Molybdenum Loss from Iron Molybdate and Supported MoO_3 Catalysts

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Formaldehyde (CH_2O) is industrially synthesized by selective oxidation of methanol over an iron molybdate (FeMo) catalyst with excess oxygen (10% MeOH, 10% O_2, 5% H_2O, balance N_2) at near atmospheric pressure and 270-400 °C. The fresh catalyst consists of $Fe_2(MoO_4)_3$ and MoO_3 and the active phase appears to be a surface layer of MoO_x on $Fe_2(MoO_4)_3$. MoO_3 forms volatile species with methanol, which migrate through the catalyst bed and decompose to MoO_3 downstream in the reactor, causing increased pressure drop and lower selectivity, resulting in a short process lifetime [1].

To improve the process, we have studied the Mo volatilization by synchrotron-based *operando* X-ray diffraction (XRD) and X-ray absorption spectroscopy (XAS) in quartz micro-reactors [2], *operando* Raman spectroscopy in a fluidized bed reactor [2] and in laboratory fixed bed reactors for up to 600 h using sieved catalyst particles [3] and using whole, ring shaped catalyst pellets in single pellet reactors [4,5]. From this we derived an engineering model including the kinetics of volatilization and diffusion of all species describing the temporal evolution of molybdenum volatilization from a single pellet and increase in pressure drop in a single reactor tube.

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