OPEN ACCESS Freely available online

Natural Products Chemistry & Research

Kinetic Modelling for The Dehydration of Methanol to Dimethyl Ether over silica doped γ-Al2O3

Vivek Ruhil

Rajiv Gandhi Institute of Petroleum Technology, India

Abstract

Scientific research in the field of energy has been focused on the findings of newer alternatives to that of conventional resources. The demand for the production of alternatives for clean energy sources has risen with the increase in depletion of oil reserves, environmental pollution, and to diversify energy resources for the country's future energy security. More particularly, the emission of pollutants from C.I engines of automobiles has initiated the research for clean and diesel alternative fuel, such as Dimethyl Ether so that we could climb up towards green economy. DME appears to be a reliable option because it can be produced from non-fossil feedstocks, but also for its low greenhouse emissions, versatility and safety. It is well known that DME could be used as a proper substitute for diesel or LPG in the coming years as it is found to have high cetane number and ignition temperature near to that of diesel. DME, as a solution to environmental pollution and diminishing energy supplies, was synthesized more efficiently, compared to conventional methods, using a Bench-top fixed bed micro reactor unit for methanol dehydration to DME over Silica doped Alumina(SIRALOX-1 (Alumina 99% and Silica 1%) catalyst with high activity and stability. Even though, Alumina based catalysts are suitable with its weak to medium acidity, due to their hydrophilic nature, water adsorbs competitively with methanol.

2CH3OH CH3OCH3 +H2O ΔH= -21.225 kJ/mole

Here in my work a kinetic model has been established for the dehydration of methanol to DME over -Al2O3 acid function. The kinetic model considers the reaction of methanol dehydration to be elementary. The effect of water in the reaction medium (due to the high adsorption capacity of -Al2O3) has been considered by adding a term to the reaction rate expression, which takes into account the partial inhibition of active site activity. Thirteen different models have been tested. The selection of the best model has been carried out on the basis of the Fisher test.The experimental set-up was modified for the kinetic studies under pressurised condition. Optimum reaction conditions were obtained by a series of experiments with varying temperature, feed rate and pressure for designing the kinetic runs. The reaction studies were performed first with change in temperature (270-330°C) and later the feed composition was varied (at 6, 12, 23 wt% of water in methanol at 330°C) at a constant feed flow rate by compensating with the change in catalyst amount. The kinetic rate data against temperature was taken and obtained the activation energy which was found to be 44.79KJ/mol. Further, different kinetic models were fitted against the experimental data. Kinetic models such as power law, L-H model, Bercic and Levec models could not be fitted. But, a model proposed by Kallo and Knozinger was well agreed with the rate data with a R2(coefficient of determination) value of 0.9812 and the kinetic parameters (A=0.63572, Kw=1.67) were found with this model. The final rate equation deduced is, $-rm = 0.636*(-44787.5RT)pm0.5pm0.5+1.67*pw$

-rm reaction rate, mol/h gcat

pm partial pressure of methanol

pw partial pressure of water

KW Adsorption constant of water

From the above experimental investigation it can be inferred that a suitable kinetic model in agreement with the experimental data was found which would be further used for the design of the pilot scale reactor for the process scale-up.

Biography

Vivek Ruhil has completed his Master degree from Rajiv Gandhi Institute of Petroleum Technology, India .

Citation: Vivek Ruhil, Kinetic Modelling for the Dehydration of Methanol to Dimethyl Ether over silica doped γ-Al2O3 . Petro Chemistry 2021, 2nd International Conference on Petro Chemical Engineering and Natural Resources, February 10-11, 2021, 10.

Nat Prod Chem Res 2020
ISSN: 2329-6836

Volume 8 | Issue 4 | 10