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Author: Jie Fu Qiang Xu

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Simultaneous Study on Energy Consumption and Emission Generation for An Ethylene Plant under Different Start-up Strategies

Jie Fu and Qiang Xu

Dan F. Smith Department of Chemical Engineering
Lamar University, Beaumont, TX 77710, USA

Abstract

Chemical plant start-ups are very critical dynamic operations, which normally consume huge amount of energy and also generate large quantities of off-spec products for flaring, causing significant and intensive air emissions. Many studies have been individually conducted on energy savings or emission reductions under plant normal conditions. However, quantitative studies on simultaneous energy consumption and emission generation for chemical plant start-ups are still lacking. In this study, plant-wide dynamic simulations are employed to investigate energy consumption and emission generation for an ethylene plant under different start-up strategies. Dynamic modeling and simulations for two start-up designs associated with three start-up operating procedures are performed. Based on plant-wide dynamic simulations, dynamic profiles of energy consumption and emission generation during the plant start-up are obtained and analyzed. Details of energy accounting on cooling and heating duties of key distillation towers, auxiliary heat exchanger duties, and power consumption for compressor system are provided for each start-up case. Through comprehensive analysis, the most desirable start-up solution is identified. This virtual study not only characterizes the emission generation during the plant start-up, supporting flare minimization activities that benefits environmental sustainability, but also enhances critical research on energy and raw material savings during the plant start-up that will benefit the industrial sustainability.

Keywords: plant start-up, plant-wide dynamic simulation, emission reduction, energy saving

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* All correspondence should be addressed to Prof. Qiang Xu (Phone: 409-880-7818; Fax: 409-880-2197; E-mail: Qiang.xu@lamar.edu).