ELSEVIER

Applied Catalysis A: General 227 (2002) 321–333

APPLIED CATALYSIS A: GENERAL

www.elsevier.com/locate/apcata

Catalyst performance testing. Radial and axial dispersion related to dilution in fixed-bed laboratory reactors

Rob J. Berger*, Javier Pérez-Ramírez, Freek Kapteijn and Jacob A. Moulijn

Industrial Catalysis, DelftChemTech, Faculty of Applied Sciences, Delft University of Technology, Julianalaan 136, 2628 BL Delft, The Netherlands

Received 23 August 2001; received in revised form 16 October 2001; accepted 7 November 2001

Abstract

The effect of different distributions of catalyst particles and diluent particles on the conversion in gas-solid systems for an irreversible first-order reaction was investigated in a laboratory microreactor. Vertically and horizontally segregated beds, as well as mixed beds were considered. The experimental investigations were performed by employing catalyzed N_2O decomposition over two different catalysts: FeZSM-5 and Co-La,Al mixed oxide. If the catalyst and the dilution are not well-mixed, the conversion may reduce significantly due to bypassing and axial dispersion. The effects are the strongest at high conversions. Since a completely homogeneous distribution of catalyst and diluent is difficult to achieve, the use of data obtained at high conversions with diluted fixed beds should preferentially be avoided, since it can lead to a wrong interpretation of kinetic data, e.g. the apparent activation energies may vary considerably.

The radial and axial dispersion coefficients were estimated from the experiments, all in the laminar-flow regime, using the Random Particle Distribution (RPD) model. The bed tortuosity derived using the model corresponds well with values reported in literature.

Keywords: Catalyst testing; Bed dilution; Radial Dispersion; Axial Dispersion, Laboratory reactor; Kinetics; Modeling; Simulation; N2O decomposition; Apparent Activation Energy.

* *Corresponding author.* Tel.: +31 15 2784316; fax: +31 15 2784452.
E-mail address: r.j.berger@tnw.tudelft.nl (R.J. Berger)