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Study of catalyst regeneration approaches based on modified montmorillonite with the aim of developing a technology for obtaining fuel iso-components during the Fischer-Tropsch synthesis

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Abstract

Despite the prevalence and effectiveness of the method of oxidative regeneration of catalysts, it is known that the application of this method leads to irreversible deactivation and sintering processes. The study of regeneration approaches and the search for alternative effective methods for restoring the activity of catalysts is an actual task. This paper presents the results of the application of various approaches to the regeneration of the Fischer-Tropsch synthesis catalyst based on modified montmorillonite. The efficiency of extractive regeneration with benzene-toluene-xylene fraction (BTX) and supercritical carbon dioxide was established by the differential thermal analysis method, the latter approach allows restoring the catalyst activity practically to the level of the fresh sample. The results of the investigation of the effect of various methods of regenerating a heterogeneous Fischer-Tropsch synthesis catalyst based on modified montmorillonite are presented. A study of the catalytic activity of a catalyst sample after each regeneration method established that after oxidative regeneration during the Fischer-Tropsch synthesis, the yield of C_5-C_8 isostructural hydrocarbons is reduced to 29.4% by weight. Presumably, the cause of the observed effect is sintering, which by its nature is an irreversible process. The use of extractive regeneration by the BTX fraction allows the yield of 53.5% by weight to be achieved. The most effective method of regeneration is the method of regeneration of SC-CO_2. The yield of hydrocarbons i-C_5-C_8 reaches the level of a fresh sample of the catalyst (58.0 % by weight). In order to determine the efficiency and stability of the catalyst operation in the Fischer-Tropsch synthesis process in combination with supercritical carbon dioxide regeneration, pilot testing was conducted for 4000 hours, and the high efficiency of the developed technical solution for the production of i-C_5-C_8 hydrocarbons was proved.

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