Microchannel reactor for Fischer-Tropsch synthesis: Feasible design spaces

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Microchannel reactors have been prefered over conventional reactors for small scale Fischer-Tropsch (FT) synthesis applications, particularly due to their enhanced process intensification arising from reduced mass and heat transfer distances. High exothermic nature of FT- reacion (heat of reaction = 165 kJ/mol of reactant CO) demands that the microchannel reactors be designed to guarantee sufficient heat removal from the reaction channels to avoid reaction run-aways and prevent catalyst deactivation. In this work, both single channel and multichannel Computational Fluid Dynamics(CFD) models of microchannel reactors are developed to study the effect of various parameters like syn-gas flow rate, catalyst-inert ratio, coolant flow rate etc. on the reactor temperature. Considering near isothermality condition in the reaction channels as the design objective, feasible design spaces are pursued in terms of syn-gas flow rate, catalyst loading, catalyst-inert ratio, coolant flow rate and channel geometry. Change in coolant type will require adjustments in the values of other design variables to achieve the same objective. This too, is also explored in this work.