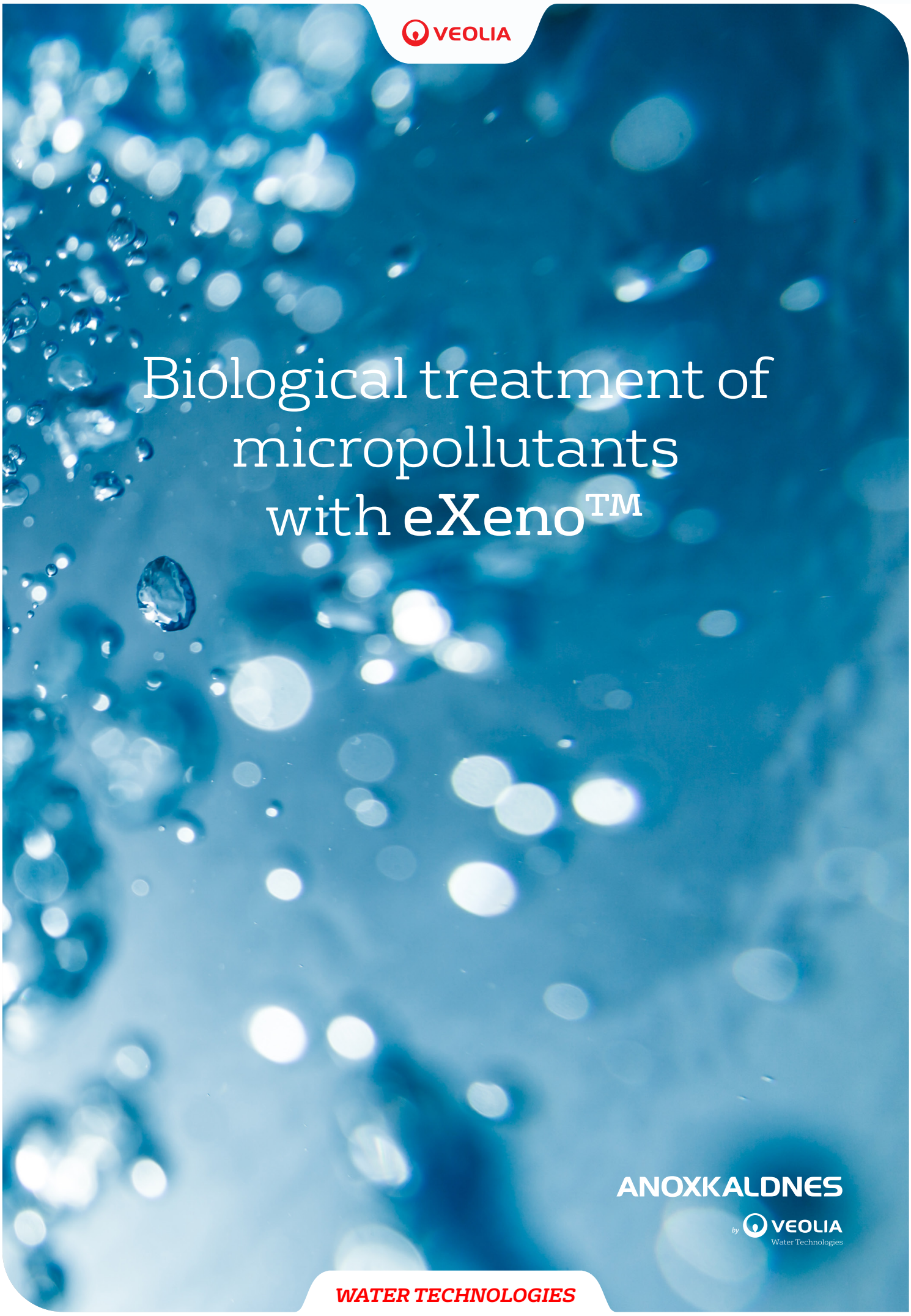

VEOLIA
Biological treatment of micropollutants with eXeno™
ANOXKALDNES
by VEOLIA
Water Technologies
WATER TECHNOLOGIES

Biological treatment of micropollutants

Micropollutants such as pharmaceuticals, personal care products or industrial chemical compounds are a large class of pollutants sometimes referred to as emerging contaminants which are typically difficult to degrade compounds.
The growing risk that these compounds find their way into our water supply system and additionally, the increasing spread of antibiotic resistance genes into the environment, places growing importance on the removal of antibiotics and other difficult compounds from both industry and municipalities.

