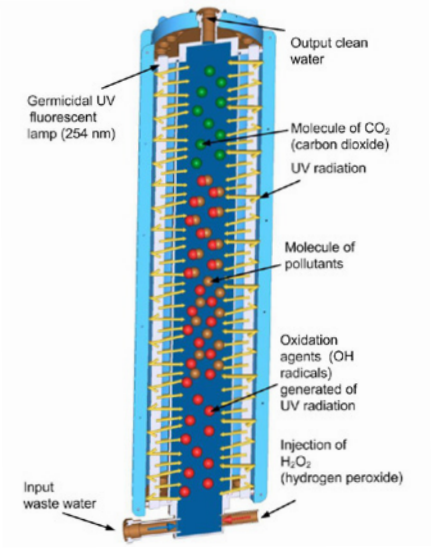
# WASTEWATER TREATMENT USING PHOTOCHEMICAL OXIDATION WITH $H_2O_2$/UVC

## PRINCIPLE

$H_2O_2$ is decomposed by ultraviolet irradiation (wavelength 254 nm) during photochemical oxidation process and the hydroxyl radicals are formed. These are able to decompose the majority of organic compounds. The hydroxyl radicals react with dissolved organic contaminants in the series of subsequent chain reactions while less toxic intermediates are formed, leading to the final oxidation products $CO_2$ and $H_2O$. If the substituted hydrocarbons are being treated, then also appropriate mineral acids or salts are formed.



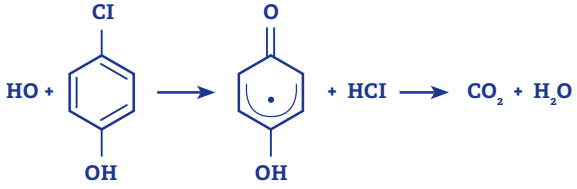

Scheme of photochemical oxidation with $H_2O_2$/UVC

## DESCRIPTION

The photochemical decontamination unite "RECHEBA" contains wo photoreactots and is placed in a mobile container. Each photoreactor consists of a cylindrical quartz tube 1200 mm long and 153 mm in diameter, which is surrounded by 20 low-pressure germicidal 36 W UV lamps. Contaminated water is pumped from the storage tank to the mixing device. Hydrogen peroxide dispenser is used for continuous dosing of $H_2O_2$ to the contaminated water, than it continues to the low part of the photoreactor. Contaminated water goes through irradiated reactors and is brought back to the storage tank then. The whole process is periodically repeated, until the target concentration of pollutants is reached.

The inlet part of photoreactor consists of redistributor and series of plastic sieves that ensure the uniform flow through the irradiated zone in the reactor. Outer jacket of the reactor is made of stainless steel sheet to prevent from emission of the UV irradiation outside the reactor construction.

The flow rate of contaminated water is 35 $l/min^{-1}$, the residence time in reaction zone is 38 s. The whole process is easy to pre-set by means of PLC board (setting of irradiation time and $H_2O_2$ dosing). The whole wastewater treatment and the data logging are then fully automated.




Photochemical reaction example

## *Main advantages of the technology*

- High efficiency in removing recalcitrant organic compounds
- Fully automatic process, only occasional control needed
- Outlet water is without chemical residuals and it is possible to drain it directly in the recipient
- No waste is produced by the technology (sludge, saturated sorbents)

