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4-Jun-19_ Heidelberg, Germany

Executive summary – evaluation of INFRA S2 catalyst at hte GmbH, Germany

INFRA S2 catalyst was successfully tested at hte, Germany, in the parallel reactor test rig R135.

INFRA S2 catalyst claims to be Gas-To-Liquid catalyst, which was confirmed by the test campaign.

Hot spot formation was negligible below GHSV of 700 h-1. Above GHSV of 1000 h-1 hot spot formation was measured and quantified for undiluted and diluted INFRA catalysts. The highest hot spot was around 16K. INFRA was concerned that hte would face runaway situations without a reactor equipped with a cooling jacket. This was not the case meaning that heat dissipation from the catalyst to the constant wall temperature was fast enough to avoid thermal runaways.

Fully shaped integral FT-Zeolite bifunctional catalysts have been tested with equivalent productivities compared to the INFRA Pilot Reactor at GHSV up to 4000 h-1.

Selectivity of methane was around 20% while higher CO conversion rate of 50 to 70% was maintained. C5+ productivity of 300.9 g/(kg*h) was observed at temperature of 230oC and GHSV of 3,000 h-1.
Mostly paraffins were formed. Most of the hydrocarbon products are detected and quantified in the gas-phase by on-line GC-FID. A small fraction of the INFRA hydrocarbon products was condensed as a clear liquid in the hot gas, high pressure condenser. After cooling to room temperature no

crystallization of n-paraffins was observed, confirming the presence of highly isomerized paraffins. No visible hard waxes were observed.

Offline analysis of the hot trap fluids (integral) were combined with online gas phase analysis. Combined Schulz-Flory plots showed one alpha for the INFRA catalyst. Deviations at higher carbon numbers we explain by the isomerization-induced inhibition of chain growth. The reason most likely correlate with the zeolite function of the catalyst.

Overall it has been shown that FT- or hybrid FT-synthesis catalysts can be tested in the small scale 16x-fold parallel fixed bed reactor test rig (powder and commercial shapes). The individual heating of the reactor allowed us to measure at the same time catalysts with very different activities and selectivity at constant GHSV and conversion at different reaction temperature. Within the limits of time it was not possible to fully rationalize the effect of FT-synthesis, hydroisomerization and / or hydrocracking at the zeolite. Since the conversions have been very high the partial pressure of hydrogen and CO at the beginning and end of the catalyst bed is drastically different, which will affect the hydroisomerization / cracking at the zeolite. CO, CO2 and water are all inhibiting the hydroisomerization / hydrocracking function of the zeolite.