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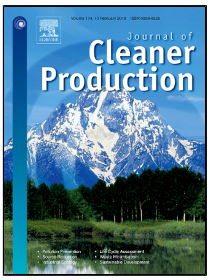

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Hamid Reza Shahhosseini, Davood Iranshahi, Samrand Saeidi, Ehsan Pourazadi, Jiří Jaromír Klemeš

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Multi-Objective Optimisation of Steam Methane Reforming Considering Stoichiometric Ratio Indicator for Methanol Production

Hamid Reza Shahhosseini[1], Davood Iranshahi *[2], Samrand Saeidi [3], Ehsan Pourazadi [4], Jiří Jaromír Klemeš [5]

[1]Department of Chemical and Petroleum Engineering, Sharif University of Technology, Tehran, Iran
[2]Department of Chemical Engineering, Amirkabir University of Technology (Tehran Polytechnic), No. 424, Hafez Avenue, Tehran 15914, Iran
[3]Technische Thermodynamik, Universität Bremen, Badgasteiner Str. 1, 28359 Bremen, Germany
[4]Department of Chemical and Process Engineering, University of Canterbury, Christchurch 8140, New Zealand
[5]Sustainable Process Integration Laboratory – SPIL, NETME Centre, Faculty of Mechanical Engineering, Brno University of Technology – VUT Brno, Technická 2896/2, 616 00 Brno, Czech Republic

Abstract

This work proposes a novel configuration for steam methane reformers (SMR) in order to improve their syngas stoichiometric ratio (S_R). This is a decisive element for methanol producers to increase their production tonnage. While the optimum theoretical S_R value is around 2, many conventional SMRs operate far beyond this value due to thermodynamic equilibrium limitations. In the new SMR design CO_2, which could be an industrial off gas, is injected into the reactor in multiple stages. The corresponding CO_2 injection flow rate is determined by a multi-objective optimization method. The optimum flow rate at each stage is chosen to minimise abs (S_R-2) while maintaining the CH_4 conversion at its highest value (about 68%). Furthermore, the new design helps to improve the thermodynamic equilibrium conversion in SMR resulting in 33% more CO production. As well as this, the pressure drop along the new reactor is proved to be substantially lower than the conventional SMR.

Keywords: Steam reforming; Methanol synthesis; Multi-objective optimisation; Pareto frontier; Methanol economy; Stoichiometric ratio S_R

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