The major sources of pharmaceuticals and other difficult compounds in wastewater are:

- Household consumption of medicines
- Chemical industries
- Hospitals

The biggest contribution of pharmaceuticals into municipal wastewater treatment plant comes from the daily consumption of pharmaceuticals in the household. Medications taken at home leave our bodies and make their way to the local municipal wastewater treatment plant where, if left untreated, they will begin to accumulate.

Chemical industries and hospitals (i.e. medication, x-ray contrast media, chemotherapy treatment) also contribute to the accumulation of micropollutants at our municipal wastewater treatment plants. All rely on the municipality to treat the effluent that is leaving their facilities.

An AnoxKaldnes micropollutant solution

eXeno™ is a technology-based on AnoxKaldnes™ MBBR (Moving Bed Biofilm Reactor) for the biological removal of drug and other complex compound residuals in wastewater. The technology is effective, economical and environmentally friendly.

The MBBR technology relies on microorganisms, as bacteria, growing on plastic carriers which are retained in the reactor. MBBR technology allows the development of biomass with significantly longer sludge retention times (SRT) compared to conventional systems. This encourages the development of slower growing organisms capable of removing difficult compounds.

eXeno™ MBBR technology typically involves multiple reactors in series where the microorganisms can be specialized to target the wide variety of complex compounds. In the first stages, more easily degradable compounds will be removed while the more difficult compounds are removed in the succeeding reactors. The low load condition allows the development of specific microorganisms capable of degrading the more complex compounds.

Development of intelligent bacteria in eXeno™

Bacteria removing easy degradable compounds

Bacteria removing medium degradable compounds

Bacteria removing difficult degradable compounds

eXeno™ benefits

Effective

High removal (50-80%) of difficult degradable pharmaceuticals

Economical

Using more bacteria and less ozone and/or activated carbon, the cost of energy and chemical usage is reduced

