liquid hydrocarbon product is enhanced dramatically on monolithic catalysts at a relatively low conversion level. Alpha numbers and olefin/paraffin ratios obtained from monolithic catalysts support the mechanisms of reduced re-adsorption of olefins on the monolith catalysts, leading to a narrow product distribution. Control of olefin re-adsorption (e.g., by tuning catalyst coating thickness) appears to be important in achieving a desired product distribution.

This study presents an important finding about the structured catalyst/reactor system, in that the product distribution highly depends on how the structured reactor is set up. Even if a catalyst is tested under identical reaction conditions (T, P, H_2/CO ratio), hydrodynamics (or flow conditions) inside a structured channel may have a significant impact on the product distribution. FT product distributions are significantly affected by choice of catalyst structure and hydrodynamic flow conditions. Higher C5-C18 liquid fractions and olefin/paraffin ratios are obtained by conducting the FT reaction in a monolith catalyst channel rather than a packed catalyst particle bed. Wax formation is mainly caused by secondary reactions in a stagnant liquid. The straight flow channels of a monolith catalyst provide little dead volume and render quick flushing of the liquid product by convective flow so that the wax formation can be minimized or eliminated. Methane formation in the FT reaction is likely due to dry catalyst surface. The fraction of the dry catalyst surface in a monolith channel is affected by the G/L hydrodynamics inside the channel under the reaction conditions. Methane formation can be decreased by assuring complete wetting of the catalyst surface at the selected reaction conditions.

We claim:

1. A modular catalyst reactor comprising:

a feed gas channel defining a feed gas inlet disposed between a cooling panel and a gas distributor, the gas distributor comprising a porous membrane with pores of a preselected size disposed adjacent a modular structured catalyst bed, the catalyst bed including at least one monolithic insert defining a reaction zone having a preselected density of open-ended channels therein, each channel including a wall comprising a syngas conversion catalyst of a selected thickness and pore structure, the gas distributor configured to distribute said feed gas into the reaction channels of the catalyst bed at a selected linear gas velocity in a direction orthogonal to the flow of feed gas entering the reactor that fields selected reaction products therein.

2. The catalyst reactor of claim **1**, wherein said monolithic inserts comprise an inert ceramic support with a coating of said catalyst thereon.

3. The catalyst reactor of claim **1**, wherein said catalyst is a component of the wall of the channel.

4. The catalyst reactor of claim **1**, wherein said catalyst is a Co—Re catalyst on alumina.

5. The catalyst reactor of claim **1**, wherein said catalyst bed includes two or more monolithic inserts.

6. The catalyst reactor of claim **1**, wherein each of said inserts includes at least one cooling panel operatively coupled to an external surface thereof that provides cooling of said surface.

7. The catalyst reactor of claim **1**, wherein said inserts include a porous membrane on one side or two sides thereof to distribute feed as into same or Fischer-Tropsch synthesis reaction products therefrom.

8. The catalyst reactor of claim **1**, wherein said preselected density is a density of from about 100 channels per square inch to about 2000 channels per square inch.

9. The catalyst reactor of claim **1**, wherein the reactor is configured to introduce feed gas into channels of the catalyst bed at a superficial gas linear velocity below about 0.2 cm/sec.

10. The catalyst reactor of claim **1**, wherein the gas distributor is a porous metal sheet.

11. The catalyst reactor of claim **1**, wherein the gas distributor provides a uniform flow of feed gas into the channels of the catalyst bed of the reactor.

12. The catalyst reactor of claim **1**, wherein the catalyst bed has a thickness between about 1 cm and about 20 cm or greater.

13. The catalyst reactor of claim **1**, wherein channels of the catalyst bed are oriented in a direction that provides gravity flow.

14. The catalyst reactor of claim **1**, further including a channel defining a reaction product outlet disposed between the modular catalyst bed and a cooling panel on a side of the reactor opposite the feed gas channel inlet that delivers reaction products out of the reactor.

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