SFC Umwelttechnik
clean water for the world

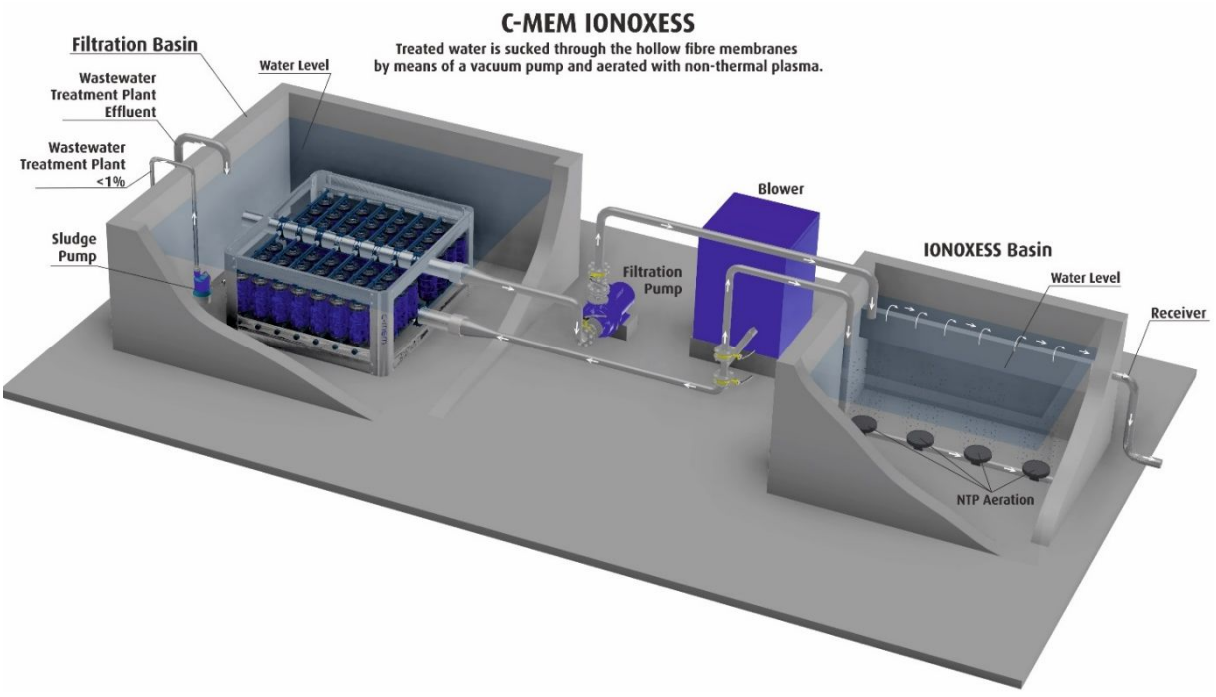
SFC Umwelttechnik GmbH
A-5020 Salzburg Austria
Julius-Welser-Straße 15

T +43 662 43 49 02
F +43 662 43 49 02-8
office@sfcu.at
http://www.sfcu.at

POST-TREATMENT OF WWTP EFFLUENT FOR THE REMOVAL OF ANTHROPOGENIC TRACE SUBSTANCES

C-ION

COMBINATION OF MEMBRANE AND PLASMA TECHNOLOGY



1. GENERAL

Anthropogenic trace substances are chemical compounds produced by man, which occur in all sectors of life and mostly serve the standards of a modern industrial society.
Through improved methods of chemical analysis it has been possible for some time to measure these trace substances in natural water cycles and document their impacts on the environment. Especially compounds with expectable effects on mankind and environment belong to these trace substances.

Four groups of effects[1] can be classified exemplarily:

- substances with hormone-like effects (e.g. contraceptives)
- substances with genotoxic effects (e.g. chemotherapy drugs)
- substances with immunotoxic effects (e.g. chemical substances that impair the immune system)
- substances with anti-infective effects (e.g. antibiotics)

Through human activities and human sewage these trace substances enter the municipal wastewater systems and finally get into surface waters via wastewater treatment plant effluents. From the surface waters they can also get into ground and drinking water.
Besides, multi-resistant pathogens and microplastics are a serious problem in the effluent of wastewater treatment plants and hence in nature. In many countries this problem becomes ever more topical and for this reason wastewater treatment plants are equipped with post-treatment facilities.
All these substances have in common that they cannot be removed sufficiently with the wastewater treatment technologies that are currently available.

