The Catalytic Dehydrogenation and Process Optimization of Propane to Propylene on Various Catalyst

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The dehydrogenation of propane is as important process to produce propylene in propane. Propylene is an important chemical intermediate, and is considered to be an core material in the petroleum industry. Propylene is a raw material for making plastic polypropylene which mainly used in the automotive and textile industries. Therefore, the propylene demand is continuously increasing in the industry, and the propylene production is an industrially important process. So, the study of propylene production through propane is valuable, related studies have been carried out continuously.

However, the yield of propylene is not always constant because most of the propylene is obtained as a by-product rather than as the main product. Also, the reaction for obtaining propylene from propane is very hard because the reaction must be heated to 600℃ or higher due to the enormous endorthermicity. It is accompanied by many problems, for example when the reaction is carried out using catalyst, most of the catalyst is inactivated rapidly and coke formation is occurred due to oxygen.

Therefore, in this study, we tried to find the conditions that inhibit the deactivation of the catalyst and inhibit the formation of coke in the reaction to produce propylene by dehydrogenation of propane, and to optimize the reaction under that condition.

The feed consisted of propane, oxygen, nitrogen and steam, and nitrogen was used as an inert gas. The main products produced through this are propylene and CO_2.

At the beginning, the composition of the initial gas mixture was checked. The composition of the gas mixture from the end of the reactor was analyzed by gas chromatography. As a result of GC, the mole fraction of each component was known, and the conversion of propane and selectivity of products were calculated.

The influence of the temperature was confirmed by the change of the temperature on the catalyst bed, and the effect of feed composition was confirmed in the results obtained by changing of feed components ratio.

Through the results of this process, we optimized the process by aligning the parameters affecting the reaction and simulated the process.

As a result of the experiment, unlike the existing dehydrogenation process of propane, the feed stream contains oxygen and steam instead of hydrogen, thereby alleviating the high cost problem caused by the heat requirement. In addition, the rate of deactivation of the catalyst relative to the existing process was slow due to the inclusion of oxygen and steam in the feed stream, and the activity of the catalyst did not decrease due to the formation of coke.

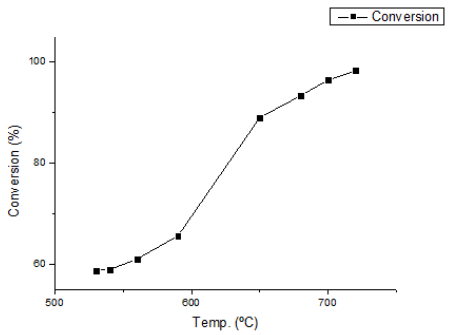

Fig.1 The effect of temperature of catalyst bed in reactor

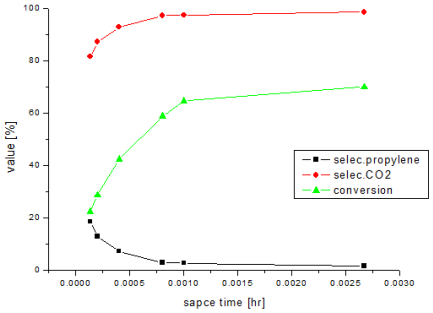

Fig. 2 The effect of space time by change of propane flow rate at feed stream

REFERENCES

[1]M.M. Bettahar, G. Costentin, L. Savary and J.C. Lavalley, Applied Catalysis A : General 145 (1996) 1-48

[2] K.A. Couch, J.P. Glavin, D.A. Wegere and J.A. Qafisheh, PTQ Q3 (2007) 33-43