The Effect of Pore Size over Cobalt-based Al_2O_3@SiC Catalysts for Fischer-Tropsh Synthesis

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Production of synthetic fuel by Fischer-Tropsh Synthesis has received considerable interest because of having higher octane numbers and lower sulfur contents. It has been suggested that the FTS is a key process in Gas-To-Liquids (GTL) technology. Limited petroleum reservoirs and global warming make GTL an attractive alternative technology for sustainable development [1].

Because FTS is a high exothermic reaction, effectively removing heat is a critically important factor for increasing selectivity and productivity of desired product. Generally, the Co-based FTS catalysts are based on oxide supports which have poor thermal conductivity. The low thermal conductivity of oxide supports can cause "hot spots" within catalyst bed and "temperature runaway" in a few cases. Therefore, the design of catalyst with high thermal conductivity could be a key approach to maintain the reaction temperature under the tested conditions [2]. It was known that SiC has superior mechanical strength and thermal conductivity. These properties were expected to be an ideal thermal conductivity enhancement for the catalyst [3].

In this study, SiC powder as a thermal conductivity enhancement of composite support was applied to Co-based catalysts for Fischer-Tropsch synthesis. It was found that Al_2O_3@SiC as a supports shows difference pore size distribution compared to pure alumina support. These Al_2O_3@SiC supports have spacious pore-size distribution and were applied to improve the pore-size effect of catalysts for Fischer-Tropsch synthesis. These supports were prepared by mixing beohmite and silicon carbide powder with diluted HNO_3 solution. After the homogenous mixing of resultants by a kneader, the catalysts were formed by an extruder which has 1.5 mm diameter die and are marumeried.

Fig. 1 shows the CO conversion and selectivity of each catalyst (Co based Al_2O_3@SiC(a) and Co based Al_2O_3(b)). Both catalysts show steady selectivity for CH_4 and C_{6+}, however CO conversion of the catalyst(a) decreased more than that of the catalyst(b). Because the average pore size of the catalyst(a) is 8.5 nm and that of the catalyst(b) is 11.5 nm. It was interpreted that the pore of the catalyst(a) can be easily blocked than that of the catalyst(b) by the deposition of wax products. And the difference of carbon number distribution between (a) and (b) means the catalyst(a) shows higher thermal conductivity than the catalyst(b). Therefore this phenomenon are considered that it may be due to the average temperature of catalyst bed is high. The catalyst(a) has more higher (>16) carbon number distribution then the catalyst(b).

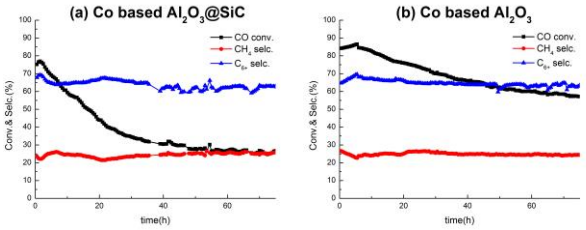

Fig.1 The performance of (a) Co based Al_2O_3@SiC, and (b) Co based Al_2O_3.

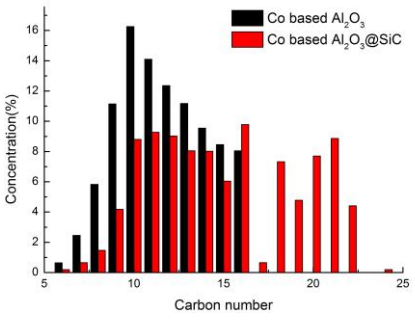

Fig. 2 Carbon number distribution chart.

REFERENCES

[1] J. S. Jung, J. S. Lee, G. Choi, S. Ramesh and D. J. Moon, Fuel 149, (2015), 118

[2] E. Asalieva, *et al*, Appl. Catal. A Gen. 505, (2015), 260

[3] P. Nguyen and C. Pham, Appl. Catal. A Gen. 391 (1-2), (2011), 443