## *Potential limitations*

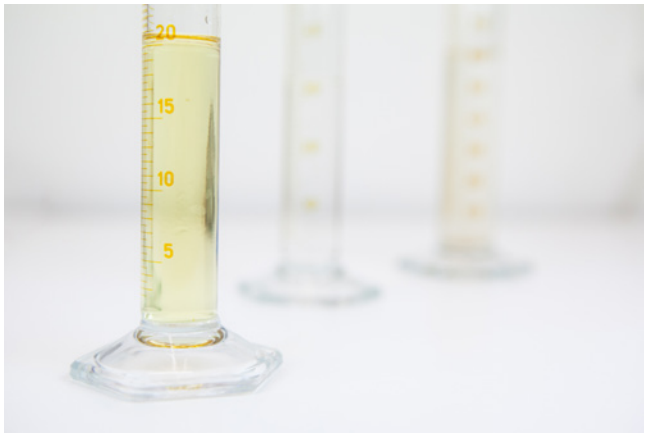
- Container technology "RECHEBA" has maximum capacity 5 $m^3$/day of treated water
- Contaminants must be dissolved in water. In case of presence of phase or suspended particles, preliminary treatment must be included
- In case of $Fe^{2+}$ and $Mn^{2+}$ concentration higher than 10 mg/L, their preliminary separation is needed
- Some organic contaminants behaviour like optical filter for penetration of UV irradiation

## *Services and products*

- Laboratory and half-scale tests to verify suitability of the photochemical $H_2O_2$/UVC oxidation technology for particular wastewater
- Design and supply of the full-scale technology, including eventual preliminary treatment
- Rent of the "RECHEBA" unit
- Monitoring of the decontamination processes, sample analysis

## *Data for technology design*

- Type and concentration of the contaminant in wastewater
- Water inflow capacity needed
- Outlet water contaminants concentration limits

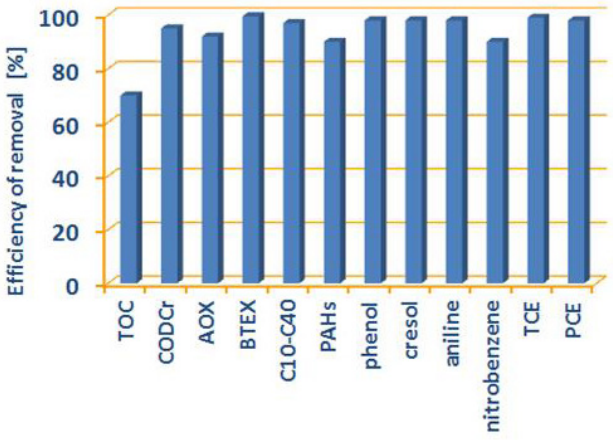



# REFERENT PROJECT

Three different wastewater sources were chosen for pilot testing of the container unit "RECHEBA". On the first site, the contaminant level was: 2.2 mg/L BTEX, 16.9 mg/L $C_{10} – C_{40}$, 5.49 mg/L phenols and 3.7 mg/L TOC.

Second testing site was contaminated by 57.4 mg/L benzene, 12.9 mg/L aniline, and 120.8 mg/L nitrobenzene. Water from testing site no. 3 contained 55.3 mg/L TOC and 305.6 mg/L chlorinated ethylenes. The "RECHEBA" unit was installed directly on site and was operated discontinuously, approx. 8 hours per day.

The water inflow was 120 L/hour and efficiency of decontamination was 70 % for TOC, 95 % for COD, 99.5 % for BTEX, 98 % for phenols, 97 % for $C_{10} – C_{40}$, 99 % for TCE, 98 % for PCE, 98 % for aniline and 90 % for nitrobenzene.




**Average efficiency of decontamination for different pollutants**
AOX: adsorbed organic halogens
BTEX: benzene, toluene, ethylbenzene, xylene
C10 – C40: fractions of hydrocarbons
COD: chemical oxygen demand
TCE: trichlorethylene
TOC: total organic carbon
PAHs: polycyclic aromatic hydrocarbons
PCE: tetrachlorethylene

# TECHNOLOGY APPLICABILITY

The presented photochemical $H_2O_2$/UVC technology is suitable for treating wastewater containing wide range of organic contaminants, including persistent organic pollutants (POPs), which are treated by conventional method with difficulties and poor effectivity.

Technology for photochemical $H_2O_2$/UVC oxidation called "RECHEBA" placed in the mobile container has maximum capacity 5 $m^3$/day of treated water and it can be easily transferred to the polluted site and its operation can be immediately started. This technology is particularly suitable for the treatment of wastewater from small-scale pharmaceutical, chemical, food and other operations.

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