Landfill leachate

Membrane distillation systems provide a one-step processing of landfill leachate effluents, with high recovery ratios and excellent distillate quality. The units are powered by low-grade heat and have a low cost of ownership.

Toxic and hazardous compounds can originate from landfill leachate as a result of the soluble components of solid and liquid wastes being leached into surface and ground water. The risk involved in landfill leachate is the contamination of ground and surface water. Substantial difficulties regarding the production of drinking water and the use of water in general can be the result. Normally landfill leachate is highly contaminated by:

- organic substances, i.e. COD, TOC or BOD5
- nitrogen compounds such as NH4-N
- heavy metals, halogenated organic compounds, etc.

Consequently, leachate is comparable to complex industrial waste streams which contain both toxic organic and inorganic contaminants. The most economical and environmentally friendly way to treat landfill leachate is to reduce the volume by 75 - 90% using membrane systems (e.g. reverse osmosis filtration) and return the concentrate to the landfill by controlled reinjection.

Treatment with reverse osmosis is however limited, resulting in low recoveries and fouling of the RO membranes. Reverse osmosis applicability is limited by conductivity, organics, and scaling inorganic elements such as CaSO4, Si, and Ba [(1)].

Deltapore, in close cooperation with Aquastill, is offering a novel approach to the treatment of landfill leachate. The treatment units are based on membrane distillation. Membrane distillation, a breakthrough technology which combines the advantages of membrane separation and distillation. Particle size or concentration levels are less relevant than in other processes thanks to the double barrier process, with hydrophobic membranes and differences in vapour pressure. These features enable high recovery ratios and high-quality distillate production. As an example, recovery ratios of 90% can be achieve whilst elements which are difficult to treat with traditional filtration technologies such as Boron are easily removed with MD.

Case study: **treatment of landfill leachate with MD units**

Challenge: reduce landfill leachate footprint in a robust and economical way.

The Landfill contains more than 12 million tonnes of waste, which consists of roughly equal quantities of household and industrial waste, and it has 25 -30 MW of installed electrical power capacity. The site has a water plant, based on MMF, Oxidation, RO & IX, with a capacity of around 30 m^3/h. The energy consumption of the RO is > 7 kWh/m3 of permeate water. The plant has a total recovery ratio of 75%.

Solution:

MD unit driven by low-grade heat to demonstrate an alternative approach. The unit has been used to treat both the landfill leachate effluent and the RO reject. The MD is powered by low-grade (waste) heat from CHPengines from the landfill, which typically produce heat at 80-90°C.

Results:

The MD unit produced a distillate from the landfill leachate and the brine of the RO with a conductivity of less than 15 µS/cm. The total recovery ratio is of 90%, with a final conductivity in the brine of >80 mS/cm. The electricity consumption of the MD plant is approx. 1.5 kWh/m^3, up to 80% lower compared to RO systems.

There are significant savings for the Capital expenditure (CAPEX) and for the Operational expenditure (OPEX). The lower CAPEX is possible thanks to the novel membrane distillation process, which uses plastic modules. These are considerably more economical than traditional systems like RO and evaporators. The lower OPEX is basically due to the low energy consumption and low maintenance of the MD systems.

Parameter	Units	Feed
pH		6.5 – 8.7
Conductivity	µS/cm	28300
AOX	ppb	722
BOD_5	ppm	4600
SO_4	ppm	1320
Pb	ppb	48
NH_4	ppm	978
N (total)	ppm	1100
Na	ppm	920
Ca	ppm	1134
Fe	ppm	29
Al	ppm	0.3
Mn	ppm	46
Hg	ppb	0.49
Cu	ppb	168
Cr	ppb	436
Sr	ppm	1.7
Zn	ppm	2.4
Cl	ppm	1010
SiO_2 total	ppm	4.3
Cl^-	ppm	1060
NO_2	ppm	1.6
NO_3	ppm	2.05
TSS	ppm	1000

Distilate quality Removal rates	
Monovalent ions	>99.9%
Polyvalent ions	>99.9%
Ammonium (pH >6.5)	99,8%
Organic high molecular compounds	99.9%