

# Pervaporation pilot plant

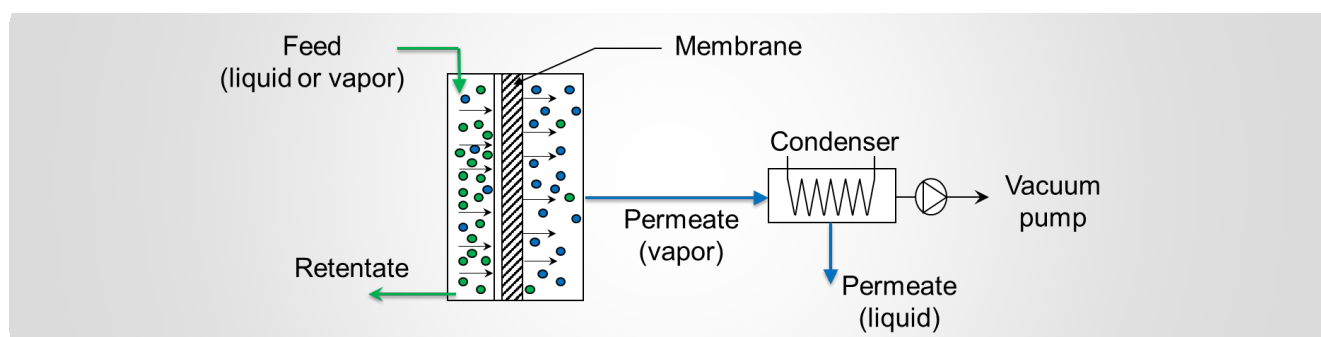
## Technical data sheet

### Innovating for the sustainability and reliability of industrial processes

Pervaporation is a process for the separation of liquid mixtures by partial vaporisation. ORELIS ENVIRONNEMENT has access to the Hybsi® technology of ceramic pervaporation membranes which allows water to be separated from solvents and organic compounds. ORELIS ENVIRONNEMENT also has a mobile system on a pilot scale

(feasibility studies, process design) and experience in the areas of solvent recycling by dehydration (Pharmaceutical), the concentration of aromatic mixtures (Fine chemistry) and the improvement of esterification processes by selectively eliminating water from the reaction mixtures (Chemicals).

### Principle of pervaporation



### Our experiences in the field of pervaporation technology

Industries	Applications	Benefits
<ul style="list-style-type: none"> <li>Pharmaceutical</li> </ul>	<ul style="list-style-type: none"> <li>Solvent mixtures recycling by dehydration</li> </ul>	<ul style="list-style-type: none"> <li>High selectivity</li> <li>Low energy consumption</li> </ul>
<ul style="list-style-type: none"> <li>Chemicals</li> <li>Petrochemicals</li> <li>Biofuels</li> </ul>	<ul style="list-style-type: none"> <li>Alcohols dehydration (IPA, Butanol...)</li> <li>Esterification mixtures dehydration</li> <li>Azeotropic breaking</li> <li>Solvent recycling</li> </ul>	<ul style="list-style-type: none"> <li>Implementation with minimum process modification</li> <li>Flexible for batch or continuous processes</li> </ul>
<ul style="list-style-type: none"> <li>Fine chemistry</li> <li>Flavor &amp; Fragrances</li> <li>Food &amp; Beverage</li> </ul>	<ul style="list-style-type: none"> <li>Concentration of aromatic mixtures</li> </ul>	<ul style="list-style-type: none"> <li>Process intensification</li> </ul>

### Why our pervaporation pilot is unique ?

- Compact design, small footprint, large membrane area for a small feed volume
- Easy integration into an industrial plant
- **Versatile pilot plant**
- Could work with vapor or liquid feed
- Extrapolation / Scaling-up: x 100
- Fast and complete dehydration of organic mixtures (100 ppm of water possible at the end of the purification)
- High water permeation flowrate > 4 kg/h
- Compatible with most types of solvents
- Continuous permeate condensation
- Extremely stable process conditions



#### Versatile pilot plant

- Ceramic or polymeric membrane
- Pervaporation or vapor permeation
- Dehydration at stable conditions or extremely quick purification
- Semi-automatic or automatic control

# Our pervaporation pilot plant

## (5): Monitoring

Control interface



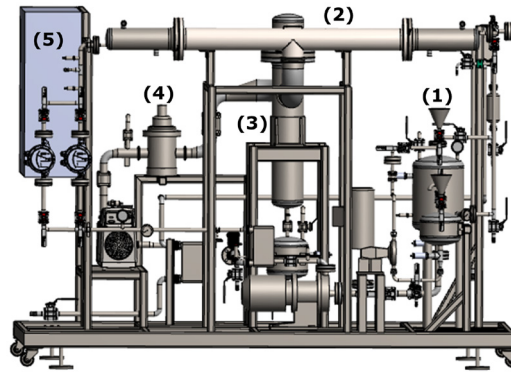
## (2): Membrane module



1 membrane	7 membranes
0,15 m <sup>2</sup>	1,05 m <sup>2</sup>

## (3) & (4): Permeate

Condenser	Cold trap
0 to -50°C	- 180°C



## (1): Feed

Max Temperature	Max Pressure
120°C	8 bar



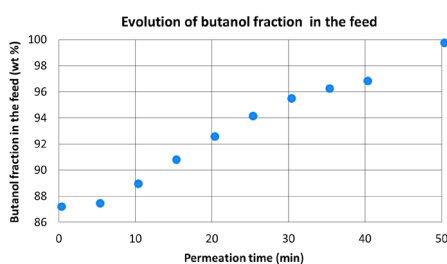
pH 2 to 14

# Performances

## Performances with HYBSI® ceramic membrane (hybrid silica)

Feed composition	Temperature (°C)	Flux (kg/h.m <sup>2</sup> )	Permeate composition
95% Butanol, 5% Water	80	3,5	2% Butanol, 98% Water
90% Ethanol, 10% Water	75	3,5	20% Ethanol, 80% Water
88% Ethanol, 5% Methyl isobutyl ketone, 7% Water	70	2,5	80% Water
92% Ethyl acetate, 2% Ethanol, 2% Toluene, 1% Acetic acid, 3% Water	70	1,5	87% Water
Ester acrylate, Alcohol, Acrylic acid, 15% Water	75	12	Ester acrylate, Alcohol, Acrylic acid, 90% Water
Water, 30g/L Polyphenols, 50g/L Suspended solids	40	2,5	Containing traces of organic compounds

## Butanol concentration (20L at 70°C)



## Butanol dehydration (80-100°C)

