ABSTRACT

In the Fischer-Tropsch (FT) synthesis, CO and H_2 (synthesis gas) are converted into plethora of hydrocarbons mainly paraffins and olefins and these can be further upgraded to high-quality fuels and chemicals. Different carbon sources such as natural gas, coal and biomass can be used as feed-stocks for the synthesis gas. In commercial applications, precipitated and fused iron catalysts are commonly used in the Fischer-Tropsch synthesis, especially when the synthesis gas emanates from coal or biomass where the CO/H_2 needs adjustments via the WGS reaction and when the desired final products are mainly olefins. However, there was a problem associated with the catalyst's mechanistic resistance; also, these types of Fe catalysts consume large amounts of iron resource. Development of cheap, efficient and robust support iron catalyst become an urgent task

Zeolites and zeolite rocks are commonly used in different industrial applications. Natural zeolites present an attractive material as supports in FTS because of their high abundance, availability, low costs and their properties. Detailed mineralogical knowledge and profound characterization of natural zeolites are essential for fitting chemical composition to use. Si/Al ratios are very import as well as the other contaminates. A fundamental difference exists between commercial supports such as silica and alumina - with functional porous materials - and natural supports such as zeolites. In this study natural zeolite called clinoptilolite (a type of zeolite found in South Africa) was used as a catalyst support. This support proved to be promising for low-temperature Fischer–Tropsch synthesis (LTFTS) targeting liquid fuel production, as well as chemical feedstock. Synthesis of this highly active catalyst was by loading of iron on clinoptilolite through the wet impregnation method. The prepared catalyst was then characterized by XRF, BET surface area analyzer, XRD and SEM. The catalyst was then loaded into the reactor and reduced with hydrogen prior to FTS. The effects of its use as support in FTS were investigated in a fixed bed reactor.

From the XRF results the molecular ratio SiO_2/ Al_2O_3 of the Clino-support was 5.86. The average crystal size of the particles from both HRTEM and XRD ranged 9.8 -11.6 nm and around 10.10nm for used and fresh catalyst. It was found that the CO consumption rate of 1.02 x 10^{-4} mol/min.gcat of which 7.24 x 10^{-5} mol/min.gcat was the actual Fischer Tropsch rate with

the remaining 2.93 x 10^{-5} mol/min.gcat consumed by the WGS reaction. The product distribution of the gaseous phase analysed were more olefinic than paraffinic. The product distribution for this condition follows a one alpha ASF distribution with an alpha value of 0.86. These findings may permit the development of new effective support materials, which are cost effective for clean fuel production via FTS process.