Journal of Farayandno – Vol 17 – No 78 (2022): pp. 95-108

National Iranian Oil Refining and Ditribution Company (NIORDC)

Journal of Farayandno

Review Paper

An Overview of Light Olefins Production Catalysts via Naphtha Catalytic Cracking Olefins

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Received: 9 Apr 2022 **Accepted:** 20 Aug 2022

1. ABSTRACT

Light olefins such as ethylene and propylene are the main foundations of the petrochemical industry. These materials are used in various industries such as the production of resin, polyethylene, polypropylene, ethylene oxide, fibers and other chemicals. The use of these materials as feedstock has led to a rapid increase in demand for them in recent years. Catalytic Cracking due to lower energy consumption and less emission of greenhouse gases can be a somewhat effective way to replace the method. Thermal cracking with vapor to produce olefins. In this paper, high performance catalysts in the naphtha catalytic cracking process to produce light olefins are investigated and compared.

Keywords: Light Olefins, ZSM-5 Zeolite, Naphtha, Catalytic Cracking

2. INTRODUCTION

Approximately two-thirds of the world's propylene consumption is used to produce polypropylene so the production of propylene has received more attention than ethylene. (Figure 1)

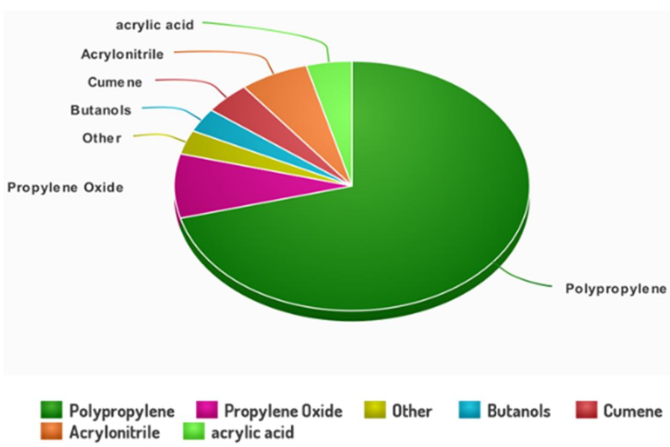

Figure 1. Consumption of propylene to produce chemicals [1]

Common technologies for the production of olefins are thermal cracking of naphtha with steam, fluid bed cracking of naphtha using zeolite catalysts, deep catalytic cracking, dehydrogenation and oxidative dehydrogenation of light alkanes and methanol to olefin process. Thermal cracking of naphtha is one of the main processes to produce light olefins but due to high energy consumption, high reaction temperature, high amount of CO_2 emission, difficult control of selectivity towards light olefins, as well as low efficiency of ethylene and propylene (about 25% and 13% respectively), this method

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Please Cite These Article Using:
Ghazimoradi, M., Safari, N., Soltanali, S., Ghasabzadeh, H., "An overview of light olefins production catalysts via naphtha catalytic cracking olefins", Journal of Farayandno – Vol. 17 – No. 78, pp. 95-108, In Persian, (2022).

is not economically justified. So other processes such as catalytic cracking is raising attentions. One of the main issues in the discussion of thermal catalytic cracking is the type of catalyst used in the process; it is very important to investigate and design a catalyst that has a higher selectivity to light olefins such as propylene and also to ethylene.

3. RESULTS AND DISCUSSION

So far, various zeolites such as ZSM-5, ZSM-48, SAPO-34, IM-5, Mordenite, etc. have been studied for the catalytic cracking of naphtha. In this part, in summary, according to the researches that have been done on the best catalysts for this issue, some zeolite catalysts have been examined. [2]

a. ZSM-5

This zeolite produces lighter products than other zeolites. Considering the increasing importance of light olefins, especially propylene, the catalytic cracking of various types of hydrocarbons by modified ZSM-5 zeolites has been investigated in order to increase the production of light olefins. The amount of propylene production compared to other olefins can be well controlled by the type and strength of acidic sites, the distribution of these acidic sites, as well as the operating conditions of the reaction.

b. SAPO-34

Silica alumina phosphates (SAPO) as molecular sieves were first reported in 1982. These molecules are similar to zeolite, but their primary structure consists of P-O-Al bonds instead of Al-O-Si or Si-O-Si.

Among the different SAPOs, SAPO-34 has good selectivity towards light olefins and is widely used in methanol to olefin process.

c. Mordenite

Mordenite is a silica-rich zeolite with a silicon-to-aluminum ratio of about 5, which occurs naturally and can be easily synthesized. The strength of acid sites in this zeolite is high, and this feature is the main reason for the widespread usage of this zeolite. Mordenite is a zeolite with large and one-dimensional cavities, which is easily deactivated due to the occupation of one-dimensional cavities. One way to solve this problem is to dealuminize this catalyst, which causes the formation of mesopores inside the pores and prevents to form coke quickly.

d. IM-5

The new IM-5 molecular sieve has a complex structure and communication channels and has a pore volume of about (0.13 cm^3/gr). IM-5 has very good hydrothermal stability, high activity in the catalytic cracking process, and the same shape selectivity as ZSM-5. The selectivity towards (C_3-C_4) using IM-5 catalyst was approximately 80% by weight, but it was less than 70% by weight for ZSM-5. [3]

e. ZSM-48

This zeolite is known from connected ferrite plates and has an irregular structural framework. ZSM-48 has a suitable catalytic performance in various reactions such as hydrocracking, hexane cracking and MTH process.

4. CONCLUSION

Catalytic cracking is one of the most important chemical processes in the world, which converts low-value petroleum materials into more valuable materials. The catalyst has a very determinative role in directing the catalytic cracking process. A little change in the physicochemical properties of the catalyst can direct the reaction in a specific direction. One of the important parameters of zeolite is the Si/Al ratio, which has a significant effect on the performance of the catalyst. The use of different additives to zeolite, such as alkali metals, alkaline earth metals, transition metals, or catalyst modification with different methods, such as post-synthesis techniques, examples of which are mentioned in this article, changes the production efficiency of light olefins.

5. REFERENCES

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