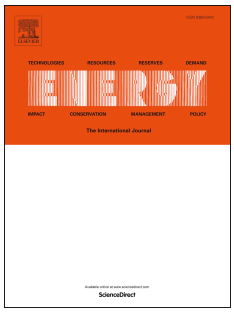
Accepted Manuscript



On-line Simulation and Optimization of A Commercial-Scale Shell Entrained-flow Gasifier Using a Novel Dynamic Reduced Order Model

Hua Zhou, Taili Xie, Fengqi You

PII: S0360-5442(18)30259-7

DOI: 10.1016/j.energy.2018.02.031

Reference: EGY 12331

To appear in: *Energy*

Please cite this article as: Zhou Hua, Xie Taili, You Fengqi, On-line Simulation and Optimization of A Commercial-Scale Shell Entrained-flow Gasifier Using a Novel Dynamic Reduced Order Model, *Energy* (2018), doi: 10.1016/j.energy.2018.02.031.

On-line Simulation and Optimization of A Commercial-Scale Shell Entrained-flow Gasifier Using a Novel Dynamic Reduced Order Model

Hua Zhou[a, b], Taili Xie[a], Fengqi You[b, *]

[a] Department of Chemical and Biochemical Engineering, National Engineering Laboratory for Green Chemical Productions of Alcohols-Ethers-Esters, College of Chemistry & Chemical Engineering, Xiamen University, Xiamen 361005, PR China

[b] Robert Frederick Smith School of Chemical Engineering and Biomolecular Engineering, Cornell University, Ithaca, New York 14853, USA

Submitted to *Energy*

Abstract

The development of computationally efficient, accurate, and stable dynamic reduced order models of Shell Entrained-flow gasifiers would help to better understand the influence of design variables, feedstocks, and processing conditions on the operating performance of the reactors. This work presents a novel dynamic model of a commercial-scale Shell entrained-flow gasifier for on-line process simulation and soft-measurement of relevant process variables. A dynamic mathematical model of the reactor is developed to obtain real-time performance data of some unmeasurable variables and assess dynamic performance of the reactor under different operating conditions. The model consists of several sub-models for devolatilization and combustion, gasification, slagging, and heat transfer. To validate the model, the simulation results are compared with the literature data. Sensitivity analysis is further performed for process optimization. Furthermore, dynamic characteristics is analyzed and optimal operational strategies for industrial Shell entrained-flow gasifier is obtained by optimizing the ratio of oxygen with carbon and the ratio of coal with carrier CO_2.

Key words: Shell gasifier, soft sensor, online simulation, optimization, entrained-flow reactor

[*]Correspondence should be addressed F. You at fengqi.you@cornell.edu.