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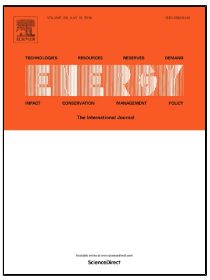

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Steady-state energy optimization and transition assessment in a process of CO_2 absorption from natural gas

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Abstract

An industrial-scale MDEA-based CO_2 absorption process is considered in this work. Natural gas plant of Aguaragüe Argentina is selected to perform the studies of optimization and dynamics. With the steady-state of the process simulated, the reboiler energy demand of the plant is optimized in Aspen Hysys v8.8. In this optimization study, we analyze the base case (current) conditions of the reference plant and also six disturbance scenarios. According to the results, the main energy requirement can be reduced in more than a 48 %, with the current process design.

In the second part of our work, the plant is simulated in dynamic mode with the aim of characterizing the transition towards the found optimal conditions. It is proved that the dynamic model can reproduce the specified values after a short-time. In addition, the absence of undesirable states during the stabilization proves that the current control scheme is appropriate to minimize the energy consume in the plant under study.

Keywords: CO_2 absorption; Natural gas sweetening; Methyldiethanolamine (MDEA); Energy optimization; Dynamic simulation; Transition assessment.

1. Introduction

Different studies have been performed to optimize the acid gas absorption process, to evaluate the dynamic performance, and to model a control scheme [1]. For instance, Panahi et al. [2] design and optimize a post-combustion plant for CO_2 capture using monoethanolamine (MEA). Lastari et al. [3] consider the energy demand as objective function and the use of the simulator Aspen Hysys to optimize the Ethane-CO_2 extractive distillation process. Also Abbas et al. [4] design and optimize the acid gas removal, particularly the absorber design in steady and dynamic modes. The developed model demonstrate that the absorption of CO_2 remains constant throughout the process, thus they generate proper process design and control loops. Furthermore, Abdulrahman and Sebastine [5], Øi et al. [6], Ghanbarabadi and Gohari [7], Al-Lagtah et al. [8], and Jassim [9] develop the steady-state of the acid gas absorption by using process simulators. Taking the capability of simulators, Mechleri et al. [10] present a dynamic simulation and control strategies applied to the post-combustion process for CO_2 capture by using MEA. In their proposed control diagram, several controllers are comprised to maintain the specified level of greenhouse gases emissions.