‘Pervamodel’ enables optimization of single and multichannel pervaporation system design

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Keywords: *pervaporation; process design; optimization*

BACKGROUND:

- Pervaporation: selective evaporation over a membrane
- Process optimization is needed to obtain the best configuration
- A simulation tool “Pervamodel” was developed to analyze and optimize the module configuration to lower capital and operating costs
- Modules can be in series and/or parallel
- Tool built within Aspen Custom Modeler

Calculations

- Feed: 7100 kg/h of 11.4 wt.% water in IPA
- Product (retentate): < 2.2 wt.% water
- 1 module contains 1.7 m^2 of membrane area
- m modules parallel and n modules in series

Two configurations: 1) no retentate recycle (Fig. 1) and 2) retentate recycle (Fig. 2)

Mass and heat balance and pressures based upon [Lipnizki]

Results and Discussion

Amount of modules in parallel + series, and total amount, see table 1.

Total costs of purification: 746 kEuro/m^2 and 590 kEuro/m^2 for configuration 1 and 2 respectively.

Mass transfer through boundary layer is rate determining: recycling increases feed velocity, decreases membrane area and decreases costs.

CONCLUSIONS

The ‘Pervapmodel’ tool developed in this work can be used to optimise a pervaporation system for any membrane type. Different geometries or flow configurations are easy to implement.

References

Lipnizki F. and Field R.W., Integration of vacuum and sweep gas pervaporation to recover organic compounds from wastewater, Sep. Purif. Technol. Vol. 22-23 (2001) 347–360.

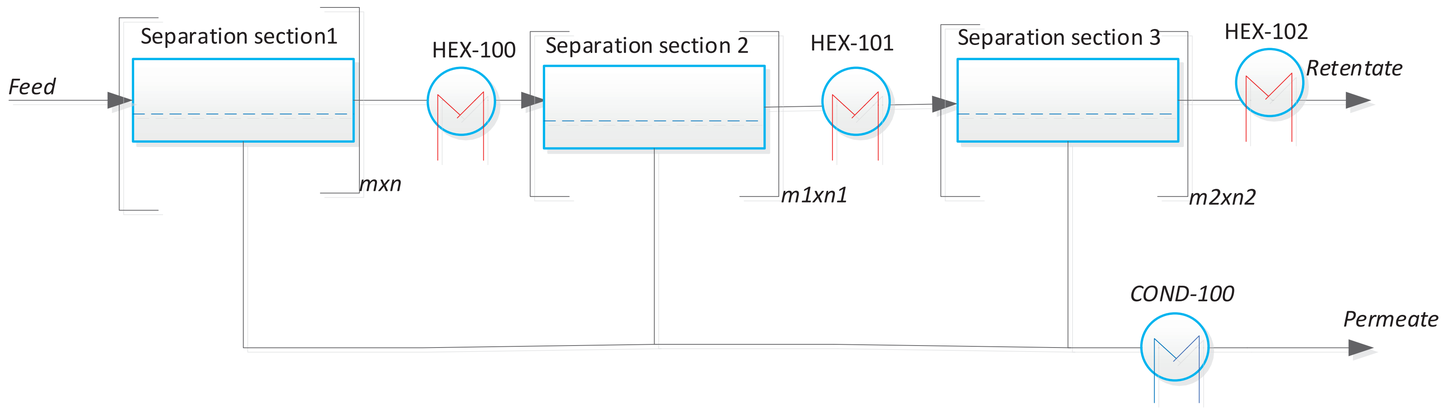

Figure 1. System without the retentate recycle

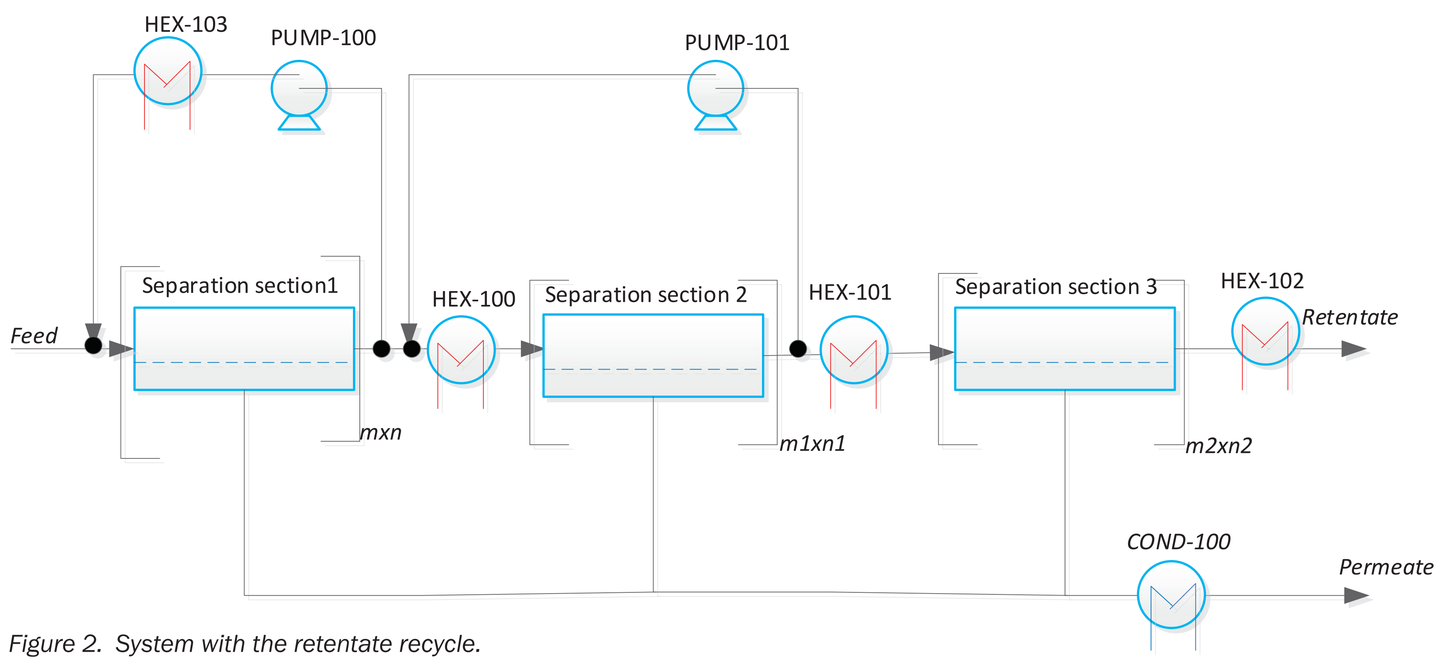

Figure 2. System with the retentate recycle.

System	Separation section 1	Separation section 2	Separation section 3	Total modules
Figure 1	2X10*	2X13	1X20	66
Figure 2	3X16	1X6	1X5	59

**Modules in parallel X series*

Table 1. Suggested system configurations by the model calculations