Enhanced performance of a biomimetic membrane for Na2CO3 crystallization in the scenario of CO2 capture

Membrane assisted crystallization (MACr) offers an innovative platform for crystallizing Na2CO3, allowing its reuse after CO2 capture from flue gases by an alkaline solution (i.e., NaOH). In this study, the biomimetic aquaporin Inside™ membrane AIM60 was employed to enhance water removal, facilitating Na2CO3 crystallization. The water channel in the active layer, comprising aquaporin proteins, and the strong wettability of membrane substrate assist a better performance. For instance, the water flux of AIM60 membrane for concentrating a 1.89molL-1 Na2CO3 solution (osmotic pressure of 94.8bar) in forward osmosis (FO) mode was 6.62Lm-2h-1 and 3.25Lm-2h-1 in pressure retarded osmosis (PRO) mode when a 5.13molL-1 NaCl solution (osmotic pressure of 304.9bar) was employed as the draw solution. This demonstrates that the AIM60 FO membrane outperformed the previously reported dense reverse osmosis membrane (0.21Lm-2h-1 in FO mode and 0.16Lm-2h-1 in PRO mode) and a porous hydrophobic hollow fiber membrane (0.08Lm-2h-1) under the same operating conditions. Crystallization utilizing the AIM60 membrane in an osmotic crystallizer was achieved without noticeable membrane scaling or degradation. Furthermore, a proper control of the supersaturation level induces crystallization of Na2CO3·10H2O crystals with a purity of 99.94%. Hence, the aquaporin Inside™ FO membrane may be a promising alternative to existing methods for Na2CO3 crystallization for its application in a CO2 capture scenario.

General information
Publication status: Published
Organisations: Department of Environmental Engineering, Water Technologies, Aalborg University, KU Leuven, Universite Catholique de Louvain
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Number of pages: 11
Pages: 75-85
Publication date: 2016
Peer-reviewed: Yes

Publication information
Journal: Journal of Membrane Science
Volume: 498
ISSN (Print): 0376-7388
Ratings:
BFI (2016): BFI-level 2
Scopus rating (2016): CiteScore 6.13 SJR 2.087 SNIP 1.731
Web of Science (2016): Impact factor 6.035
Web of Science (2016): Indexed yes
Original language: English
Keywords: Physical and Theoretical Chemistry, Materials Science (all), Biochemistry, Filtration and Separation, Biomimetic aquaporin membranes, CO2 capture scenario, Forward osmosis, Membrane crystallization, Biomimetics, Carbon dioxide, Osmosis, Reverse osmosis, Sodium, Tobacco, Alkaline solutions, Aquaporins, Biomimetic membrane, Hydrophobic hollow fibers, Membrane scaling, Pressure retarded osmosis (PRO), Membranes
Electronic versions: postprintYe.pdf. Embargo ended: 22/10/2017
DOIs: 10.1016/j.memsci.2015.09.010
Source: FindIt
Source-ID: 2282338646
Research output: Contribution to journal › Journal article – Annual report year: 2016 › Research › peer-review