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INNOVATIVE APPROACH TO IMPROVING THE PROCESS OF OBTAINING ETHYLENE MONOMER BY PYROLYSIS

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Abstract
Ways to improve the production of ethylene monomer by pyrolysis of hydrocarbon raw materials at Shurtan gas-chemical complex were studied and the kinetic as well as activation parameters of propane pyrolysis, the formation of methane and ethylene monomer were determined. The rate constant (k) was calculated using a first-order equation, which is confirmed by the linear dependence of ln1/1-α on the phase contact time.

Keywords: natural gas, ethylene, ethylene monomer, pyrolysis, conversion, polymerization, rate constant, phase contact time.

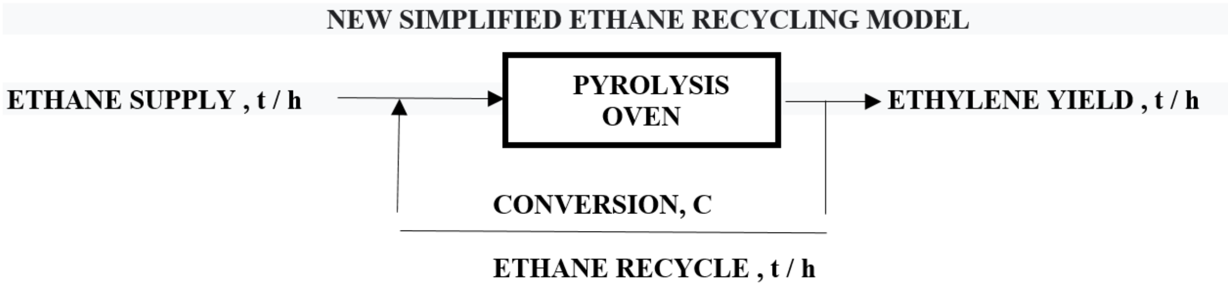
Introduction

Ethylene is a raw material for the production of oligomers and other products of organic synthesis. Therefore, one of the most important tasks of the gas processing industry is to improve existing methods for processing associated gases into lower alkenes C_2-C_4, which are used as the base raw material for the production of polymers and rubbers. In this regard, an urgent task is to study the technology for producing ethylene monomers, propylene, isobutylene, butadiene-1,3 and isoprene from natural gases [1-5]. For this purpose, ethane, propane, butane contained in associated gases from oil production, thermal and catalytic cracking gases, as well as liquid hydrocarbons: gas gasoline and low- octane fractions of straight-run oil are used as raw materials.

This work shows the yield of ethylene, conversion and recycling of ethane and other target products of the pyrolysis process from the composition of hydrocarbon feedstock at the Shurtan Gas Chemical Complex (ShGChC).

Materials and Methods

The technological process of pyrolysis consists of the following main stages: pyrolysis in tube furnaces, preparation of pyrolysis gas for compression, compression pyrogas, cleaning and drying, deep cooling, gas separation and processing of pyrocondensate. In addition to ethylene, pyrolysis plants produce hydrogen, methane, propylene, $C_{4\ fraction}$ containing 30-40% by weight, butadiene, 25-30% by weight, isobutylene, $C_{5fraction}$, heavy pyrolysis resin and pyrolysis gasoline (liquid pyrolysis products), from which aromatic hydrocarbons are isolated. The flow diagram of the pyrolysis process is a short-term high-temperature treatment of hydrocarbon feedstock at 750-880^{o}C in order to obtain pyrolysis gas with a maximum content of ethylene and propylene.



Results and Discussion

The process is accompanied by a significant number of chemical transformations of hydrocarbons. We have studied the change in temperature control in the alkaline tertiary treatment column DA - 1201 of ShGChC based on the inlet temperatures of the pyro - gas , since during the operation of the alkaline purification and neutralization unit of spent alkali, a problem of polymer formation was observed in the alkaline tertiary treatment column DA -1201, which is a sign development of undesirable reactions in the column. As a result of the formation of polymer in the column, polymer accumulation and clogging of the column plates and filters of the upper and lower circulation pumps of the alkaline solution and waste alkali were observed. And due to fluctuations in the temperature of the wash water supplied to the alkaline column and a sharp change in the composition and flow of pyrogas, the ability to maintain effective temperature control of the DA -1201 column will decrease, and as a result, the likelihood of developing undesirable reactions will increase.

Therefore, it was proposed to change the control of the TS-12001 control valve based on the pyrogas inlet temperature. The application of this proposal for three months gave a positive result. When carrying out the technological process, as a result of the interaction of alkali and hydrogen sulfide, sulfur-alkaline wastewater is formed , and in the process of side reactions of aldol condensation, a by-product is formed - “yellow oil”. “Yellow oil” is removed for thermal neutralization together with the treated hydrocarbon solvent from the unit for neutralizing sulfur-alkaline wastewater. Contamination of the system with “yellow oil” leads to contamination of the internal devices of the column with the consequences of a decrease in the efficiency of the column, expressed in a deterioration in the degree of extraction of acid gases, an increase in the consumption of fresh alkali, an increase in the consumption of spent alkali, leading to an increase in the cost of waste treatment, due to contamination of waste alkali. Periodically, the resulting “yellow oil” is removed from the bottom of the column to prevent it from being recirculated and causing further contamination.

The density of the "yellow oil" is less than the density of the caustic solution and, therefore, it must accumulate above the caustic solution level in the waste caustic section. The kinetic and activation parameters of propane pyrolysis and the formation of methane and ethylene monomer were calculated. The calculation of the rate constant (k) was carried out using a first-order equation, which is confirmed by the linear dependence of ln 1/1- α(where αis the degree of conversion) on the phase contact time (τ), shown in Figure 1.

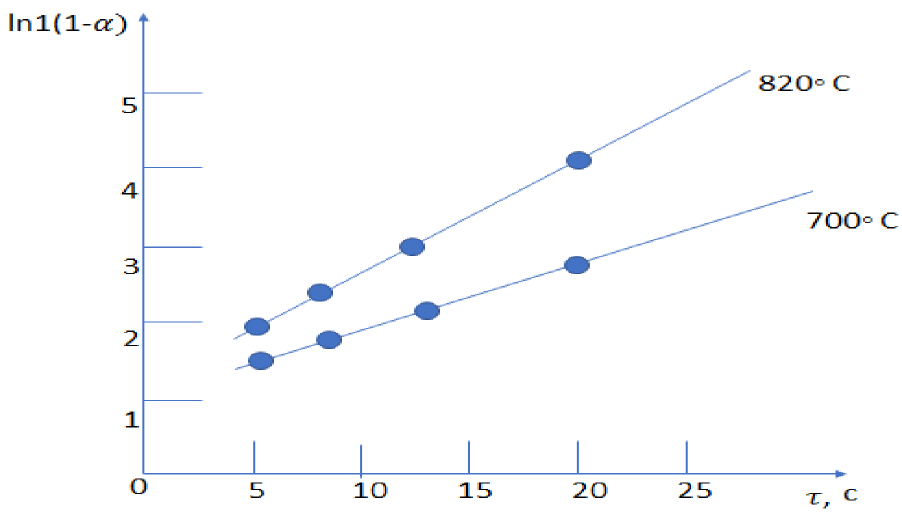


Fig.1. Dependence of the degree of hydrocarbon conversion on time

Conclusion

Thus, for the first time, a way to improve the production of ethylene monomer by pyrolysis of hydrocarbon raw materials at the ShGChC has been completed in order to use the results of the work in production activities.

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