A new innovative advanced wastewater treatment technology
Highly effective and environmentally friendly technology

APOP is a new concept for advanced photo oxidation processes at wastewater treatment plants.

By using the APOP-concept a non-hazardous effluent from wastewater treatment plant can be achieved.

**APOP-characteristics**
- Simple system for disinfection of wastewater
- Simple system for removal of endocrine disruptors and other hazardous compounds
- Flexible system
- Easily installation
- Advanced process control technology

**Advantages**
- UV-lamps with high energy intensity
- Low capital cost
- Low operation cost

**Environment and health**
- Excellent bathing quality
- No risks for recipient water bodies and eco-systems.
Background

Endocrine disruptors can be found in birth-control pills, cosmetics, washing powder and many other products used in normal households.

The consequence of discharge of endocrine disruptors into the nature e.g. by wastewater is that intersex among fish, roach and snails has been found in recipients water bodies.

The APOP-system is able to eliminate pathogenic micro-organisms and endocrine disruptors from wastewater. The principle in the system is that light from ultraviolet lamps is able to destroy mechanisms inside bacteria and remove chemical substances from wastewater with use of oxidants, e.g. ozone or chloride dioxide.

The ultraviolet lamp used in this project is developed and patented by a Danish company Scan Research A/S.
Performance

Disinfection
Dose-response curve for disinfection (removal of pathogenic microorganisms)

Disinfection
The APOP-system has demonstrated that it is possible to reach a quality of the effluent from wastewater treatment plants for pathogenic microorganisms equal with excellent bathing water quality according to the EC Directive for bathing water.

Operation cost = 1.5 cent per m$^3$ wastewater

Endocrine disruptors
The APOP-system is useful for removal of endocrine disruptors and other hazardous compounds from treated wastewater to a non-hazardous level without estrogenic activity (removal of 99.8%).

Operation cost = 2.0 cent per m$^3$ wastewater for ozone

Endocrine disruptors

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Test</th>
<th>Bisphenol-A</th>
<th>Estrone</th>
<th>17β-Estradiol</th>
<th>17α-Ethinylestradiol</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ozone 1</td>
<td>1</td>
<td>96% ± 2.1%</td>
<td>99% ± 1.2%</td>
<td>86% ± 2.6%</td>
<td>94% ± 4.0%</td>
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<tr>
<td></td>
<td>2</td>
<td>93% ± 1.7%</td>
<td>98% ± 1.9%</td>
<td>88% ± 7.9%</td>
<td>88% ± 6.5%</td>
</tr>
<tr>
<td>Ozone 2</td>
<td>1</td>
<td>95% ± 0.5%</td>
<td>99% ± 1.0%</td>
<td>95% ± 1.8%</td>
<td>99% ± 1.2</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>99% ± 0.9%</td>
<td>98% ± 1.5%</td>
<td>97% ± 2.1%</td>
<td>100% ± 0.0%</td>
</tr>
<tr>
<td>Chloride</td>
<td>1</td>
<td>94% ± 3.0%</td>
<td>99% ± 1.0%</td>
<td>98% ± 1.2%</td>
<td>98% ± 1.2%</td>
</tr>
<tr>
<td>dioxide</td>
<td>2</td>
<td>96% ± 6.0%</td>
<td>99% ± 1.0%</td>
<td>98% ± 2.1%</td>
<td>100% ± 0.0%</td>
</tr>
</tbody>
</table>
Attractive and available

The APOP-system can be implemented on any scale

The first APOP-system was installed at Usserød Wastewater Treatment Plant (Denmark). Usserød WTP has a capacity of 50,000 person equivalents.

The APOP-system at Usserød WTP consist of two channels with three racks in each. 16 ultraviolet high pressure lamps (APOP-lamps) is installed in every racks.

Usserød WTP is installed with dispersing system with the availability of using different oxidants for removal of hazardous compounds in the wastewater.

The APOP-system installed at Usserød WTP. The system has a hydraulic capacity of 700 m³/h.
The Danish Environment Minister Connie Hedegaard was invited to the official opening of the APOP-plant at Usserød WTP in September 2005 and expressed the potential in the APOP-system.

The Minister said, “around the world is there an anxiety against endocrine disruptors found in the nature. Here we have a unique possibility to clean up”.

In Central Europe lot of efforts is used against contaminated rivers by endocrine disruptors. The APOP-system will here a big opportunity as the used technology.
The best technology for disinfection and removal of endocrine disruptors?

Probably!

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