UAEU جامعة الإمارات العربية المتحدة United Arab Emirates University

The College of Graduate Studies, the College of Engineering and KU Leuven, Faculty of Engineering Science, Department of Chemical Engineering Cordially Invite you to a

PhD Dissertation Defense (Dual Degree)

Entitled

MULTI STAGE MODIFIED SOLVAY PROCESS FOR CO_2 CAPTURE AND REJECT BRINE DESALINATION

by

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Abstract

Brine management is an environmental concern, as many desalination plants need to find suitable approaches for the treatment or disposal of the large amounts of concentrated brine that are produced. Many conventional methods are used such as disposal through deep well injection, but these methods still suffer from many drawbacks. An alternative approach is to further process the brine by extracting the salts through reactions with carbon dioxide. The chemical reactions of reject brine with high alkalinity products and carbon dioxide are postulated to constitute a new, effective, economic and environmentally friendly approach. On the other hand, a major challenge of these approaches is the low salinity reduction of the treated brine which is in the range of 15-20%. Accordingly, there is an urgent need to develop a new process for the desalination of reject brine that improves the desalination efficiency. This PhD study proposes a new multi-stage desalination process to improve the reduction in brine salinity, capturing CO_2 and recovering solids product of potential commercial values. In addition, a novel contact reactor system with different hydrodynamics is evaluated at different operation conditions using a computational fluid dynamics-based simulation model. A novel multi-stage technique is tested by passing the same brine through seven stages. The overall reduction of the entire process for, Na^+, Ca^{2+}, K^+, and Cl^- was 51%, 93.59g, 79%, and 43.63%, respectively. Moreover, solid products from each stage were characterized using SEM, XRD, FTIR, and Raman spectroscopy. The products of each stage have diverse industrial applications.

Keywords: Brine Desalination, CFD simulation, CO_2 Capture, Modified Solvay Process, Multi-stage desalination, Reactor Hydrodynamics.