dbe DAVID BROMLEY ENGINEERING LTD.

Mr. Wong's simple 3 step operation with no hassle maintenance

Who is Mr. Wong?

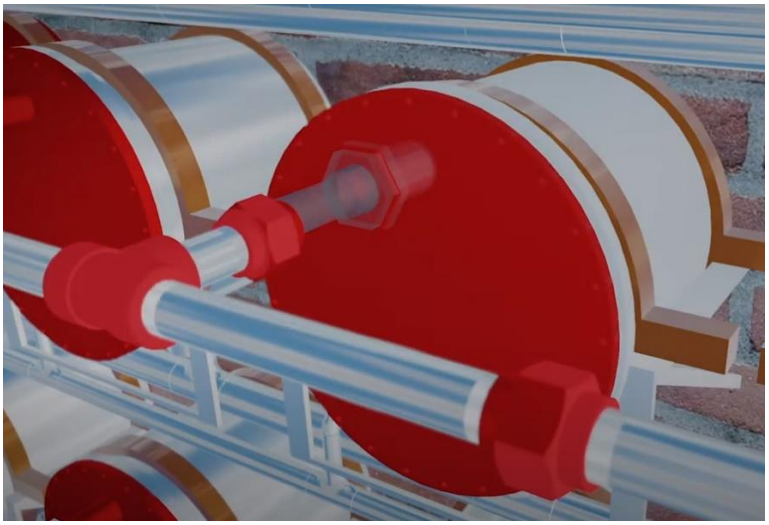
Mr. Wong was the gardener at our Beijing test center. When DBE Hytec Ltd undertook the operation of the 25 m3/hr **RSL Membrane™** to treat produced water for Petro China, one of the worlds largest oil and gas producers, Mr. Wong was asked to support the field labour component for the project. As there was a shortage of operators, Mr. Wong became more involved in the day-to-day operation. Within one month he became the chief operator of the **RSL Membrane ™** system. The technology is simple to operate with the three easy steps.

1. ***Fill the housing with treated water and add the ionic powder to the surface of the membrane. RSL Membranes™*** *rely on an ionic powder to simulate a highly ionic localized environment on the surface of the membrane in a contained housing full of water. The ionic powder is applied at the beginning of each filtration cycle. This step takes 4 minutes*
2. ***Undertake the filtration of the water:*** *A filtration cycle will last 2 to 30 hours, depending on the raw water quality. The ionic powder creates a 100 µm powder skin layer on the outside surface of a membrane tube. The membrane tube has pore sizes of 3 to 5 µm. As the filtration of the water continues the TMP increases.*
3. ***Undertake a backwash:*** *Once the pressure across the membrane (TMP) reaches 70 kpa (10 psi), the ionic powder skin layer is backwashed from the membrane tube. The contents of the membrane housing are also removed to a sludge tank. This step takes 28 seconds. Step 1 is then repeated. The housing is filled with water and a new ionic powder is placed on the membrane tubes.*

The powder is the replaceable skin layer, hence the name Replaceable Skin Layer (RSL) Membranes™.

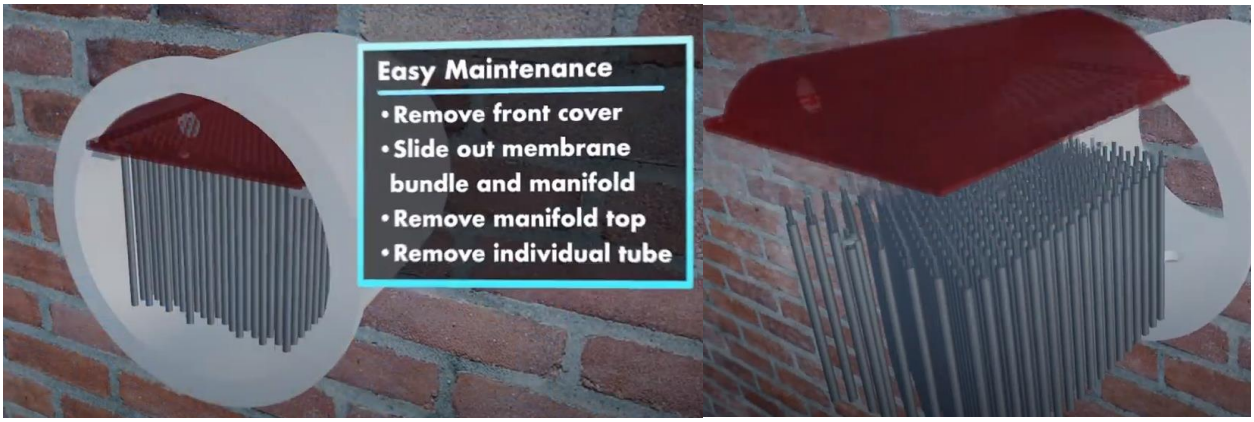
Video link

The **RSL Membrane™** has been further simplified with the new design where the membrane housing sits horizontally allowing for easy access to the membrane if maintenance is required. The front cover can easily be removed and the membrane manifold and tube bundle slide out. The manifold and hanger plate holding the tubes can be quickly accessed and cleaned or replaced if necessary. RSL Membrane replacement will be significantly less than conventional



membranes. The reduced replacement requirement is because of the protective **RSL™ Powder**

The following graphic shows the removal of the front cover and the sliding out of the tube bundle and manifold.



Conventional membranes pot the membrane tubes, typically 2mm outside diameter (OD) hollow fibre membranes, in an epoxy. The hollow fibre membrane tubes are placed 1 to 2 mm apart in a membrane bundle. The intent of this design is to provide a high volume of membrane area in a compact housing. However, if one tube fractures or malfunctions the entire bundle of tubes must be replaced. In addition, for high solid applications, the spacing of the tube requires frequent back washes.

RSL Membranes™ use 12 mm OD tubes with a cap on the bottom of the tube and a threaded nut and bolt on the top. Each tube is bolted to a hanger plate. The hanger plate is the bottom plate on the membrane manifold. Filtration is from the outside to the inside of the tube. The permeate travels up the inside of the tube into the manifold. When the front cover of the housing is removed the membrane manifold and tube bundle slides out of the housing and one or all tubes can be easily replaced, cleaned, or repaired. There is 6 mm between tubes allowing for a high solid loading into the membrane housing.

Typically, with this design, one would assume the footprint for **RSL Membranes™** would be larger than with the conventional design. Not so. In fact, **RSL Membranes™**, with their very high flux rates, have at least a 33% footprint advantage over conventional membranes. See" *Footprint and cost impact*"

RSL Membranes™ have been designed to fit easily into a sea container for shipping or enclosure requirements. The design allows for easy front and rear access to all valves, pumps and sensors. In the sea container the back of each **RSL Membrane™** module is accessed by opening the end doors of the sea container. Access to the front of the **RSL Membranes™** is from a wide aisle in the sea container itself.

Research and Development Objectives

1. Develop simple cleaning methods with noncorrosive acids, steam, CO2
2. Develop snap in place membrane tube.