Pervaporation module design with CoorsTek support tubes

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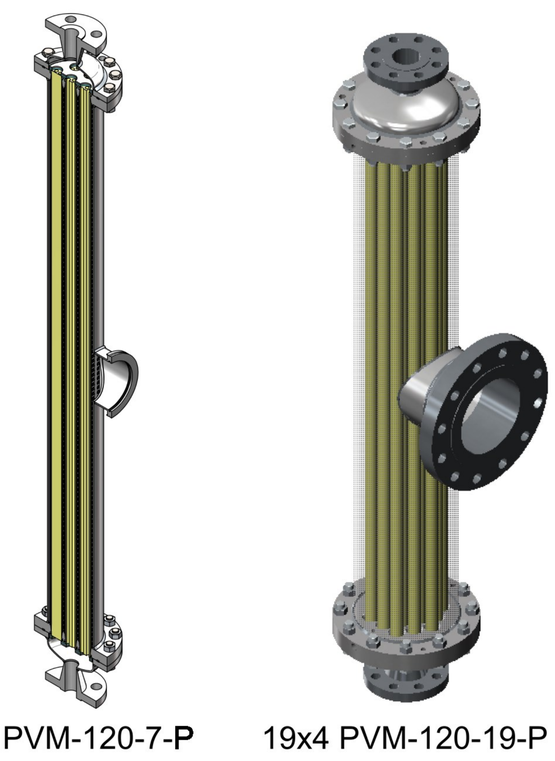
Introduction:

- Pervaporation, evaporation of a component of liquid mixture over membrane [1]
- Membranes: porous ceramic support tubes, thin selective layer [2]
- Modules: 7 / 19 membrane bundles (0.74 / 2.0 m^2), Fig. 1



7x4 PVM-120-7-P 19x4 PVM-120-19-P

Figure 1. Pervaporation modules

➢ Pressure drop permeate side < 1 mbar?

Computational Methods:

- COMSOL 4.3b Single-Phase Fluid Flow
- 4 work planes; 250,000 elements
- Stationary solver

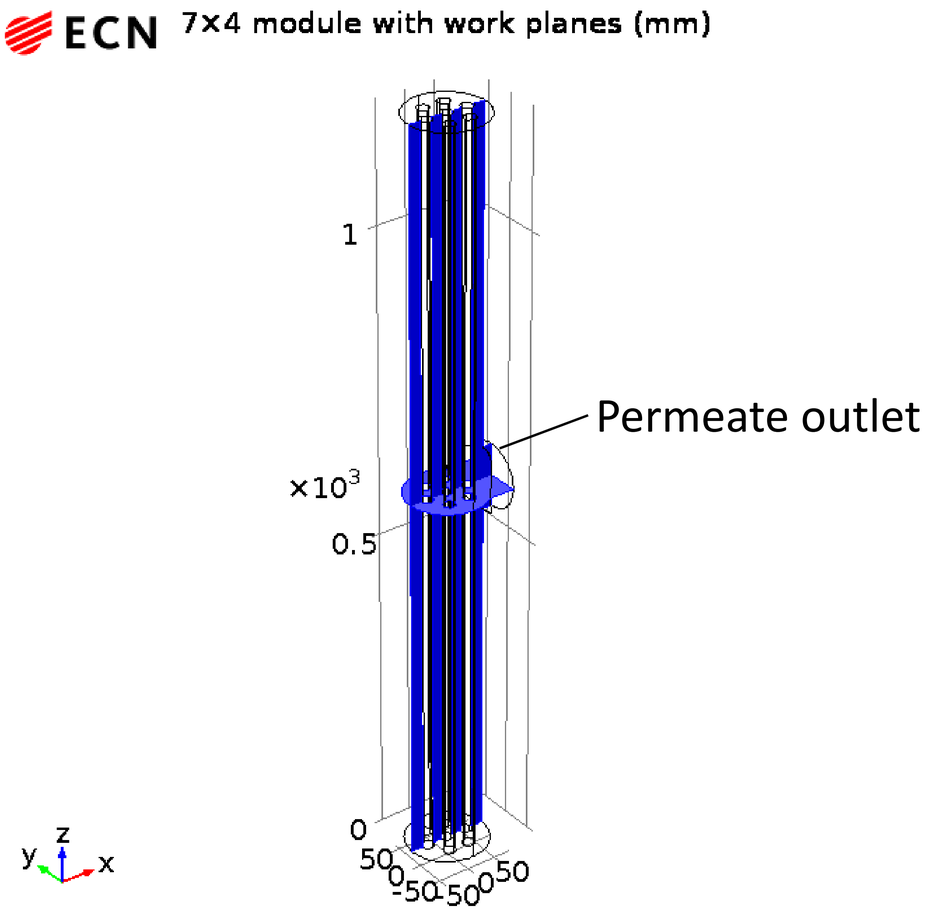


Figure 2. Permeate/vacuum side model

Results:

