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Experimental Investigation on Oxidative Coupling of Methane (OCM) in Reactive Gas-Solid Vortex Reactor (RGSVR)

Aim

To determine the effect of operating parameters such as CH_4/O_2, slots in vane ring, temperature, and solid loading on optimal production of C2 through OCM in RGSVR

Justification

Oxidative Coupling of Methane (OCM) is one of the preferred routes for the conversion of methane to light olefins. These light olefins (such as ethylene) constitute crucial raw materials for the production of polymers and chemicals. Although the predominant technology for such production relies on steam cracking of crude oil in presence of steam, the process being energy-intensive and a major contributor to CO_2 emissions, OCM provides an attractive alternative. Besides, the availability of abundant methane from natural sources makes this technology commercially viable. However, due to inherent complexities in terms of selectivity of C_2 products and heat management because of the highly exothermic process, the design of the reactor is of critical importance. In this regard, gas-solid vortex reactor (GSVR) has emerged as a potential candidate for a sustainable OCM reaction.

In a GSVR, gas (mixture of CH_4 and O_2 diluted with N_2) is injected at very high velocity tangentially in the reactor. A specially designed vane ring with slots acts as a gas distributor. Such a design ensures a swirling gas injection that transfers its momentum and energy to a solid catalyst. Several past studies have established that such a flow pattern ensures high slip velocities which are conducive for heat and mass transfer. For these attributes, the application of RGSVR for OCM is being sought to be studied. The proposed project thus aims to establish RGSVR for OCM through optimal CH_4/O_2, design of vane ring, temperature, and catalyst loading.

Program

- Literature study on the background of GSVR and OCM processes.
- To investigate the influence of CH_4/O_2 and slots in vane ring on CH_4 conversion and C2 selectivity.
- Further, determination of the effect of temperature and effect of catalyst loading on optimizing the OCM reactions.

Relevant literature

- Manzano, M.N., Quiroga, A.G., Perreault, P., Madanikashani, S., Vandewalle, L.A., Marin, G.B., Heynderickx, G.J. and Van Geem, K.M., 2021. *Journal of Analytical and Applied Pyrolysis*, 156, 105165.
- Vandewalle, L.A., Marin, G.B. and Van Geem, K.M., 2021. *Chemical Engineering and Processing-Process Intensification*, *165*, 108434.
- Gonzalez-Quiroga, A., Kulkarni, S.R., Vandewalle, L., Perreault, P., Goel, C., Heynderickx, G.J., Van Geem, K.M. and Marin, G.B., 2019. *Powder Technology*, *354*, pp.410-422.