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Reactor Material and Gas Dilution Effects on the Performance of Miniplant-Scale Fluidized-Bed Reactors for Oxidative Coupling of Methane

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Keywords: Fluidized-bed; OCM; FeCrAlloy; Mn-Na₂WO₄/SiO₂ Catalyst; Dilution; Stability

Oxidative coupling of methane (OCM) represents a process concept for conversion of methane as a major component of natural gas into chemical intermediates such as ethylene at high temperatures between 700-900 °C.

The objective of this work is to study the performance of two miniplant-scale fluidized-bed reactors made of FeCrAlloy and quartz glass, respectively, with same dimension (inner diameter of 56mm). The aim is to find the necessary reaction conditions for optimizing the C₂ yield of the process, and to study the effect of the reactor material in a larger scale. These findings are important for future industrial scale applications.

2.2%Na₂WO₄-2%Mn/SiO₂ catalyst, tested for this study, was prepared by incipient wetness impregnation method and 55 g of it was tested for each experiment in the reactor. The maximum C₂ yield achieved at low nitrogen dilution gas composition was 23% for the quartz glass reactor and 20% for the FeCrAlloy reactor at 830 °C. Due to the reactivity of the reactor wall in the metal reactor, the methane and oxygen conversion as well as the C₂ selectivity are influenced. However, the results were promising considering that the reactor scale under study is the largest tested for this catalyst so far. After 7 hours of stability testing, the catalyst in the quartz glass reactor exhibited stable performance and high mechanical stability.

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