Environmentally friendly

Avoiding the release of by-products typical of advanced treatment reduced

Proven technology with broad application

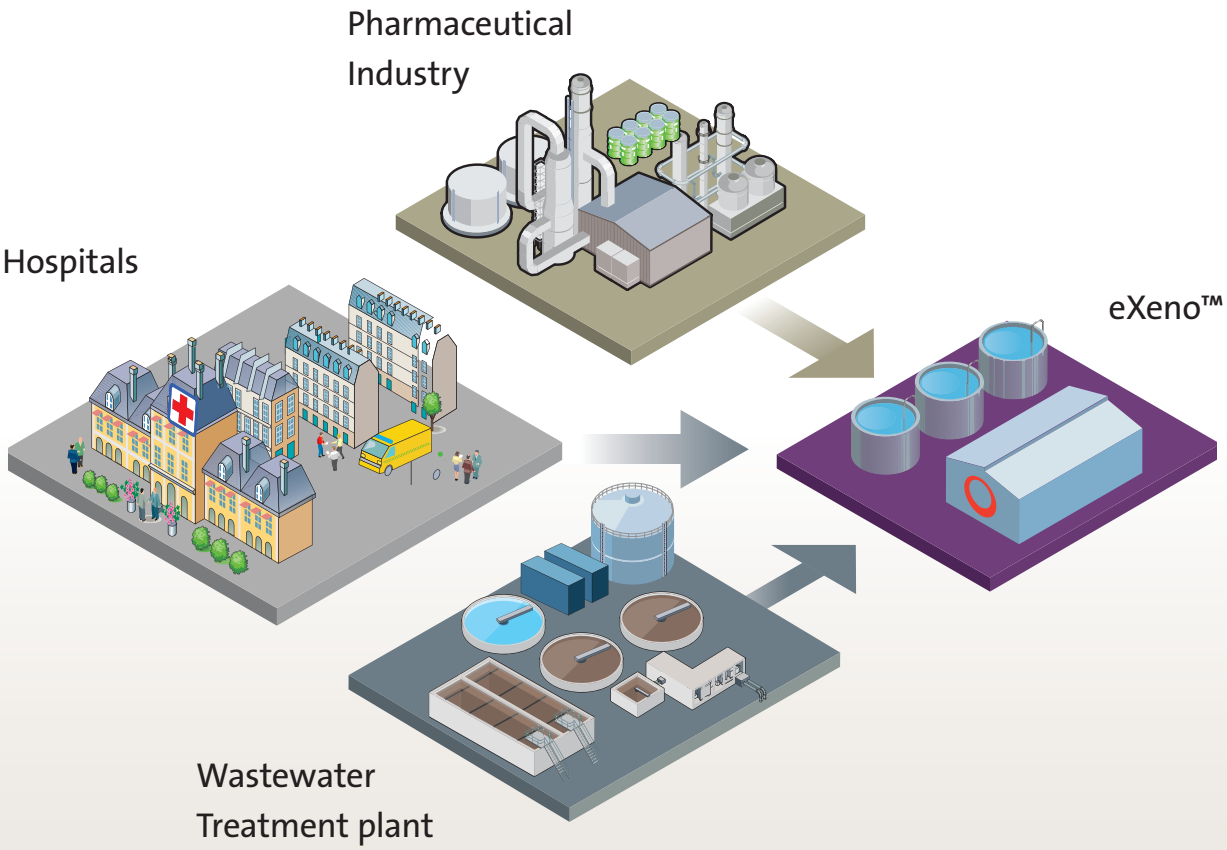
eXeno™ is based on more than 30 years of experience of AnoxKaldnes in wastewater treatment of pharmaceutical production. With more than 25 references worldwide within the pharmaceutical industry, AnoxKaldnes has gained the expertise for treating these complex compounds. eXeno™ technologies ranges from complete treatment of pharmaceutical/industrial wastewater and hospital wastewater to tertiary solutions for municipal applications.

eXeno™-P and eXeno™-H are typically full treatment systems including carbon and nitrogen removal in addition to pharmaceutical treatment.

eXeno™-M for municipal wastewater is the newly launched patented solution for post-treatment of municipal treatment plant for removal of drug residual due in anticipation of upcoming regulations.

