Use Of Natural Gas Become a Petrochemical with Zeolite Catalyst

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Abstract. Methane is a hydrocarbon compound that can be used for various purposes. Currently, methane is widely used as fuel, and continues to be developed as a synthetic gas material and petrochemical products that have added value, one of which is formaldehyde. This study aimed to study the partial catalytic oxidation reaction of methane to formaldehyde using $\text{MoO}_3/\text{zeolite}$ as a catalyst. Reactant gas stream consisting of pure O_2 and CH_4 were contacted with a rate ratio of 1:20, put into Fixed Bed Reactor therein contained 30 grams of catalyst $\text{MoO}_3/\text{zeolite}$, and the pressure was maintained at 1 atm. The temperature and flow rate of the incoming reactant gas were used as variables. The main product produced was formaldehyde, besides that there were also CH_3OH , CO , CO_2 , H_2O . The results were analyzed using Gas Chromatography, so it was known that the converted methane was 5.18% and the volume fraction of formaldehyde formed was 1.46%.

Keywords: Natural Gas, Zeolite Catalyst, Methane

1 Introduction

Zeolite is an acid catalyst that is interesting enough to be investigated and studied further for its performance in catalyzing hydrocarbon reactions. This is due to the nature of zeolite which is generally suitable as a catalyst or as a catalyst support. Therefore, zeolites can be used as filters, ion exchangers, absorbent materials and catalysts [1]. This suitability is due to the structure of the zeolite which generally provides effective site cavities for several chemical reactions, at high temperatures the catalyst activity is more effective, H-zeolite has good activity stability [2].

In Indonesia, the availability of zeolites is in large enough deposits. However, its benefits are still not so widespread. Methane is a hydrocarbon that can be utilized for various needs. The main use of methane at this time is as a fuel, recently it has been continuously developed as a synthetic gas material and also other petrochemical products. In connection with very excessive and cheapness of methane encourage people to convert it into other products that have added value. Which now has done are converting vapor methane into syngas, converting the syngas into methanol and then converting methanol into chemicals which are more useful for example, methanol can be oxidized to formaldehyde through commercial catalytic processes. Formaldehyde is known as a raw material for

manufacturers of insulation and adhesive materials. Formaldehyde industries generally use metal catalysts of Fe and Mo, as the metal catalyst is more tolerant of contaminants so that widely applied in the industries [3].

The partial oxidation reaction of methane to formaldehyde was carried out by Spencer [4]. Through the experiments, Spencer reacted methane and oxygen gas with a molar ratio of 19: 1 to 6: 1 at a pressure of 1 atm. The gas was flowed through the $\text{MoO}_3/\text{SiO}_2$ catalyst at a temperature variable of 848 °K to 923 °K and a gas velocity (GHSV) of 2500-10000 per hour. Results of Spencer's experiment showed that methane was converted around 0-5%, while the selectivity of formaldehyde between 30-89%. As well as known that mechanism of oxidation of methane into formaldehyde of the order of 1 to methane, the reaction equation as follows:

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length of residence time in the reactor, so the catalytic oxidation reaction will run well.

Fig.4. Relationship between CHOH and τ at various temperature

As seen in the figure, there is a gradual increase in formaldehyde, then tends to stabilize. this is because the maximum volume of the reactor is no longer capable, so that formaldehyde becomes stable.

Fig.5. Relationship between H₂O and τ at various temperature

It can be seen in the figure that H₂O increased with increasing residence time. Due to the activity of catalyst and also by the formation of H₂O

Fig.6. CHOH selectivity relationship with temperature at various τ

The decrease in selectivity of formaldehyde was due to the formation of other products during the oxidation

reaction, namely CO, CO₂, H₂O and methanol. The highest selectivity of formaldehyde occurred at 300 °C about 97.8 %.

4 Conclusion

1. From the results of oxidation reaction methane to formaldehyde obtained the highest conversion CH₄ of 5.18% with a volume fraction of formaldehyde out of the reactor 1.46%
2. The catalytic oxidation reaction studied is an order reaction 1 to methane.

References

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