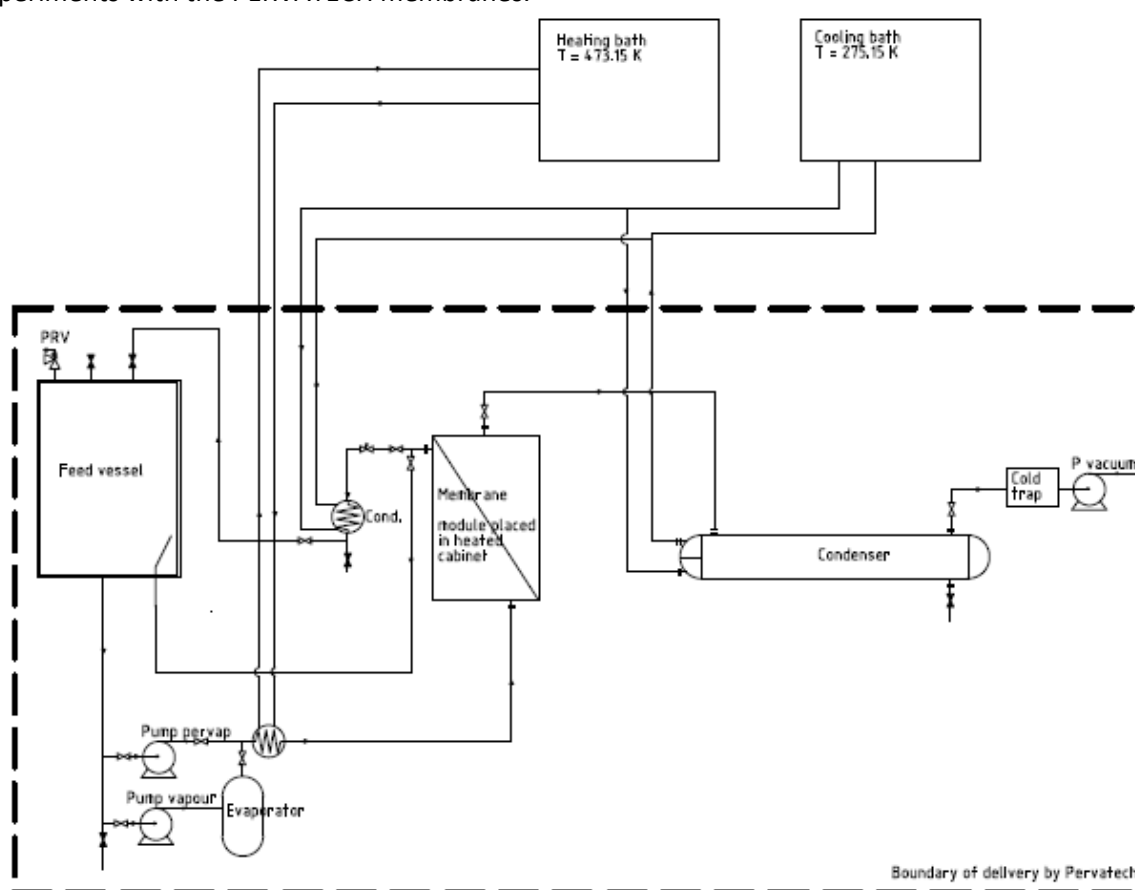


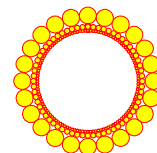
## Datasheet: Lab Scale Unit CTU-054

The unit is developed to conduct laboratory scale pervaporation/vapour permeation process experiments with the PERVATECH membranes.



The base unit consists of:

- Frame, SS 316 tubing, appendages
- Feed vessel 2 litre SS 316 and piping SS 316
- Frequency controlled magnet driven turbine pump, 150° C, 2500 litre/h, max head 2,5 bar, max pressure 10 bar, 230 Volt 50 Hz, 0,37 KVA, certified for Ex zone 2
- Injection pump, 1,8 ltr/h, max pressure 40 bar, certified for Ex zone 2
- Flasher
- Super heater
- Pressure control valve
- Retentate condenser
- I-materials, flow P vac, either analogue or certified for Ex zone 2
- Electric heating mounted onto the tank, certified for Ex zone 2
- Vacuum pump, non-Ex to be placed remotely
- Permeate collection: Duplex cold trap with coolant -20°C to -196°C (liquid N2).
- 4-tube module type PVM-043, including 4 ceramic pervaporation membranes.
- Electrically heated autoclave
- Electric control cabinet, non-Ex - remote control
- Manual



### Process description of the Application Tester in pervaporation mode

The feed stream is re-circulated over the module, meanwhile transporting the permeate through the membrane with vacuum applied on the permeate side.

The feed (liquid) comes from the feed tank with capacity of 2 litre, and is regulated by a frequency controlled positive displacement pump, which facilitates also the re-circulation over the module. The feed tank is heated by thermal oil.

The cross-flow over the membrane can be set by the frequency controller of the feed pump. Typical liquid linear velocity through the membrane module is about 1,5 to 2 m/sec, to prevent concentration polarization. Lower velocities will reduce the refreshing of the species to be transported through the membrane.

The permeate vapour is liquefied in the cold traps using liquid nitrogen, dry ice/acetone or any coolant serving the condensation as required.

Vacuum is established by means of a non-Ex dry membrane vacuum pump which is placed remotely.

### Process description of the Application Tester in vapour permeation mode

The feed stream is injected in the flasher where it evaporates. The vapour is superheated and fed to the module. The residence time of the vapour in the module is controlled by the pressure control valve in the module outlet side. The residence time determines the rate of dehydration of the feed. The retentate is condensed and the permeate vapour is liquefied in the cold traps using liquid nitrogen, dry ice/acetone or any coolant serving the condensation as required.

### Options

Fractionated condensation trap

The permeate vapour is liquefied by this first condenser, which is cooled with cooling water, the remaining non-condensables are solidified in the cold traps. The fractionated condensation facilitates separating the higher boiling point species first, followed by solidification in the cold trap system.

1-tube module type PVM-035, including 1 ceramic HybSi pervaporation membrane.

Maximum process temperature for the membrane 150°C.

Standard enclosure with O-ring EPDM-PC, max temperature 130°C.

Kalrez O-rings are available upon request and will be charged extra.

Dimensions of the tubular ceramic membrane: 250 x 10 x 7 mm (Length x diameter outside x diameter inside), with the membrane coated on the inside of the ceramic tube and the ends glazed.

Test cell SS 316 for flat sheet PDMS membranes, dimension of the Test Cell 280 x 130 mm. Dimensions of the flat sheet membrane 210 x 68 mm. Active membrane area  $\approx$  85 cm<sup>2</sup>.

Feed flow channel 8,4 x 2 mm (0,168 cm<sup>2</sup>). Feed connections with Swagelok 1/4" NPT Union fittings. Vacuum connection NW16. Enclosure with 14 x M12 bolts. Designed for atmospheric pressure. Temperature rating for the Test Cell is limited by the maximum temperature the flat sheet membrane can tolerate.

Remarks:

- The design is based on the standard flow sheet for this system, the cooling bath is excluded
- Commissioning on site is not included, which has to be agreed upon when placing the order
- Instruction and basic training on site is not included, instructions are presented in the manual
- Travel and lodging expenses, if necessary, are not included
- Final design of the base frame to be discussed