using various empty bed contact times (EBCT) from 6 to 20 min [2] [3] [4] [5] [6]. The complete *in-situ* regeneration using ozone gas injection into the dried-bed reactor has also been validated in the lab [7] [8] [9]. Figure 2 depicts the results of six adsorption-regeneration cycles with an EBCT of 20 minutes and 6 hours of ozone gas injection using a concentration of 90 mg/L. [9]. Afterwards AdOx has been scaled-up into a pilot plant, based on promising feasibility study results for full-scale application [10]. It was designed using an EBCT of 10 min, taken as an average value from the lab experiments, and 3 h of gaseous ozone injection with a concentration range of 90-100 mg/L. The pilot plant integrates filtration and regeneration in a complete 1-week cycle, with 7 d of filtration and 8 h of the total regeneration time. It has been operated at WWTP Leiden-Noord under *Hoogheemraadschap van Rijnland* and takes its water from the secondary clarifier's effluent. In order to ensure that the removal capacity remains after long-term use, having strong and wear-resistant zeolite grains, is a key factor. The grain formation was carried out

	together with a zeolite producer as a partner company using the extrusion method. The trial granules are also being tested in the pilot plant. The results of the pilot plant, to be presented at AIWW , will give insights for full-scale demonstration/implementation and possibilities for optimization, both from the process steps and the granule development.
Figures/diagrams/illustrations	 *Figure 1 AdOx process steps*

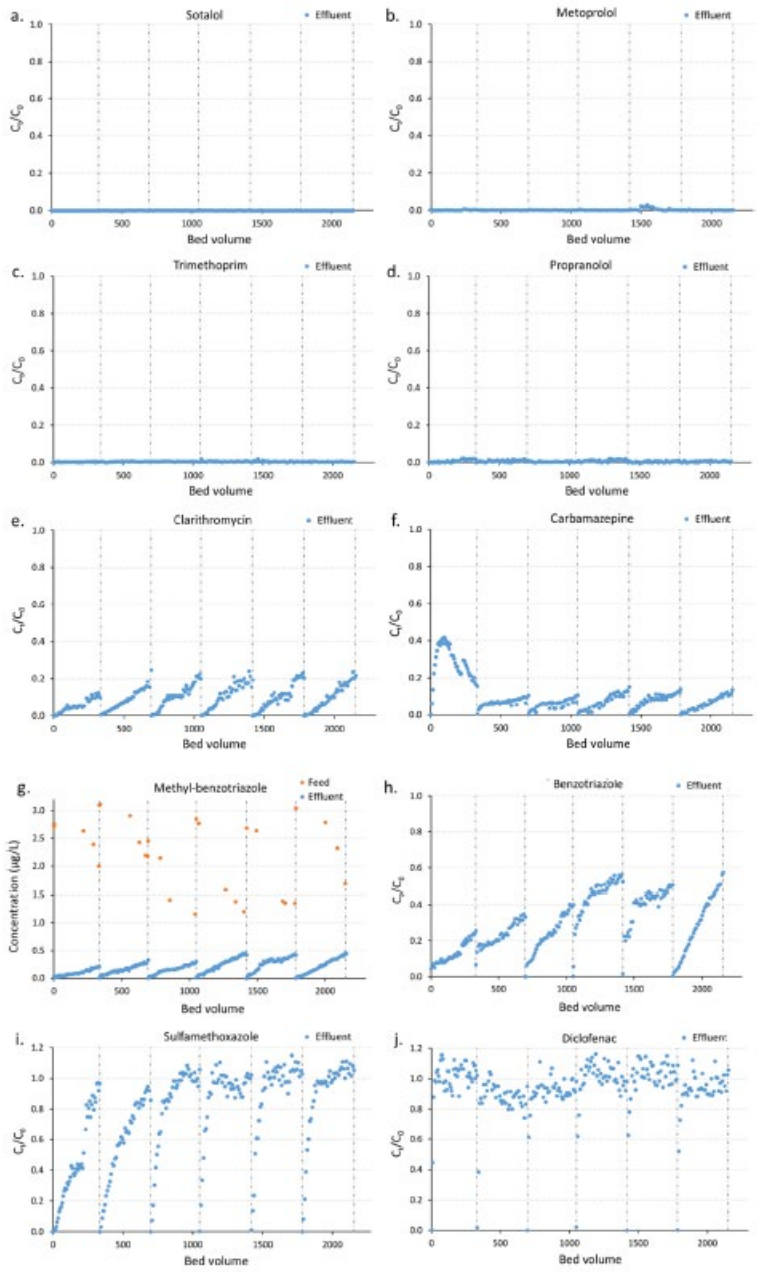


Figure 2 (a-j) . Adsorption breakthrough curves of OMPs in six cycles [9]

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