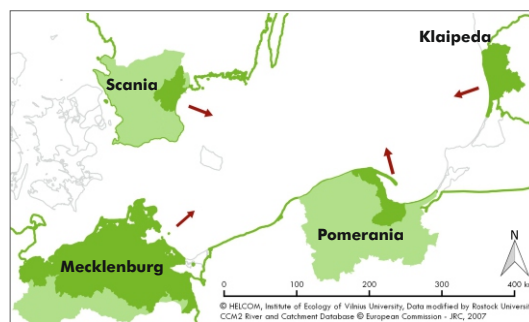


MORPHEUS – Policy Brief No. 2

Overview of advanced technologies in wastewater treatment for removal of pharmaceuticals and other micropollutants

Background and aim – MORPHEUS

The aim of MORPHEUS is to support actions in reducing the constant release of pharmaceutical substances via WWTPs to the South Baltic Sea. Therefore, MORPHEUS integrates information on pharmaceutical consumption, existing technologies and release rates of selected WWTPs as well as environmental occurrence downstream in the coastal regions Mecklenburg (Germany), Skåne (Sweden), Pomerania (Poland) and Klaipeda (Lithuania). This information can aid wastewater treatment utilities and authorities in a future implementation of a suitable advanced treatment technology.



Pharmaceuticals and other micropollutants (MPs) - key issues to know before implementing advanced treatment technology

Over 30,000 different chemical substances are in daily use (e.g. human and veterinary pharmaceuticals, plant protection products, biocides, personal care products, household chemicals and detergents) and it tends to increase. The effectiveness of conventional WWTPs ability to remove MPs vary largely, thus some MPs may go through the treatment process unchanged and finally end up in the surrounding water bodies (receivers). Most EU countries are convinced that the presence of MPs in the environment poses a serious problem for the aquatic life and for humans (causing e.g. hormonal changes or antimicrobial resistance). However, there is currently a lack of EU recommendation on WWTP effluent standards for many MPs including pharmaceuticals. In addition, the 'polluter pays' principle is very complex in terms of MPs since it is unclear who the polluter is, e.g. chemical producers, the pharmaceutical sector, hospitals or the consumer groups. Therefore, two approaches need to be developed simultaneously (see Figure 1): (1) the substitution of the production of critical MPs and usage (source and user measures) and (2) the mitigation of the dissemination of MPs by WWTPs (end-of-pipe measures). Since pharmaceuticals are rather essential in our healthcare systems and cannot be fully replaced with harmless alternatives, end-of-pipe technologies seem to be an essential part of the solution.

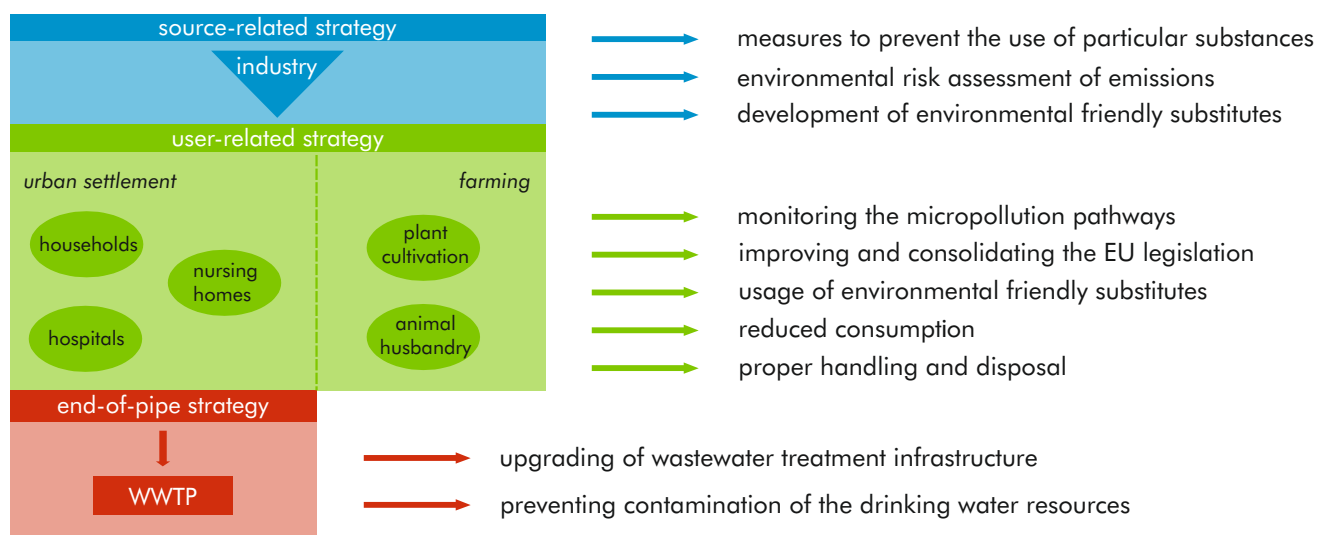


Figure 1. Strategies required to reduce the release of pharmaceuticals, antibiotics, hormones and other MPs to the aquatic environment

There are no requirements to remove pharmaceuticals from wastewater within the EU, but there is a need, posed by the European Commission and other organizations, to monitor them, to develop methods, and to investigate the feasibility of upgrading selected urban WWTPs with advanced treatment to eliminate a broad range of MPs at reasonable costs.