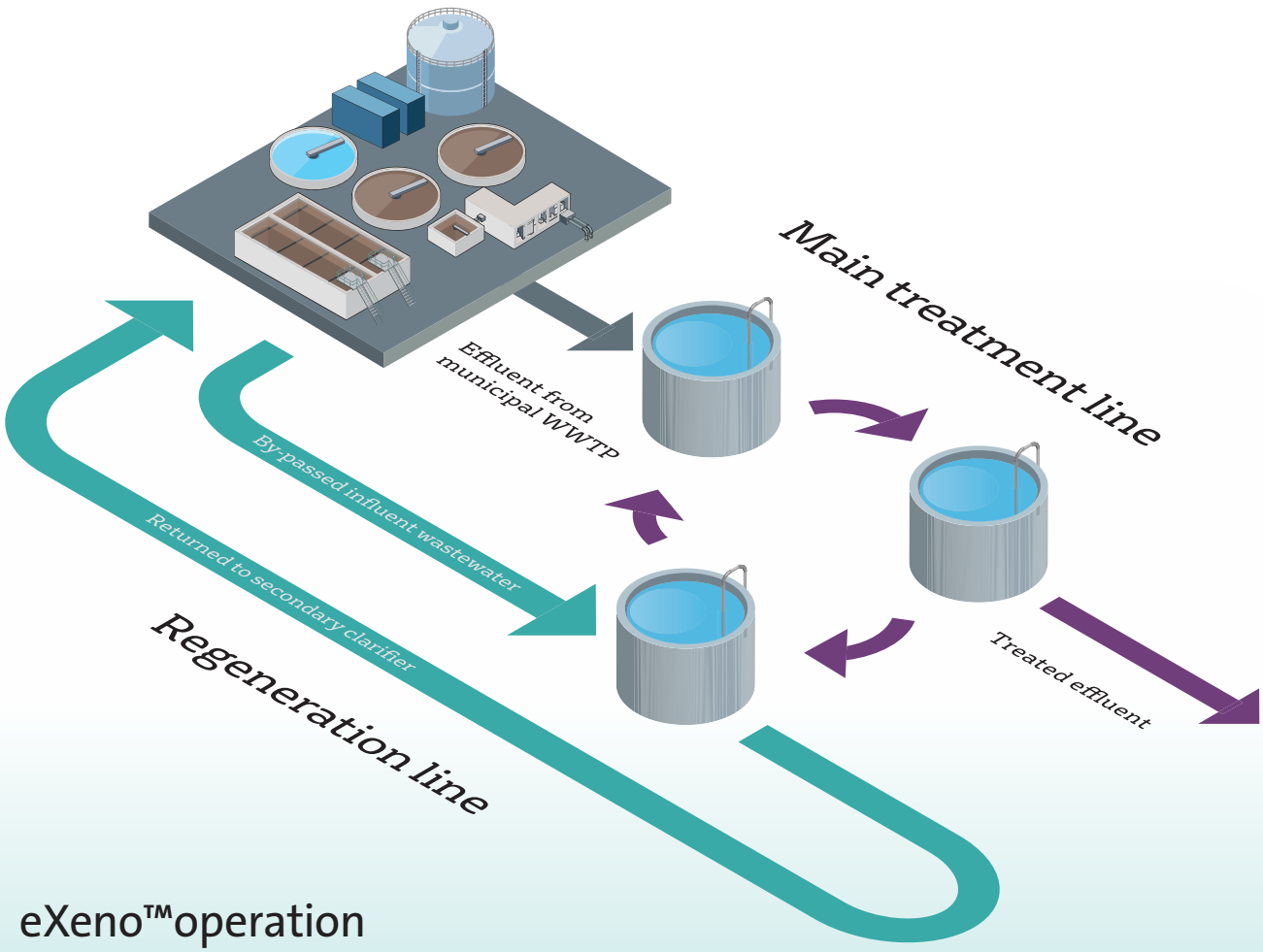
Treatment systems

Pharmaceutical = eXeno™-P
Hospital = eXeno™-H
Municipal = eXeno™-M



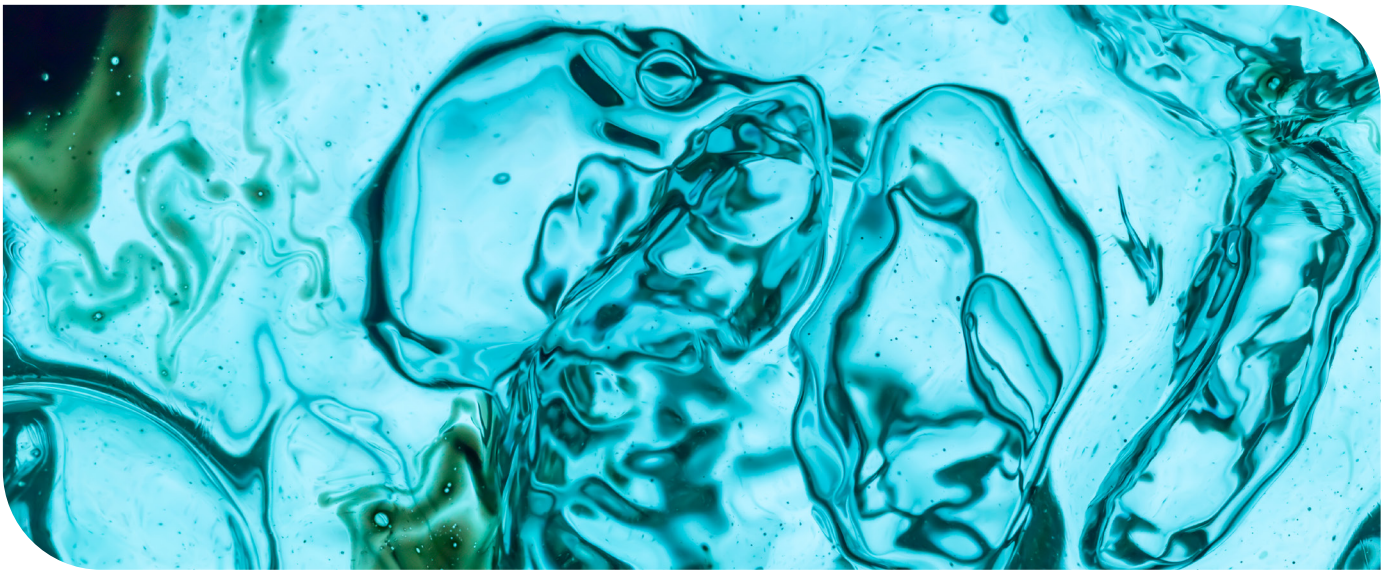
Patented technology for post treatment of municipal wastewater

