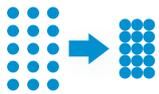


Leachate Treatment

Using Aquaporin Inside® forward osmosis



UNIQUE CUTTING-EDGE PRODUCT



HIGH EFFICIENCY

5x volume reduction for pre-treatment leachate



HIGH REJECTION

High rejection of trace elements



HIGH WATER RECOVERY

> 82% of the water can be reused and recycled



COST REDUCTION

Over 80% reduction in leachate treatment cost



DECENTRALISED TREATMENT

Landfill leachate treated, reused & disposed in-situ

Landfill leachate production is a persistent global environmental pollution issue that is difficult to solve. This is due to its' inherent high pollution load and varying composition depending on the 'waste age'. Regardless of the method used, treatment is usually expensive. When left untreated, leachate presents as a

problem to both ground and surface water sources. Aquaporin Inside® forward osmosis membranes can become a cost-effective novel technology that can be combined with solar evaporation & condensation to take on this issue.

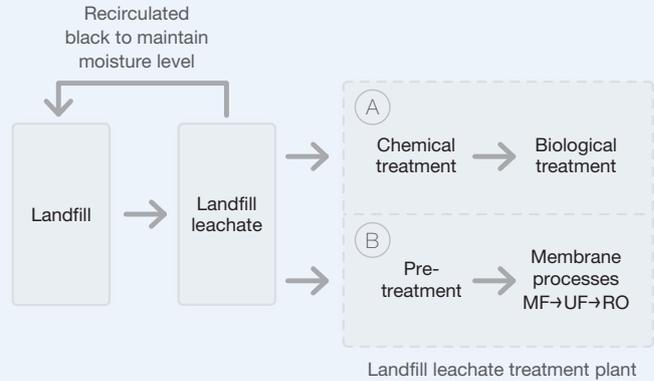
LEACHATE TREATMENT USING FORWARD OSMOSIS

Current process

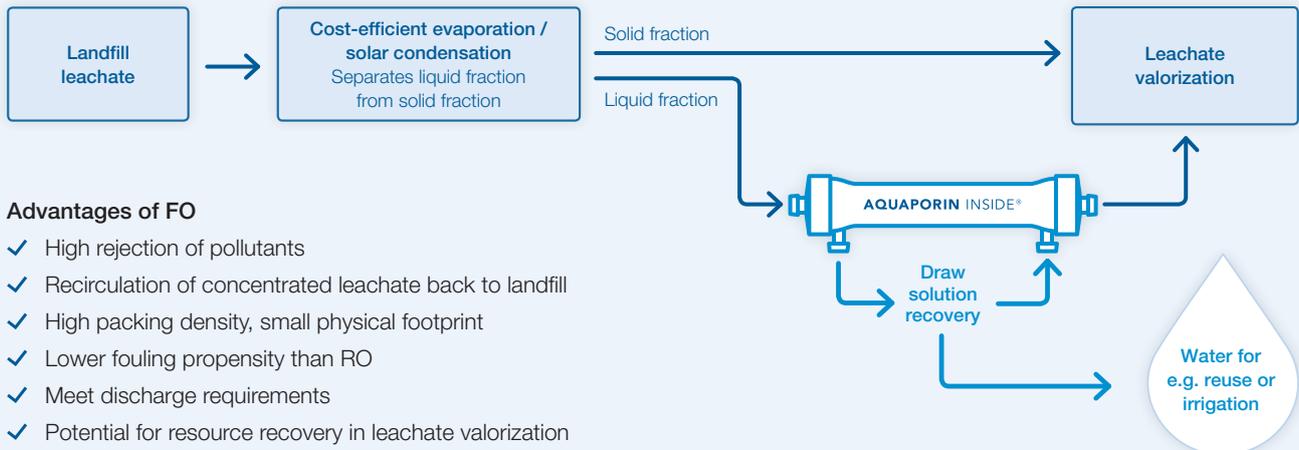
In the absence of treatment, leachate is either sent to wastewater treatment plant (WWTP) or recirculated back to landfill to maintain moisture levels for microbial activity.

Issues arising from current process:

- Backlash from WWTP over stringent discharge requirements
- WWTP has to be individually customized to each landfill's characteristics (no "one-fit-all" solution)
- Offsite treatment incurs high hauling and disposal costs
- On-site treatment has land & space constraints



Incorporating Aquaporin Inside® FO



Advantages of FO

- ✓ High rejection of pollutants
- ✓ Recirculation of concentrated leachate back to landfill
- ✓ High packing density, small physical footprint
- ✓ Lower fouling propensity than RO
- ✓ Meet discharge requirements
- ✓ Potential for resource recovery in leachate valorization

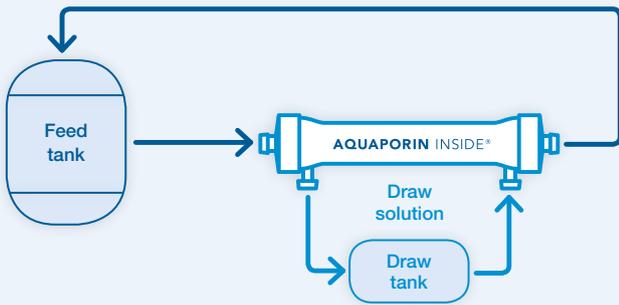
CASE STUDY

Landfill leachate condensate concentration using Aquaporin Inside® hollow fiber FO

Method

A lab-scale study using Aquaporin Inside® HFFO2 was carried out to validate the technical feasibility. Experiments were performed in FO mode where active layer of the membrane was facing the feed side.

