

NPRP 08-261-2-082: Development of Novel Fischer-Tropsch Reactor Technology for Operation in Near Critical and Supercritical Fluids Condition

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Project/Technology Description

- **Objective:**
 - This study aims to provide systematic investigations on the potentials of supercritical fluids Fischer Tropsch synthesis (FTS) reactor technology. It covered the thermodynamics of the reaction (e.g., phase behavior of reaction mixture); the reaction kinetics; the energy integration and optimization; and the process control.
 - The ultimate goal is to design novel Gas-to-liquid (GTL) technology that may further support Qatar’s global leadership in natural gas processing.
- **Intellectual property position (if any):**
 - Designed novel FTS reactor with solvent separation systems. Technology filed as a provisional patent (No. 62/044,945).

Technical Approach and Solution:

- **Major Challenges addressed:**
 - Several fundamental issues relating to the use of supercritical fluid medium in FTS (SCF-FTS) reaction were addressed
- **Approach/Solution:**
 - The design for a high-pressure reactor unit for operation in various reaction media including the conventional gas phase and the supercritical fluid phase was accomplished through the series of systematic studies involving:
 - Developing a detailed reaction kinetics model for the SCF-FTS
 - Thermodynamic phase behavior studies in both the gas phase as well as SCF-FTS
 - Control system and safety analysis, process integration and optimization studies

Benefits/Potential Applications/Customers/Markets

- **Application:**
 - This design of the novel reactor configuration for FTS will open the door for future potential FTS reactors beyond the conventional multi-tubular reactors of Shell and slurry reactors of Sasol.
- **Potential Customers/Market:**
 - Energy companies who are currently working in the field of advancing the gas/biomass/coal-to-liquid technologies
 - Researchers in the field of reaction engineering and non-conventional reaction media.
 - Economists and consultant firms who are working in future GTL technology.
 - Chemical industry

Key Outcomes

- Synthesized novel reactor configurations and designed separation systems.
- Developed a process to identify the optimum supercritical solvent(s) for the FTS
- Optimized the overall FTS process design using advanced process integration techniques
- Evaluated the performance of the synthesized systems via process simulation.
- Designed, constructed and commissioned a novel FTS reactor rig to facilitate the process in different reaction media.
- Won several awards, including Qatar Foundation’s “Best Energy and Environment Program of the Year”.
- Published numerous papers in journals, conferences and workshops

Major Impacts: Designed, constructed and commissioned a novel high pressure FTS reactor rig capable of operating in various reaction media such as the gas phase and the supercritical phase