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Simulation of Light Naphtha Isomerization Process

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Abstract

An approach to modeling the isomerization process implemented in the technological scheme with the maximum normal paraffins conversion was described. The comprehensive mathematical model was designed as a powerful tool for optimization. It is based on the influence of the feedstock composition for assessment of the current catalyst activity. According to the calculations, the optimal operating parameters are determined by the refined feedstock composition.

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Keywords: isomerization, catalyst, mathematical simulation.

1. Introduction

The decrease in aromatic hydrocarbon content of gasoline can be achieved by blending reformate, alkylate and isomerate while meeting high octane rating[1]. Also the isomerization process allows refining the low octane light fractions thereby increasing the overall yield of gasoline. However the maximum conversion of low octane C_6 hydrocarbons into high octane dimethylbutanes corresponds to low process temperature which reduces the kinetic factor of reactants conversion. Currently, a great number of works are devoted to the synthesis and experimental study of new catalysts for the isomerization[9 - 11], besides a lot of attention is paid to the study of the hydrocarbons conversion mechanism during the catalytic isomerization process[14, 16]. According to[13, 19], the main problems arise in

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the study of the mechanism of carbenium ion formation, catalyst acidity role of different promoters and hydrogen in the process. Optimization and prediction of light naphtha isomerization process is a complex technological problem. The most effective solution of this problem is the use of mathematical simulation method of physical and chemical laws of the process.

2. Research object

Among the multifold of isomerization process flow diagrams the most effective is «Isomalk-2» technology with platinum oxide catalyst which has considerably higher efficiency than the Pt/zeolite catalysts, as well as high resistance in comparison with Pt/Al_2O_3-Cl systems[2, 20]. Depending on the flow structure «Isomalk-2» technology allows obtaining a product with RON from 82 to 92 points. Light straight-run gasoline fraction NBP-62 °C is used as feedstock. Complete conversion of pentane-hexane fraction is provided by two recycle process scheme for unbranched pentane and hexane (Fig. 1).

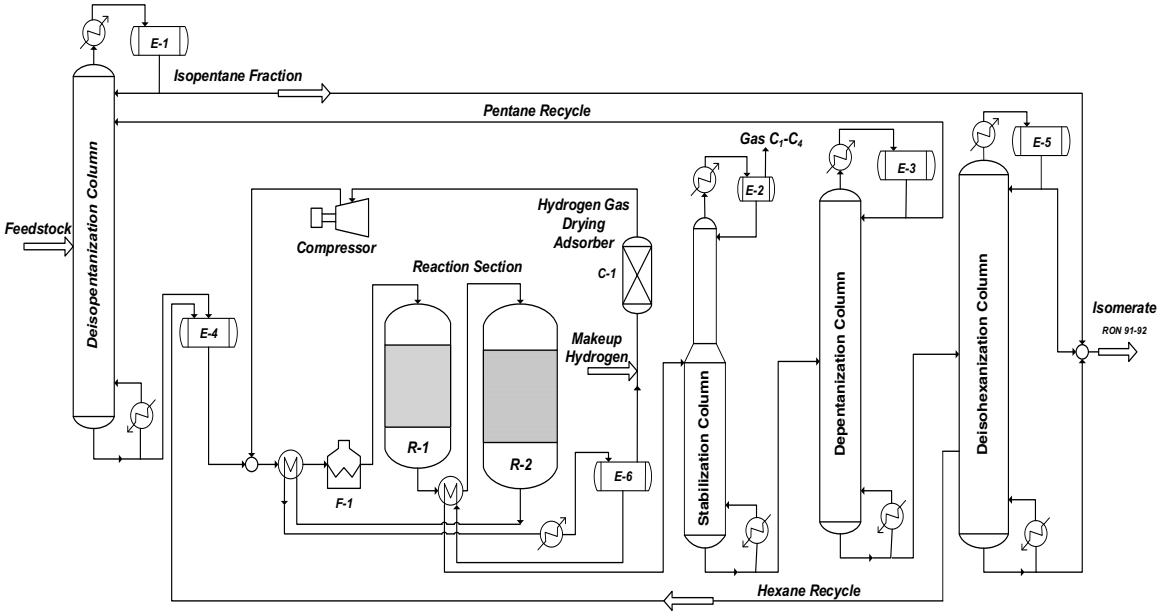

Fig. 1. Light straight run naphtha isomerization process flow diagram

The hydrotreated feedstock enters the column of the deisopentanizator for isopentane fraction separation, and then after blending with the deisohexanizator the side cut flows to E – 4, and then with makeup hydrogen passes the preheater, the combined feed successively passes the two isomerization reactors R-1, R-2. The hydrogen separation occurs in E-6 separator, after that hydrogen is mixed with the fresh hydrogen stream, and passes through the adsorption drying unit (C-1 adsorber) and is fed to the reception of the circulation compressor. The off gases C_1 - C_4 are separated in the stabilizer column. The stable isomerate enters the depentenization column for pentane fraction separation. The depentanized isomerate is then supplied to the deisohexanization column, where the mixture of unconverted unbranched C_6 hydrocarbons is separated as a side cut flow. This flow structure allows maximizing the potential of «Izomalk-2» technology. Implementation of pentene and hexane recycles can help to achieve the 91-92 point isocomponent RON.