Abstract

Projecting the Performance of a Continuous Bosch Carbon Dioxide Reduction System

Kinetic studies using a subscale reactor were used to develop power-law rate equations for the two primary reactions contributing to the Bosch carbon dioxide reduction process: the reverse water-gas shift reaction and the carbon monoxide hydrogenation reaction. An alloy catalyst in bead form was used in these studies, which investigated both the dependence on gas composition and the dependence on time as the beads gradually disintegrate during carbon formation. Bead disintegration impacts both the rates and the relative activities of the two primary reactions. Although the kinetic testing was conducted in a single-pass mode, the target Bosch application requires operation in a recycle mode to achieve high conversion. Further, the proposed design concept for a full-scale carbon dioxide reduction system would allow carbon to be removed continuously in contrast to previous Bosch processes that required replacement of expendable catalyst cartridges. The developed power-law kinetic rate equations were used in conjunction with a reactor model to project the operating conditions, performance, and sizing of a continuous Bosch system.

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