Strategy for pharmaceuticals and other micropollutants removal from wastewater in: Switzerland, Germany, Sweden, Poland and Lithuania

Switzerland as an up-stream country, in 2016 (first in Europe) introduced a legal basis for implementation of advanced treatment technologies in wastewater treatment: about 100 out of the total 700 WWTPs are going to be extended or upgraded by 2040. Aims: the elimination of indicator MPs (e.g. pharmaceuticals) to 80% in wastewater treatment and to treat 50% of the total wastewater volume generated in Switzerland.

In **Germany**, there are as yet, no legal requirements for the application of technologies to remove MPs. The national micropollutant strategy is currently in the consulting phase. However, some federal states, in particular North Rhine Westphalia and Baden-Württemberg, have already equipped several WWTPs with advanced treatment (voluntary basis).

In **Sweden**, the government has already funded several projects related to MPs (mainly pharmaceuticals) removal from wastewater. Currently, the knowledge and operating experiences of various technical solutions are complete and available as a foundation for a full-scale introduction of advanced treatment technologies.

In **Poland and Lithuania** there is neither a legal basis nor other documents related to monitoring and/or the removal of pharmaceuticals from wastewater. However, both countries are introducing national regulations imposing the need to assess priority substances.

Advanced wastewater treatment technologies suggested for pharmaceuticals and other micropollutants removal

Various technical solutions are available and have proved to be effective in MP removal with possible integration with existing treatment processes in an expedient manner. The solutions that have been evaluated are mainly based on activated carbon and/or advanced oxidation processes like ozonation and various combinations thereof. [Limitations of each method are widely discussed in Del. 5.2 of the MORPHEUS project \(for details see \[www.morpheus-project.eu/downloads\]\(http://www.morpheus-project.eu/downloads\)\)](#). Some examples of full scale implementations are given in Figure 2a and 2b.

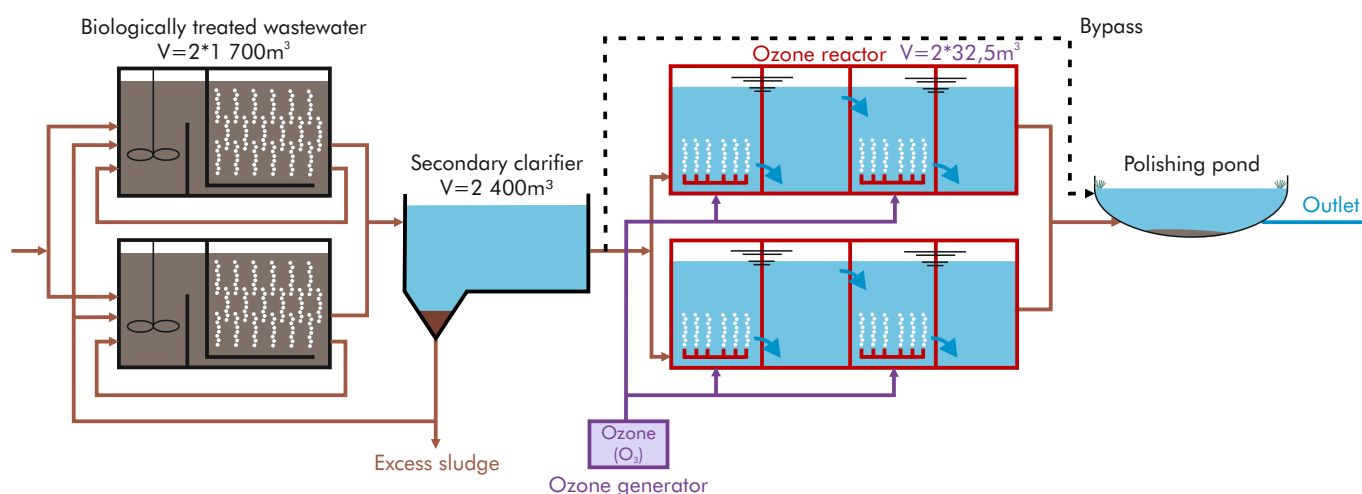


Figure 2a. Scheme of the ozonation system at WWTP Bad Sassendorf in Lippeverband, Germany

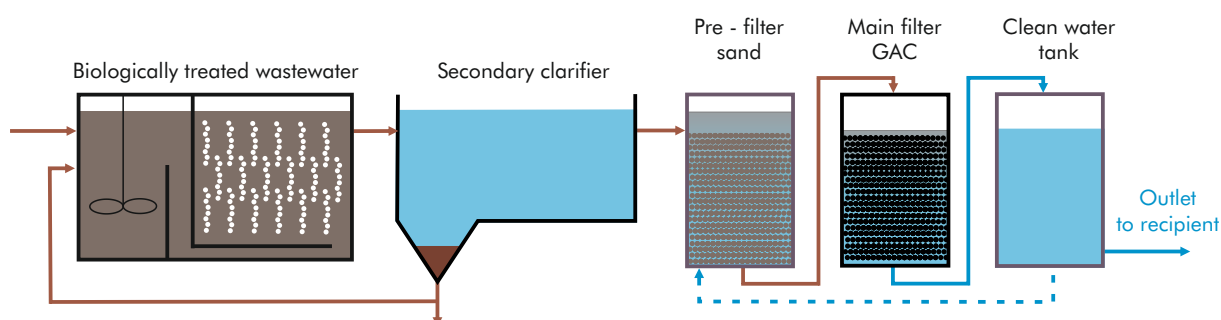


Figure 2b. Scheme of the granulated activated carbon (GAC) filter-system at Kristianstad WWTP, Sweden