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Author: Rahul C. Patil Pinakiranjan Patra Ajay Gupta Asit Das

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Effect of reactor Configuration on Performance of Vacuum Gas Oil (VGO) Hydrotreater: Modeling Studies

Rahul C. Patil, Pinakiranjan Patra, Ajay Gupta*, Asit Das

Refining R&D, Reliance Industries Limited, Jamnagar, Gujarat, India

ABSTRACT

While kinetics is independent of either scale or configuration of hydrotreating reactor, hydrodynamics of reactor depend on both. The hydrodynamics of reactor which comprise of phase mass-transfer, catalyst wetting and pressure drop affect its performance significantly and should be addressed adequately while deciding on configuration or scale up issues. This study evaluates and compares the performance of different configurations of commercial VGO hydrotreater by employing mathematical model encompassing kinetics and hydrodynamics. Two configurations have been studied:

1) Conventional trickle-bed reactor, subdivided into a) beds in parallel b) beds in series.
2) Pre-saturated one liquid flow (POLF) reactor, subdivided into a) reactor with single pre-saturator (POLF-SP) b) multiple reactors in series with intermittent pre-saturators (POLF-MP)

The performance of conventional reactor in series/parallel is found to be superior to POLF configurations. The inferior performance of POLF configurations is attributed to mixed flow behaviour due to recycle as against plug flow behaviour in conventional trickle-bed reactors.

Keywords: trickle-bed reactor, Pre-saturated One Liquid Flow (POLF), hydrotreating, vacuum gas oil, reactor configurations

* Corresponding author: Main Administrative Building, B3G, Refining R&D, Reliance Industries Limited, Village Motikhavdi, Post Reliance Greens, District – Jamnagar, Gujarat, India – 361142, Email: ajay.h.gupta@ril.com, Phone: +91 28840 12340