7x4 PVM-120-7-P Module

- Water flux 20 kg m^{-2} h^{-1}
- Velocity maximum 27 m s^{-1} (Fig. 3)
- Pressure drop 0.1 mbar (Fig. 4)

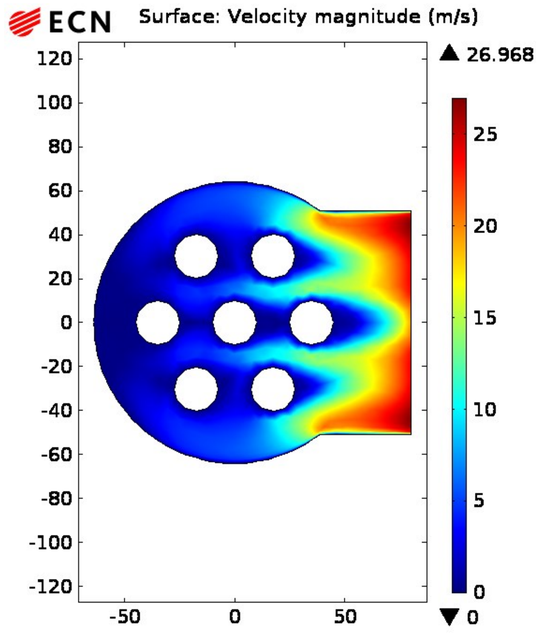


Figure 3. Velocity 7x4

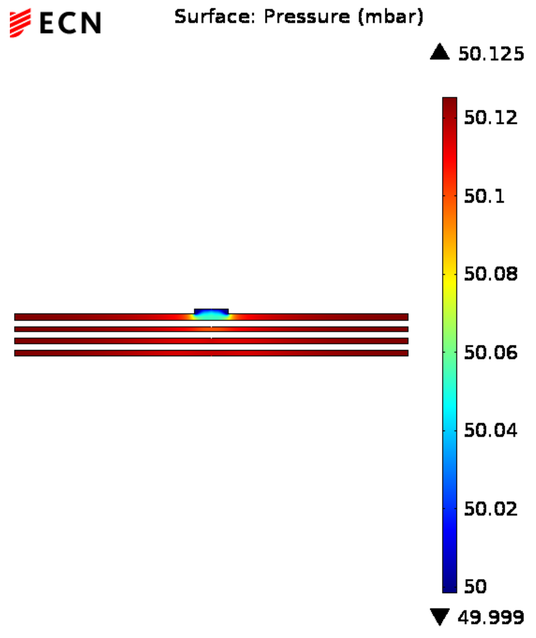


Figure 4. Pressure 7x4

19x4 PVM-120-19-P Module

- Water flux 20 kg m^{-2} h^{-1}
- Velocity maximum 32 m s^{-1} (Fig. 5)
- Pressure drop 0.2 mbar (Fig. 6)

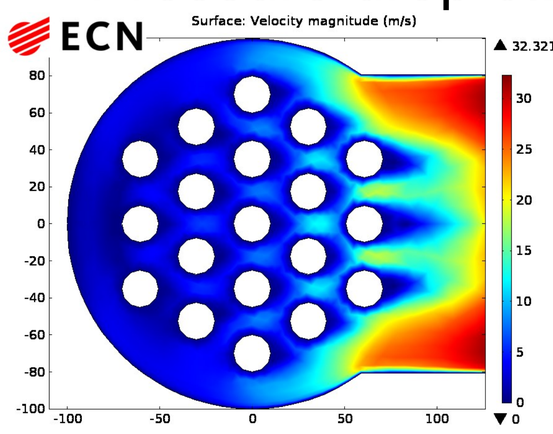


Figure 5. Velocity 19x4

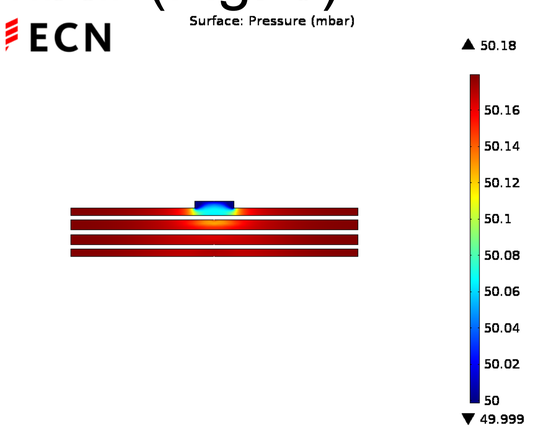


Figure 6. Pressure 19x4

Conclusions:

- No mass transfer resistance (pressure drop) on permeate side
- No modifications required to reduce pressure losses

References:

1. HybSi website http://www.hybsi.com
2. PervaTech http://pervaporation-membranes.com/
3. Boon et al., Pervaporation module design, Sep Purif Technol, to be submitted (2016)

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