

High Throughput Catalyst Evaluation of Commercial Hydrogenation Catalysts for Processes with High Hydrogen to Feed Ratios

E. Lorenz¹, T. Zimmermann¹, F. Schneider, M. Dahlinger¹, J. Haertle¹, N. S Govender¹, S. Teli¹, A. A. Almathami²

¹hte GmbH, Sipchem, ²Prince Mohammed Bin Fahd University

Abstract

Butanediol is an important intermediate for the production of polymers and agricultural products that can be manufactured starting from different feedstocks. The fastest growing process is the gaseous reaction starting from butane via maleic anhydride and dimethyl maleate to form butanediol with high selectivity. Sipchem a globally recognized manufacturer of base chemicals, intermediates and polymers requested a catalyst performance test to assist the catalyst selection for the next turnaround. hte supported this task by performing an accelerated catalyst ageing study on a 16-fold high throughput catalyst screening system.

The herein investigated reaction is a multi-step selective hydrogenation which is operated under high hydrogen to substrate ratios on industrial scale. Such conditions are practiced routinely for vapor phase hydrogenations, e.g., butanediol from dimethyl maleate, fatty acid methyl esters to fatty alcohols, or nitroaromatics to aromatic amines.

We describe how the process was successfully transferred to laboratory scale. The entire parameter space relevant for commercial application was screened at a closed mass balance. The high severity protocol for accelerated ageing included varying reaction temperature, total pressure and feed concentration for 16 different spatial catalyst arrangements in parallel. The tested catalyst showed a very high activity with a product yield close to thermodynamic equilibrium, suppressing the formation of side products to a minimum. We observed excellent stability within 500 hours 24/7 operation.

Sipchem was impressed by data quality, reproducibility. hte's proprietary solutions for advanced big data handling provided a fast and convenient way to evaluate the results by selective clustering. These results facilitated the further decision process for the next catalyst change out.