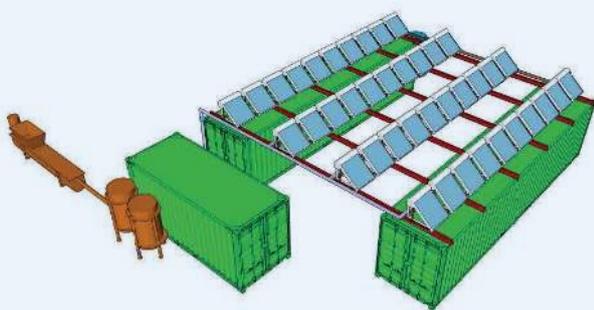
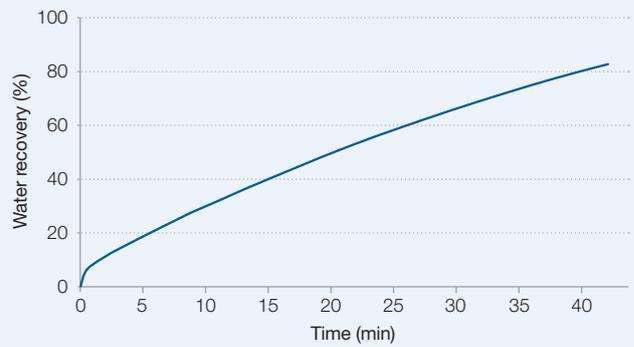
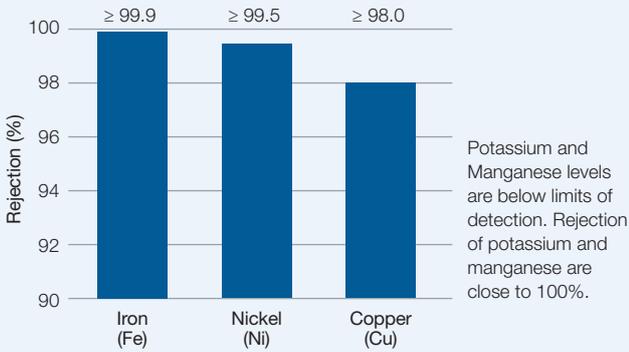
| | |
|-----------------------------|--|
| Mode of operation | Feed and draw in batch mode |
| Draw solution | 35 L of 2M MgCl ₂ |
| Feed solution | 31 L of landfill leachate condensate Potassium: 35.3 mg/L Manganese: 0.009 mg/L Iron: 0.22 mg/L Nickel: 0.05 mg/L Copper: 0.56 mg/L |
| Operating conditions | 60 L/h feed inlet 25 L/h draw inlet FO mode (feed in lumen side), counter-current, room temperature (20°C) |
| Membrane type | Aquaporin Inside® Hollow Fiber Forward Osmosis Module (2.3m ²) |
| Membrane QC | Before and after test |



Results

Hollow Fiber FO batch concentration results:

- ✓ More than 5x reduction of landfill leachate condensate (82% recovery)
- ✓ High rejection of unwanted compounds



Pilot plant under construction

The Life Leachless project partners were very satisfied with the permeate quality and the achieved landfill leachate volume reduction. A lab scale system has been setup at Triton Water Group to conduct further FO testing. The Life Leachless project is currently focusing on the design and construction of a pilot plant. The pilot unit will be used for 2 replication studies (1 in Spain and 1 in Greece).

Quality control test

Membrane QC tests were carried out before and after application to check for irreversible fouling during the filtration process. FO performance remains within acceptable range after cleaning. Further studies will be required to investigate the cause of the increase in water flux and reverse salt flux.

Membrane QC tests before and after applications with subsequent cleaning

■ J_w (LMH) ■ J_s/J_w (g/L)



CONCLUSIONS



The Aquaporin Inside® FO can be used to concentrate landfill leachate liquid, and at the same time reject the unwanted compounds which allows for water reuse or safely discharge of the permeate.

Want to learn more about how Aquaporin Inside® FO can benefit your business? Please contact Aquaporin's FO experts at FO@aquaporin.com for more information.

Want to learn more about the Life Leachless project? Please visit www.lifeleachless.eu, contact Managing Director Triton Water Technologies, Pedro Garcia at p.garcia@tritonwatergroup.com, Managing Director InfnitVE, Marc Basany at mbasany@infnitve.com or Cartif Project Coordinator, Francisco Corona at fraenc@cartif.es.

About Aquaporin

Aquaporin A/S is a global water technology company located in Denmark.

Aquaporin is dedicated to revolutionizing water purification with its' novel membrane technology.

The main goal of Aquaporin is to develop the Aquaporin Inside® technology which is capable of separating and purifying water from all other compounds.

The Aquaporin Inside® platform uses biotechnological principles in a technological context, which is a novel upcoming field with large commercial perspectives. This is a field where Denmark has taken an early global lead.

About LIFE LEACHLESS

Dealing with Landfill Leachate in a sustainable way

Large amounts of leachates are generated globally. Due to the composition it has a high pollution load. The LIFE LEACHLESS project (LIFE15 ENV/ES/00053) proposes a treatment model that will be carried out "in-situ" using a cost-effective novel technology that combines solar evaporation/condensation with Aquaporin Inside® forward osmosis membranes. The prototype will be powered by renewable energies (solar energy, biomass and residual heat), which will minimize the carbon footprint of the process.

The final effluent quality will be very high, allowing reuse or discharge into watercourses. A minority semi-solid residual stream will be also generated in the process. Due to its special composition (rich in metals and inorganic elements), this stream will be valorized in ceramic industries to improve the final products characteristics.



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