

Purifying landfill leachate: An SCWO-based solution for Odense Waste Management Company Ltd.

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How do you keep 200,000 cubic meters a year of harmful landfill leachate from landfill sites from harming the environment? Denmark's biggest public landfill facility has already recognized that on-site SCWO-based treatment systems could be a solution. International experts from leading consulting group COWI agree that new leachate treatment methods are needed.

The principle of using landfill sites for disposal and decomposition of many types of solid waste is a traditional and well-known part of waste management systems. But the challenge of effectively purifying large volumes of environmentally harmful leachate for safe release into the environment remains.

Problematic leachate from landfill sites arises from forms of deposited waste requiring many years or even decades to decompose and leach, making the leachate problem serious and long-term. Today, landfill operators such as Odense Waste Management Company Ltd. are unable to remove the most persistent components of leachate including heavy metals and complex organic

compounds. Odense Waste Management and Aquarden are now working together to test and eventually develop an operational SCWO-based solution for on-site treatment of leachate. Odense Waste Management has already recognized that SCWO technology could be instrumental in resolving the landfill leachate treatment challenge.

Current leachate treatment methods

Odense Waste Management currently operates 110 hectares of open landfill sites. Precipitation on the area percolates through the waste and dissolves organic and inorganic compounds from the waste thus producing leachate. The membrane and leachate collection

system at the bottom of the landfill ensures the effective collection of the leachate. This prevents the leachate from polluting the surroundings of the landfill. The leachate is removed from the landfill through a system of drains and pumps.

Odense Waste Management's landfill sites are used for three types of solid waste: Mixed waste, mineral-based waste, and hazardous waste. The three types of waste produce three very different kinds of leachate. Odense Waste Management also operates a now closed old-fashioned municipal waste dump containing 10 million tons of mixed solid waste. This waste dump includes municipal waste and it produces complex forms of leachate. Today, the leachate is pre-treated in a traditional mechanical-biological treatment plant before discharge to the municipal wastewater treatment facility. This leachate disposal approach costs Odense Waste Management about a million EUR per year.

The need for new treatment methods

Leachate from mixed waste landfills is harmful to the environment and contains problematic organics as well as ammonia and nitrogen, while mineral-based solid waste usually contains heavy metals and salts. Finally, hazardous solid waste leachate contains for example compounds extracted from synthetic materials, paint, rubber, foam, and more. Such forms of waste can produce leachate of an even more harmful composition including complex organic compounds.

.. the upcoming stricter requirements from the EU regulation will pose a challenge regarding the future management of leachate. SCWO is likely to play an important role in this respect.

*Mr. Steen Stentsøe
Senior landfill engineering consultant, COWI*

Treating the leachate in a traditional mechanical-biological sewage treatment plant does not ensure that all the harmful or non-degradable components are effectively removed. According to Steen Stentsøe, senior landfill engineering consultant from COWI, these systems – such as the system used by Odense Waste Management today – are designed to treat municipal sewage in order to remove nutrients, nitrogen-, phosphor-based compounds, and some organic compounds.

Other and possibly more environmentally problematic substances are diluted and pass through the system into the environment.



Aquarden's SCWO solution is a cost-efficient and fully-automated method for treating leachate from landfills. Unlike biological treatment, SCWO completely destroys organic and toxic compounds.

“Today, the heavy metals contained in landfill leachate are only partially removed from the leachate with the sludge from the treatment process. And hard, slowly- or non-degradable organic compounds are also not destroyed. This means that such harmful compounds will end up somewhere in our environment if we do not start employing other methods for their removal,” says Steen Stentsøe.

In contrast to traditional mechanical-biological treatment systems, SCWO-based systems completely destroy complex organics and separate out inorganic salts including heavy metals into a concentrated salty solution to be treated separately. SCWO in this manner completely removes harmful leachate components before any of these are allowed to damage the environment.

Meeting EU regulations

EU environmental directives will soon enforce stricter regulations on the release of certain polluting compounds in the discharge from for example a sewage treatment plant. Such regulations dictate that a number of prioritized compounds must be reduced or completely

removed before discharge into the environment within a short time span. Mercury is being phased out and as a part of that process the discharge of treated sewage must not contain any mercury from 2015 onwards. Other compounds will also be restricted within the next 3-7 years.



