A review of heat integration system in dividing wall column for oleochemicals separation

Malakiah Sidek, Norul; Rizza Othman, Mohamad
[a] Department of Chemical Engineering, Faculty of Chemical Engineering and Natural Resources, Universiti Malaysia Pahang, Lebuhraya Tun Razak, Gambang Kuantan, 26300, Malaysia

ABSTRACT
The dividing wall column (DWC) alone is exclaimed to be energy-efficient compared to typical distillation column (DC). However, as with DC, there is further potential energy saving can be made in the DWC through heat integration. This article reviews the recent developments of heat integrated DWC technologies including heat pump assisted distillation and internally heat-integrated distillation column (HIDiC) as well as its applications. Yet, none of these discoveries have been applied to oleochemicals separation. The underlying reasons other than limited familiarity and flexibility, are higher requirements on operation as well as design and controllability problems. This uncovered topic is of great interest and the existing literatures on the heat integration technology of the DWC would be beneficial in the attempt of designing and simulating the intensified heat integration DWC for oleochemical distillation.

KEYWORDS
Dividing wall column; Heat integration; Heat pump assisted distillation; Hidic; Oleochemicals separation

REFERENCES

[1] A.C. Christiansen, S. Skogestad, K. Lien, Partitioned Petlyuk Arrangements for Quaternary Separations. IChemE Symp. Ser. 142, 1997, pp. 745–756.

[2] I. Dejanović, Lj. Matijašević and Ž. Olujić, Dividing Wall Column-A Breakthrough towards Sustainable Distilling, Chem. Eng. Process, 49, 2010, pp. 559–580.

[3] Z. Olujić, M. Jödecke, A. Shilkin, G. Schuch and B. Kaibel, Equipment Improvement Trends in Distillation, Chem. Eng. Process., 48, 2009, pp. 1089–1104.

[4] A. Kiss, Advanced Distillation Technologies: Design,Control and Applications. John Wiley & Sons, 2013.

[5] Faessler, Peter & Kolmetz, Karl & Wan Seang, Kek & Lee, Siang Hua, Advanced fractionation technology for the oleochemical industry, Asia-Pacific Journal of Chemical Engineering, 2, 2007, pp. 315 - 321.

[6] Smith, R., Chemical Process Design and Integration. JohnWiley & Son, West Sussex, England, 2005,17–33.

[7] A.K. Jana, A new divided-wall heat integrated distillation column (HIDiC) for batch processing: Feasibility and analysis, Applied Energy, Volume 172, 2016, pp. 199-206.

[8] Minbo Yang, Xiao Feng, Guilian Liu, Heat integration of heat pump assisted distillation into the overall process, Applied Energy, Volume 162, 2016, pp. 1-10.

[9] Kiss, A. A., & Olujic, Z., A review on process intensification in internally heat-integrated distillation columns, Chemical engineering and processing : process intensification, 86, 2014, pp. 125-144.

[10] Illner, Markus and Othman, Mohamad, Modeling and simulation of a dividing wall column for fractionation of fatty acid in oleochemical industries, PERINTIS e-Journal, 5, 2015, pp. 34-44.

[11] Jana, Amiya, Advances in heat pump assisted distillation column: A review. Energy Conversion and Management, 77, 2014, pp. 287-297.

[12] Bruinsma, D and Spoelstra, S., Heat pumps in distillation. Proc. Distillation and Absorption, 2010, pp. 21-28.

[13] Olujic´Z, Jodecke, M., Shilkin, A., Schuch, G., Kaibel, B., Equipment improvement trends in distillation. Chem. Eng. Proc. 48, 2009, pp. 1089–1104.

[14] M. Gadalla; Ž. Olujić; A. de Rijke and P.J. Jansens, Reducing CO2 emissions of internally heat-integrated distillation columns for
separation of close boiling mixtures, Energy, 31, (13), 2006, pp. 2409-2417.

[15] Annakou, O., and Mizsey, P., Rigorous investigation of heat pump assisted distillation, Heat Recovery Systems and CHP, 15(3), 1995, pp. 241-247.

[16] Long, Nguyen and Lee, Moonyong, Design and optimization of heat integrated dividing wall columns for improved debutanizing and
deisobutanizing fractionation of NGL, Korean Journal of Chemical Engineering, 30, 2012.

[17] Jia Mei Chew, C.C.S. Reddy, G.P. Rangaiah, Improving energy efficiency of dividing-wall columns using heat pumps, Organic Rankine Cycle and Kalina Cycle, Chemical Engineering and Processing: Process Intensification, Volume 76, 2014, pp. 45-59.

[18] Yuliang Liu, Jian Zhai, Lumin Li, Lanyi Sun, Cheng Zhai, Heat pump assisted reactive and azeotropic distillations in dividing wall columns, Chemical Engineering and Processing: Process Intensification, Volume 95, 2015, pp. 289-301.

[19] Luo, H., Bildea, C. S., and Kiss, A. A., Novel heat-pump-assisted extractive distillation for bioethanol purification. Industrial and engineering chemistry research, 54(7), 2015, pp. 2208-2213.
[20] Iulian Patraşcu, Costin Sorin Bildea, Anton A. Kiss, Dynamics and control of a heat pump assisted extractive dividing-wall column for bioethanol dehydration, Chemical Engineering Research and Design, Volume 119, 2017, pp. 66-74.
[21] William L. Luyben, Control of an azeotropic DWC with vapor recompression, Chemical Engineering and Processing: Process Intensification, Volume 109, 2016, pp. 114-124.
[22] Shi, Li & Huang, Kejin & Wang, San-Jang & Yu, Jieping & Yuan, Yang & Chen, Haisheng & Wong, David, Application of Vapor Recompression to Heterogeneous Azeotropic Dividing-Wall Distillation Columns, Industrial & Engineering Chemistry Research, 54, 2015.
[23] Xu, Lianghua & Gao, Lianrui & Yin, Xiaohong & Yuan, Xigang, Improving performance of dividing wall column using multistage vapor recompression with intermediate reboiler, Chemical Engineering Research and Design, 134, 2018.
[24] B. Suphanit, Optimal heat distribution in the internally heat-integrated distillation column (HIDiC), Energy, Volume 36, Issue 7, 2011, pp. 4171-4181.
[25] Jana, Amiya, A new divided-wall heat integrated distillation column (HIDiC) for batch processing: Feasibility and analysis, Applied Energy. 172, 2016, pp. 199-206.
[26] Amiya K. Jana A Novel Divided-Wall Heat Integrated Distillation Column: Thermodynamic and Economic Feasibility Industrial & Engineering Chemistry Research, 57 (36), 2018, pp. 12127-12135.
[27] Lestak, F & Smith, Robin & Dhole, V.R., Heat Transfer Across the Wall of Dividing Wall Columns. Chemical Engineering Research and Design, 72, 1994, pp. 639-644.