Fluidized bed hydrodynamic modeling of CO2 in syngas: Distorted RTD curves

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Abstract

Bubbles rising through fluidized beds at velocities several times superficial velocities contribute to solids backmixing. In microfluidized beds, the walls constrain bubble sizes and velocities. To evaluate gas-phase hydrodynamics and identify diffusional contributions to longitudinal dispersion, we injected a mixture of H2, CH4, CO, and CO2 (syngas) as a bolus into a fluidized bed of porous fluid catalytic cracking catalyst while a mass-spectrometer monitored the effluent gas concentrations at 2 Hz. The CH4, CO, and CO2 trailing RTD traces were elongated versus H2 demonstrating a chromatographic effect. An axial dispersion model accounted for 92% of the variance in the data but including diffusional resistance between the bulk gas and catalyst pores and adsorption explained 98.6% of the variability. At 300 °C, the CO2 tailing disappeared consistent with expectations in chromatography (no adsorption). H2 and He are poor gas-phase tracers at ambient temperature. We recommend measuring the RTD at operating conditions.

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