

# Protecting our environment from hormones and endocrine disruptors with new SCWO-technology

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*The global consumption of pharmaceutical products and the industrial use of substances that disrupt the endocrine system are on the rise, causing serious problems for our natural environment and for human health. SCWO<sup>1)</sup>-based wastewater purification technology holds the potential to completely destroy such organic pollutants and to protect our environment for generations to come.*

## Sources of hormones and endocrine disruptors

There are a variety of routes through which harmful substances can end up in the natural environment. Hormones are for example discharged into the sewage system through the widespread use of birth control pills or through hospitals where patients consume large quantities of medicine.

Other endocrine disruptors include dioxins, PCBs, pesticides, synthetic hormones, non-ionic surfactants (detergents), and bisphenol A (BPA). These substances are found globally, often from chemical, pharmaceutical, cosmetics, and health care industries.

## Effects on nature and humans

Such contaminants typically collect in landfill leachate and in public sewage where they are not adequately purified or contained, polluting groundwater, oceans, and rivers.

Research shows that endocrine disruptors harm the reproductive systems of fish and cause sex changes in frogs. In humans, such compounds have been linked to genital deformities<sup>2)</sup>, forms of cancer, and a host of other severe health problems.

“Today there is clear scientific evidence that endocrine disruptors cause sex changes in male fish. This has been discovered through field studies and verified by

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*Mr. Poul Bjerregaard  
Professor of biology at University of Southern Denmark*

laboratory experiments,” says Poul Bjerregaard, professor of biology at University of Southern Denmark. “There are serious reasons to be concerned about the future effects of such substances especially on aquatic environments if better means of wastewater purification are not adopted,” Mr. Bjerregaard continues.

### Conventional methods versus SCWO

The current purification capabilities of conventional treatment methods can be limited when dealing with hormones and endocrine disruptors.

For example, sewage and wastewater treatment plants typically remove at most 80-90 %<sup>3)</sup> of hormones, while the rest invariably ends up in surface water. In the United States, a national survey found that 13 out of 50 wastewater treatment plant effluents displayed endocrine disruption activity in fish<sup>4)</sup>.

“Our natural environment would be much better protected from harmful contaminants if industries and public bodies decided to purify wastewater streams better,” suggests Poul Bjerregaard.

An alternative for treating wastewater containing hardly degradable hazardous compounds is incineration, but this can be a highly expensive process.

Today, all of these harmful compounds can be virtually eliminated using new SCWO-based purification technology at a fraction of incineration costs. This will allow more organizations to manage their wastewaters with zero discharge of hazardous compounds.

### Destroying hormones

Hormones are found in many pharmaceutical products and consequently appear in wastewater generated from pharmaceutical manufacturing plants. Such wastewater can be very expensive to treat. For example, pharmaceutical companies producing synthetic estrogen are often faced with wastewater treatment costs that exceed 250 USD per cubic meter when using traditional purification and disposal means like incineration. In contrast, Aquarden’s SCWO-based systems can completely destroy estrogen in wastewater at a cost below 40 USD per cubic meter.

While the economic benefits of SCWO are attractive for reducing wastewater treatment costs, the long-term benefits of securing our environment and protecting human health for future generations are even greater.

#### SCWO: Complete purification

##### Estrogen

Ingoing concentration	Outgoing concentration	Reduction %	Conventional cost per m <sup>3</sup>	Aquarden cost per m <sup>3</sup>
5 mg/L	<1 ng/L*	>99.99998	USD 250	USD 40

##### Triton X-100 (detergent)

Ingoing concentration	Outgoing concentration	Reduction %	Conventional cost per m <sup>3</sup>	Aquarden cost per m <sup>3</sup>
2000 mg/L	<60 µg/L*	99.997	USD 270	USD 40

Aquarden has tested the purification performance of SCWO-based systems on different types of endocrine disruptors and hormones with remarkable results. In both cases SCWO treatment has proven to be an extremely efficient and cost-effective water purification solution, especially for pharmaceutical and chemical companies.

SCWO employs the purification properties of supercritical water to completely destroy complex organics, reducing them to harmless products like water, carbon dioxide, and nitrogen gas that can be safely released into the environment.

\* Below detection limit.

Aquarden has conducted SCWO experiments that demonstrate significant reductions in estrogen content in wastewater streams by 99.99998 % – from 5 mg/L to less than the detection limit of 1 ng/L

“Some wastewater components are so harmful that they inflict a lasting negative impact on our natural environment for many generations. Aquarden's goal is to eliminate all such substances,” says Zhuoyan Cai, Director of Aquarden.

### Destroying endocrine disruptors

An example of a known endocrine disruptor is the non-ionic surfactant (detergent) Triton X-100. Triton X-100 is sometimes used as a general-purpose detergent and in chemical production. Wastewater in Denmark containing Triton X-100 is commonly incinerated, costing around 270 USD per cubic meter of wastewater.

Aquarden has tested the performance of SCWO-based systems on Triton X-100 with outstanding results. At least 99.997% of the substance is effectively removed from the wastewater stream to below the detection limit of 60 µg/L – again at costs below 40 USD per cubic meter.



*Aquarden's facilities comprise a fully equipped laboratory for chemical analysis including a lab-scale SCWO reactor allowing Aquarden to test and optimize the treatment of all types of organic wastewater. Results from testing of hormones and endocrine disruptors on Aquarden's systems are impressive.*

### SCWO-based purification systems in practice

SCWO-based purification systems can be a prudent solution for companies across all industries aiming to comply with ever-tightening wastewater discharge standards. Aquarden's team of experts designs and integrates customer-specific SCWO-based solutions

into existing wastewater processes to meet all purification demands.

“We commonly incorporate pre and post-treatment processes such as concentration systems or ion-exchangers into our SCWO systems to accommodate flow, discharge, and other specific requirements. This is standard practice for us,” explains Zhuoyan Cai. “In many cases we have shown that our SCWO systems exhibit outstanding purification while providing significant cost-savings.”

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*Mr. Zhuoyan Cai  
Founder and director of Aquarden Technologies*

### About Aquarden

Aquarden is a leading developer and manufacturer of systems for purifying toxic wastewater. Aquarden's innovative SCWO systems can help industries and public waste management organizations resolve their most difficult and critical wastewater purification challenges. Aquarden's SCWO technology completely destroys all hardly degradable organic compounds contained in wastewater while separating out salts and heavy metals.

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#### Notes:

- 1) Supercritical water oxidation
- 2) New York Times, June 27th, 2009: "It's time to learn from frogs"
- 3) Danish Ministry of Environment, "Degradation of Estrogens in Sewage Treatment Processes", Environmental Project No. 899, 2004
- 4) United States Environmental Protection Agency, "Ecosystems & Environment: Wastewater Treatment"