Kinetics of Malonic Acid Degradation in Aqueous Phase over Pt/Graphite Catalyst

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Abstract

This work aims at describing quantitatively the catalytic decarboxylation of malonic acid over a 5.0 wt.% Pt/graphite catalyst. The study was carried out using a slurry phase continuous flow stirred slurry reactor (CSTR) at a temperature range of 120–160 °C and at a reactor pressure of 1.8 MPa. The conversion of malonic acid during catalytic oxidation was found to proceed via decarboxylation to CO_2 and acetic acid, and also oxidation to CO_2 and H_2O. No indication of deactivation of the platinum catalyst was observed at a maximum residual oxygen pressure in the reactor up to 150 kPa. A reaction mechanism involving elementary steps has been suggested to explain the decarboxylation and oxidation of malonic acid. A kinetic model that accounts for both non-catalysed and catalysed decarboxylation of malonic acid has been developed and validated. The non-catalysed reaction is first order in malonic acid. The activation energies and adsorption enthalpies have been determined. The model is able to describe the experimental data adequately.

Keywords

Wastewater treatment;
Malonic acid;
Acetic acid;
Decarboxylation;
Kinetics;
Platinum catalyst;
Multiphase reactors