



RSL Membranes™ - The world's lowest cost low pressure membrane. Patent Protected

Technology Overview:

Video: [Overview of the RSL Membrane™ -world's lowest cost low-pressure membrane.](#)

RSL Membranes™ are a patented new membrane technology, developed six years ago, to treat water and waste water and replace

- all conventional flotation (DAF, IGF) technologies,
- clarifier or sedimentation type technologies,
- oil water separators,
- sand or multimedia filters,
- low pressure membranes such as UF and MF membranes, and
- all conventional disposal type bag filter and cartridge technologies

The above processes are commonly used to separate suspended solids, colloidal solids and oil (either emulsified or in free oil form) from water.

RSL Membranes™ have been tested on numerous waters and waste waters. The technology is now being finalized for commercialization. Specifically, the **RSL Membranes™** have been used to treat produced waters from the oil and gas industry.

RSL (Replaceable Skin Layer) Membranes™ operate based on replacing the skin layer on the membrane substrate. Conventional membranes consist of a skin layer attached to a substrate tube. The skin layer has a pore size that acts as a barrier to solids passing through the membrane. **RSL Membranes™** use a charged ionic powder as the skin layer and is added to the surface of a polymeric, stainless steel or titanium membrane tube. The powder manipulates the electric double layer (EDL) around a colloidal solid such that the solid repels from the surface of the membrane. Solids do not cake on the surface of the membrane tube which is typical for filter cake, precoat or dynamic membranes.

The science being applied for the manipulation of the EDL is well explained as the DLVO theory. This repulsion of solids from the surface of the membrane then allows for high loading (flux) rates on the membranes. Typically, the loading (flux rate) is 10 times conventional membranes. Because of this significant loading rate advantage, DBE Hytec claims that the **RSL Membranes™** are the lowest membrane cost in the world.

There are three key operational steps

1. Applying the **RSL™ powder** layer to the surface of the membrane tubes. The application occurs with the tubes insitu (there is no removal of the tubes from the membrane housing). Time to apply the 50-micron thick powder skin layer is 3 minutes.
2. Filtration of the water to be treated (raw water) occurs once the powder is applied to the membrane tubes. Filtration cycle length is 2 hours to 30 hours depending on raw water quality.
3. Backwash with air and water takes approximately 1 minute.

The technology has undergone significant commercialization development through three major projects

1. **Canadian Natural Resources Ltd** – A successful one year \$13 million oil sands tailings pond water treatment project where the RSL Membranes™ were compared to Veolia's silica carbide ultrafiltration

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membranes. The objective of the project was to select a pre-treatment technology for RO membranes that were intended to remove a monovalent ion from the recycle water used for the bitumen extraction. The project validated **RSL Membranes™** and the 10-fold flux rate improvement at pressures less than 70 kpa (10 psi) compared to conventional low-pressure membranes (i.e. MF and UF membranes). CNRL was the first major corporation to endorse the potential of **RSL Membranes™**

2. **Steam Assisted Gravity Drainage produced water** is a \$16 million project was funded both by the private sector and government funding. The objective of this project was to confirm the design of the commercial membranes, housing, **RSL™ Powder** application and backwashing. The **RSL Membranes™** are intended to replace the existing produced water treatment train which includes induced gas flotation, walnut shell filter, lime softening clarifier, sand filter and centrifuge for solids management.
3. **Petro China treatment of produced water.** In China, the specification now used to for reinjecting water produced from oil and gas production facilities (produced water) into the formation is < 5 ppm oil, < 1ppm suspended solids and < 1 micron maximum particle size (commonly known as 5-1-1). Petro China has evaluated numerous technologies. Only two could provide this level of treatment; **RSL Membranes™** and conventional UF membranes. The problem with UF Membranes is that they fouled very quickly. After 6 months of testing, Petro China has selected **RSL Membranes™** as their lead produced water technology. Petro China has now ordered a 25 m³/hr (4000 bbl/day) **RSL Membrane™** system to be used for produced water treatment at Daqing.

RSL Membranes™ have also been reviewed by numerous third-party assessments where the technology has won awards. Recently, Isle Utilities of the UK and the Netherlands undertook an offshore oil and gas industry directed project to identify the world's leading technologies to treat produced water. **RSL Membranes™** were the favored technology.

Recently **RSL Membranes™** were tested to treat produced water from a conventional fracking operation in the Permian basin. The conventional technology being applied at the site was dissolved air flotation. The treatment objective was to produce a reusable frack water with an NTU<10, however, typically it was higher than 10 NTU.



The **RSL Membranes™** were applied to the same water using a small 3 bbl/day test unit and consistently reduced turbidity from 130 NTU to less than 0.4 NTU.

Permian Basin Produced water treatment- 135 NTU to <0.4 NTU with no chemical addition

An economic assessment was also prepared which showed the significant cost advantages of the RSL Membranes™.

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