2. OUR SOLUTION

SFC Umwelttechnik GmbH offers a most economic post-treatment step, based on a process combination of filtration (C-MEM™) and destruction of these substances with non-thermic plasma (ionOXess). The combined process step is called C-ION.

The usage of non-thermal plasma (NTP) is a very new method for oxidizing several inorganic and organic compounds. In general, this plasma can be formed via ionising radiation (natural and cosmic radiation), electrical glow discharge (lightning) and UV-radiation, respectively. The ion*OX*ess technology is based on the electrical glow discharge to form mainly negatively charged oxygen radicals. Thereby highly reactive small ions are formed, which are stabilized via cluster formation. Thus, their life span is long enough to bring them into the treatment unit for further reaction. For oxidation purposes mainly negatively charged oxygen ions are involved in this process.

Mainly formed compounds in water are super oxide radical anions (in an excited state) which dissociate to oxygen radical anions:

$$e^- + O_2\left(^3\Sigma_g^-\right) \longrightarrow O_2^{\bullet -}\left(^2\Pi_u\right) \qquad \text{and}$$

$$O_2^{\bullet -} \longrightarrow O^{\bullet -} + O$$

Due to the very high oxidation potential (2 V and higher, comparable to ozone), these radicals are able to oxidize most organic compounds (via proton transfer or hydrogen atom transfer). Compared to ozone much less ionization energy is necessary, and the elaborate pre-treatment of air as well as the destruction of the remainder ozone can be omitted.

3. PROCESS DESCRIPTION

The innovative process consists of 2 main steps:

C-MEM™ ultrafiltration

In a first step the effluent of the wastewater treatment plant is directly treated with the C-MEM technology, whereby suspended solids, turbidity, microplastics and micro-organisms (pathogens) are removed in one process step. The filter consists of a membrane with an average pore size of only 20 nm. Hence, C-MEM functions as a physical barrier and safely separates the contaminations mentioned above.

Through this step a part of the trace substances, which are adsorbed at particles, is also separated, which improves the subsequent destruction of the dissolved trace substances.

Minimum residues in the filtration tank are sucked away from the tank bottom and are then returned into the wastewater treatment plant and removed via sludge disposal from the system respectively.

ionOXess destruction of dissolved trace substances

In the following oxidation step the basin is flowed through in free fall and aerated with non-thermic plasma (NTP), which destroys the dissolved trace substances or splits them into subcomponents that are easily biologically degradable in the receiver. Usually, additional treatment is not necessary any more then.

The modular system of the process is suitable for all construction sizes of existing and new wastewater treatment plants.

4. ADVANTAGES

The main advantages of the combination of ***C-MEM™*** und ***ionOXess*** are as follows:

- much lower energy demand than conventional ozone and filtration treatment
- no inflow air treatment required, no ozone destructor necessary
- no active carbon required, thus lower operating costs
- complete removal of suspended solids, bacteria and viruses (membrane barrier)
- reduction of other organic pollutants (NH_4, COD, pesticides, herbicides)
- small footprint
- modularly expandable
- easy installation and start-up
- start-up/stops of operation possible
- long lifetime of equipment, cheap and easy replacement
- no additional chemicals necessary
- robust process, no fine mechanical parts

5. CASE STUDY

The effectiveness and the practical application of the process were tested positively with different lead substances at Bad Reichenhall WWTP (Germany) in a several month case study.

Parameter	**Effluent Quality[2]**
sulfatmethoxazol	< 0.6 µg/L
carbamazepin	< 0.5 µg/L
diclofenac	< 0.05 µg/L

6. REFERENCES

[1] Anthropogene Spurenstoffe, DWA-Position, Dezember 2010

[2] M. Schmied, Effect of Non-Thermal Plasma on Anthropogenic Trace Substances in Domestic Wastewater for the Implementation of a Fourth Treatment Step. Diploma Thesis, Innsbruck, 2016.