Kinetics and Modelling Study of the Catalytic Reaction of Methane and Hydrogen Sulphide over Mo/La_2O_3-ZrO_2 Catalyst

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ABSTRACT

In recent times the availability of liquid fuels reserves is constantly declining. This reality has triggered research for the discovery of new solutions using other energy resources.

Catalytic steam reforming is a widely used method today either to produce hydrogen or to give syngas as the first step for the conversion of methane into liquid fuels through the Fischer-Tropsch synthesis.

The reforming of CH_4 by H_2S can be considered as the first step of an alternative route to produce light hydrocarbons from methane. With this process, the removal of H_2S in natural gas streams is no longer necessary and sulfur, usually considered as a strong pollutant on liquid fuels in refineries, is used as a reagent in H_2S form of hydrodesulphurization processes. Furthermore, this alternative produces hydrogen, a valuable chemical and clean energy source, and carbon disulphide as a secondary petrochemical.

The open literature concerning the kinetic study of the methane-hydrogen sulphide reaction is very poor. In this research the reaction of CH_4 and H_2S over zirconia catalyst modified with lanthanum oxide impregnated with molybdenum has been studied in a fixed bed tubular reactor varying the inlet CH_4 flowrate over a temperatures range of 1023 – 1323 K and feed molar ratio CH_4:H_2S of 1:12. The Langmuir-Hinshelwood theory has been used to determine kinetic models. Model discrimination has been performed by using statistical and thermodynamic constraints.

Finally, the simulation process of reforming CH_4 by H_2S has been developed in which separation of the reaction product and H_2S involves absorption through diethanolamine. A tubular reactor from kinetic parameters was designed. Aspen Plus ® 11.1 simulation software was used. Preliminary results showed a high H_2 produced by this route, also; low temperatures where considered to performance this reaction.

Keywords: reforming, hydrogen, kinetics