For post-treatment of municipal wastewater, eXeno™-M is based on a cyclic operation of 3 MBBR reactors. Effluent wastewater from a municipal wastewater treatment plant is continuously treated in a main treatment line consisting of 2 MBBR reactors in series. Intermittently, one of the 2 reactors is taken offline and moved into a regeneration phase where it is exposed to higher loads (e.g. influent wastewater). The reactor that was in regeneration phase is put back in service as reactor 1 in the main line. Intermittent exposure to higher loads allows for more biomass growth and promotes biodiversity.



eXeno™operation

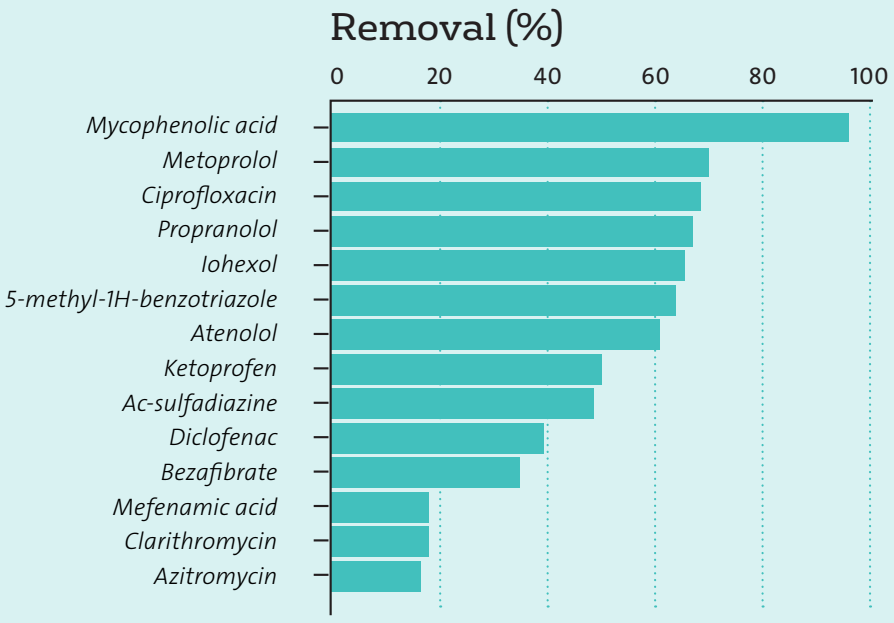
- Regeneration phase every 6-48 hours.
- 5-20% of WWTP influent flow by-passed to regeneration line.
- Intermittent aeration allows for nitrification and denitrification in the regeneration line for effluent to be returned in secondary clarification.



Eliminating a broad range of compounds

More than 30 pharmaceuticals and other difficult substances were intensely studied in three different eXeno™-M pilot studies. Degradation tests indicated removal of the substances ranging between 20 - 100% with reaction rates much higher when compared to other biological systems.

