

Author's Accepted Manuscript

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PII: S0376-7388(17)30694-4
DOI: <http://dx.doi.org/10.1016/j.memsci.2017.05.047>
Reference: MEMSCI15281

To appear in: *Journal of Membrane Science*

Received date: 13 March 2017
Revised date: 9 May 2017
Accepted date: 12 May 2017

Cite this article as: Chun Feng Wan, Tianshi Yang, G. Glenn Lipscomb, Donald J. Stookey and Tai-Shung Chung, Design and fabrication of hollow fiber membrane modules, *Journal of Membrane Science* <http://dx.doi.org/10.1016/j.memsci.2017.05.047>

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Design and fabrication of hollow fiber membrane modules

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Abstract

Membrane technologies are widely used in separation processes because of their compact size, mild operating conditions and ability to conduct separations that may not be technically or economically viable by other technologies. Relative to flat-sheet membranes, hollow fibers possess unique advantages including high membrane area, self-supporting structure and ease of handling. However, they must be assembled as large modules for industrial application. Fluid hydrodynamics within these modules is as important as intrinsic membrane separation properties. Companies have explored myriad design strategies to improve fluid hydrodynamics and mass transfer inside modules as documented in the patent literature. This review summarizes the techniques taught to fabricate high performance hollow fiber bundles. More importantly, designs to (1) promote uniform shell flow, (2) enhance mixing and (3) incorporate internal sweep within modules are discussed to inspire novel designs for next-generation hollow fiber modules.

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