Author’s Accepted Manuscript

Numerical simulation of 3D hollow-fiber vacuum membrane distillation by Computational fluid dynamics

Yonggang Zhang, Yuelian Peng, Shulan Ji, Shaobin Wang

Chemical Engineering Science

www.elsevier.com/locate/ces

PII: S0009-2509(16)30288-3
DOI: http://dx.doi.org/10.1016/j.ces.2016.05.040
Reference: CES12979

To appear in: *Chemical Engineering Science*

Received date: 5 November 2015
Revised date: 24 May 2016
Accepted date: 29 May 2016

Cite this article as: Yonggang Zhang, Yuelian Peng, Shulan Ji and Shaobir Wang, Numerical simulation of 3D hollow-fiber vacuum membrane distillatio by Computational fluid dynamics, *Chemical Engineering Scienc* http://dx.doi.org/10.1016/j.ces.2016.05.040

Numerical simulation of 3D hollow-fiber vacuum membrane distillation by computational fluid dynamics

Yonggang Zhang[a], Yuelian Peng[a*], Shulan Ji[a*], Shaobin Wang[b*]

[a]Beijing Key Laboratory for Green Catalysis and Separation, Department of Chemistry and Chemical Engineering, College of Environmental and Energy Engineering, Beijing University of Technology, Beijing 100124, P. R. China,

[b]Department of Chemical Engineering, Curtin University, GPO Box U1987, Perth WA 6845, Australia.

pyl@bjut.edu.cn

shul@bjut.edu.cn

Shaobin.wang@curtin.edu.au

**Corresponding authors. Tel.: +86 10 13401022604; fax: +86 10 67391983.*

Abstract

Computational fluid dynamics (CFD) was employed for modelling and simulation of the heat and mass transfer processes in hollow-fiber vacuum membrane distillation (VMD) under laminar flow conditions. A three-dimensional VMD model was first developed and validated by coupling the latent heat with the energy conservation equations and experimental data. Then it was used to analyze the effects of operating conditions and module dimensions on local temperatures, heat transfer coefficients, temperature polarization coefficients, heat and mass fluxes and total thermal efficiency in an operation of the feed flowing in the lumen of the fibers and the shell in vacuum. Thermal efficiency varied with feed temperature and feed velocity. Temperature polarization became more significant at high feed temperature and low feed velocity. Mass transfer was controlled by the heat transfer in the feed boundary. Local heat and mass fluxes decreased along the fiber length because of high local heat transfer coefficient in the inlet region and thin thermal boundary. More importantly, total thermal efficiency decreased with increasing module length, thus a short module was better used for high efficiency of VMD.

Keywords: Computational fluid dynamics (CFD); vacuum membrane distillation (VMD); hollow fiber; operating conditions; module dimensions.