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Reverse Flow Reactors: Process Intensification for High Temperature Chemistries

Federico Barrai[2], Dhaval Bhandari[1], Charlie Chun[1], Frank Hershkowitz[1,3], James R. Lattner[2], Elizabeth Mahoney[2], Brian Weiss[1]*

[1]ExxonMobil Research and Engineering Co., Corporate Strategic Research, [2]ExxonMobil Chemical Co., Global Process Research, [3]Becht Engineering

**Corresponding author: dhaval.a.bhandari@exxonmobil.com*

Highlights

- RFR enables high temperature chemistries with effective heat management
- Multifunctional reactor technology provides capital, energy and yield benefits
- A inter-disciplinary effort is advocated to advance novel reactor technologies

1. Introduction

Global chemicals demand is expected to surpass 200 million metric tons by the end of this decade, with a growth pace faster than the global GDP. The precursors to these chemicals are often manufactured using high temperature endothermic reactions such as reforming and pyrolysis. Substantial energy is consumed to heat feed streams to reaction temperatures, and ineffectively captured as product streams are further processed. Additionally, the significant capital, physical and carbon footprint requirements make these processes ideal for the development of multifunctional and non-conventional reactors.

2. Methods

We describe a reverse flow reactor (RFR) approach that efficiently integrates heat-transfer, chemical reactions and cyclical in-situ de-coking by alternating flows between reaction (endothermic) and reheat (exothermic) steps in a fixed bed reactor. The use of high surface area, thermally robust ceramic internals allow operating temperatures up to 1500 °C enabling higher conversion and short residence times (higher selectivity) long sought out for optimal performance.

3. Results and discussion

This presentation will provide a brief introduction to RFR, discuss the key reactor features and exemplify a few applications. Finally, the need for a multi-disciplinary approach involving interplay of value proposition, modeling, materials development, and experimental demonstration is advocated for the advancement of any new non-conventional reactor technology.

4. Conclusions

High temperature endothermic reactions are a key part of modern chemical industry. Highly developed, integrated nature of conventional reactors paired with high CAPEX and slow replacement rates make it a tough challenge. Reverse flow reactors can be an advantageous manufacturing tool on several fronts i.e. capital, energy, advantaged yields, and CO_2 emissions. A multi-disciplinary effort is required to advance any new reactor technology.

Keywords

Reactors; Process Intensification; heat management; reaction engineering

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