“One way for sewage treatment plants to meet such future restrictions is to push the problem back to the industry. This would require that the industries treat their sewage sufficiently before releasing it to the sewage treatment plant or they may choose to phase out the compounds in question all together. But the landfill operators cannot phase out such compounds in the leachate, as leachate is generated from waste that may be decades old. Landfills will possibly also receive waste containing such compounds for many years to come. This means that the leachate still needs to be treated effectively for such compounds for many years into the future,” says Steen Stentsøe.

Treating landfill leachate the intelligent way

Aquarden’s SCWO-based treatment systems also promise a much more refined and intelligent approach to treating leachate. And Odense Waste Management already offers a vision for how SCWO will be applied effectively.

“Today we are using the same treatment method for all leachate types. We believe that working with Aquarden will allow us to optimize our treatment methods by designing and dimensioning on-site SCWO-based solutions that address specific leachate challenges effectively. This is the intelligent way of resolving the leachate challenge,” says Rasmus Olsen, operations engineer for Odense Waste Management.

The vision for a new and more effective leachate treatment approach includes a custom configured on-site SCWO-based treatment system for each individual landfill site. The end products of the treatment process will be clean water that can be disposed of into the sea and a small amount of concentrate, which will be lead to external treatment plants.

Odense Waste Management believes that SCWO-based systems will be of great benefit to the environment when used as part of an approach where different types of leachate are treated according to their properties. The cost of implementing such systems would also remain within the current budget for leachate treatment, Rasmus Olsen says.

“We believe we can get a much better leachate treatment result than we have today by rethinking our general approach and adopting SCWO-technology on specific types of leachate even without increasing our current budget of about 1 million EUR per year in treatment cost,” says Rasmus Olsen.

Resolving the leachate challenge

The first phase of the joint Aquarden and Odense Waste Management project includes testing the effectiveness of Aquarden’s SCWO-based solutions on specific leachate types from the landfills. Based on previous experience in treating leachate, Aquarden expects that SCWO technology will offer Odense Waste Management exceptional purification results.

We’re excited about the potential of SCWO technology. SCWO solutions will allow us to meet demands of environmental legislation effectively and intelligently.

*Mr. Rasmus Olsen
Operations engineer, Odense Waste Management Company*

In the following phases of the project, experts from Aquarden and Odense Waste Management will together develop a proposed end-to-end design for the complete leachate treatment process including a specific SCWO-based solution meeting the exact purification and capacity needs of Odense Waste Management.

"We're excited about the potential of SCWO technology. SCWO solutions will allow us to meet demands of environmental legislation effectively and intelligently," says Rasmus Olsen.

Aquarden believes that a leachate treatment system will offer landfill operators an effective solution at about the same cost level as current methods with the added benefit of effectively removing all environmentally harmful substances.

"Today, landfill operators pay a lot of money for treatment of the leachate - a treatment where the efficiency may be questioned. Although the sewage treatment plants meet the outlet requirements of today, the upcoming stricter requirements from the EU regulation will pose a challenge regarding the future management of leachate. SCWO is likely to play an important role in this respect," says Steen Stentsøe.

About Aquarden

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

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The facts: The exceptional performance of SCWO in purifying leachate

Aquarden has already successfully tested the capabilities of SCWO in treating leachate from landfill sites. SCWO can reduce the COD-value of leachate by 99.5 % while biological treatment only reduces COD by about 10 %. $\text{NH}_4^+\text{-N}$ is reduced by 98 % when considering the end-to-end solution including pre-treatment and SCWO.

The values for COD and ammonia are so low that the purified waste stream can be discharged directly into the sea. Initial conductivity tests indicate that the distillate is so clean that there are no remnants of heavy metals in the purified stream.

COD reduction (%)



The graphic above shows how the costs and effectiveness for leachate treatment of various wastewater treatment systems compare with SCWO as both the most effective and cost-efficient solution.