Pharmaceuticals known to be highly recalcitrant like iohexol, a common contrast agent for X-ray and and generally not biodegradable by activated sludge, was removed up to 70%. Diclofenac, an anti-inflammatory drug raising high interest for its toxic effects to the environment, can be removed in eXeno™-M up to 40%.



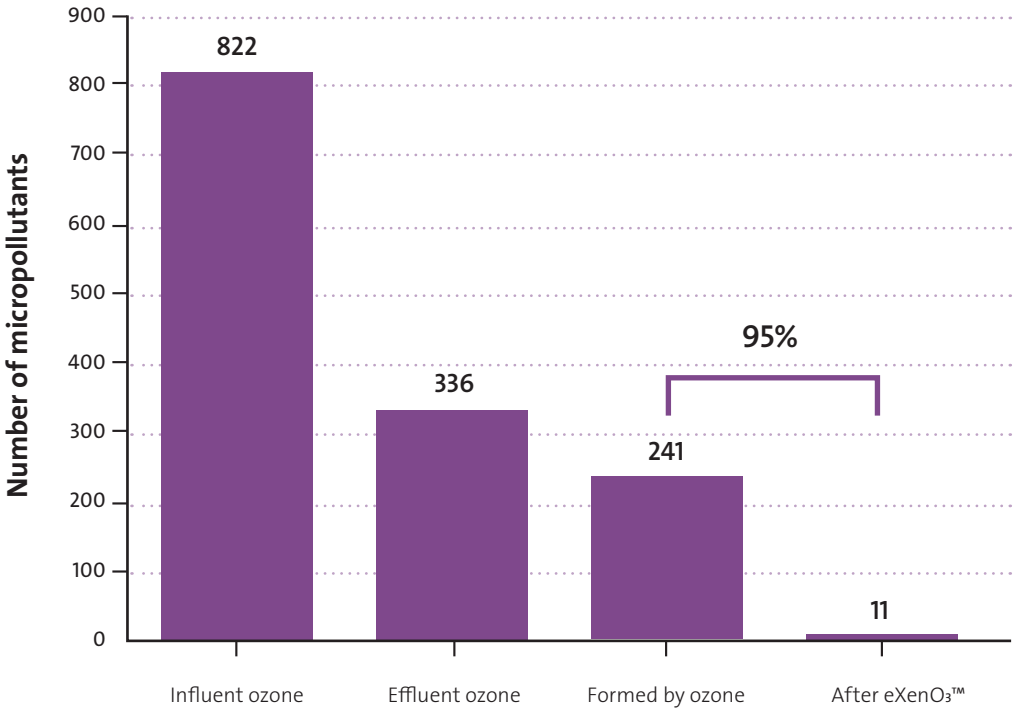
Indicator compounds and their maximum expected removal with eXeno™-M

Combining eXeno™ and ozone for efficient polishing

Biological removal of drug residue is an effective and environmentally friendly process. By optimizing the biological degradation it is possible to limit the consumption of chemicals such ozonation or the use of expensive physical processes such as activated carbon.
However, some of the existing micropollutants found in wastewater can have low biodegradability and therefore the combination of different removal process can be necessary. eXenO₃™ combines biological degradation with the efficiency of oxidation. eXenO₃™ can be combined as a biological pre-treatment to ozonation to decrease the ozone dosage which results in both capex and opex savings. In addition the process of ozonation produces by-products that are themselves toxic and need to be treated. eXeno™ is also an efficient post-treatment to remove by-products from ozonated water.

Results from full-scale installations show 95% removal of by-products formed by ozone treatment, as shown in the figure below.

Results from full-scale installation



** Itzel et al. 2019. Evaluation of a biological post-treatment after full-scale ozonation at a municipal wastewater treatment plant.*

Can eXeno™ solve your challenges?

To identify treatability with eXeno™ we offer bench-scale testing in our accredited Lab at AnoxKaldnes headquarter in Lund, Sweden.

Resourcing the world

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