TECHNOLOGICAL PROCESSES OF PRODUCING ALTERNATIVE AVIATION FUELS FROM ALCOHOL RAW MATERIALS

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Introduction. Alternative aviation fuels (AAF) have the potential to make a major contribution to achieving the environmental sustainability, energy security and economic stability of global aviation. In the long run, reducing CO_2 emissions from alternative fuels compared to conventional fuels can have a very beneficial effect on ICAO's climate change challenges. The characteristics of aviation fuels also allow to reduce emissions, which has a significant negative impact on local air quality.

Aim and methods of the study: To study the possibility of using technological processes for obtaining alternative aviation fuels from alcohol raw materials. The following methods were studied within this research: obtaining AAF by Fischer-Tropsch synthesis, hydrotreating of esters and fatty acids, hydrotreating of fermented sugars, processing of alcohol raw materials, processing of alcohol raw materials containing aromatic hydrocarbons, catalytic hydrothermolysis.

Tasks of the study:

- To consider the technology of alcohol production, to analyze the main stages of this production, the current state and prospects for the development of the chemical industry;
- To analyze the problems and prospects of greening the chemical industry;
- To consider the possibility of greening alcohol production in general.

AAF ATJ-SPK (alcohol-to-jet synthetic paraffinic kerosene) is understood as AAF obtained by processing alcohols into synthetic paraffin kerosene. There is such a technological process of production of fuel for gas turbine engine from alcohol, which involves the presence of aromatic compounds in the fuel. ATJ fuel production consists of two separate stages: alcohol production and conversion of alcohol to hydrocarbon fuel.

To synthesize fuel from alcohol, it is first dehydrated to the corresponding alkene product, then the product is separated from the liquid phase (water) and fractionation impurities and enters the next stage of the process in the form of gas. In the next step, the gaseous material is oligomerized to unsaturated compounds with a higher molecular weight. Unsaturated oligomers having a molecular weight approximately compatible with the fuel for aircraft jet engines are separated and further processed in the third major stage - hydrogenation over a solid phase catalyst in a hydrogen gas environment. In the final stage, the hydrogenated product is distilled to obtain the final products, among which is the fuel for the gas turbine engine [1].

The main manufacturer of alternative aviation fuel ATJ-SPK is Gevo. ATJ fuel production technology has been certified using Gevo isobutanol as a feedstock.

There is also a process of obtaining AAF by processing alcohols into synthetic paraffin kerosene containing aromatic hydrocarbons. In principle, the technological process of obtaining ATJ-SKA (alcohol-to-jet synthetic kerosene with aromatics) fuel is the same as the technological process of ATJ-SPK, except for the additional stage of aromatization.

The raw material for AAF ATJ is the corresponding alcoholic raw material; at the same time, the raw materials for the production of alcohols are very diverse. Currently, a common approach is the fermentation of lignocellulosic raw material residues, but in general, the raw material can be any biomass, as well as inorganic substances – New Zealand company LanzaTech has developed a gas fermentation process, which can produce ethanol in steel production as a single source carbon and energy [2].

Fuel for ATJ-SPK gas turbine engine is made from alcohols $C_2 – C_6$, which are biotechnologically available, such as fermentation. After dehydration of alcohols, the obtained alkenes are oligomerized. These higher olefins are then hydrogenated to form iso-alkanes. The alcohols used to produce ATJ-SPK can be obtained from sugar from biomass using mature and simple microbial fermentation technologies.

Alcohols are produced in biofermenters at low concentrations and at about room temperature so that microorganisms can survive. Ethanol can be easily dehydrated to ethylene using acid catalysts such as alumina, silica aluminophosphates, zeolites and heteropolyacids. Dehydration of C4 alcohols also occurs smoothly over acid catalysts, although obtaining one olefin remains a challenge. Isobutanol can be easily converted to isobutylene using alumina catalysts [3].

Conclusions

As a result of this work, the main characteristics of alternative fuels for gas turbine engines, obtained by the studied technologies on the basis of different types of raw materials, were analyzed. The influence of AAF on the quality parametrs of blended fuels for gas turbine engines with different AAF content is substantiated. A SWOT-analysis of technological processes for obtaining alternative fuels for gas turbine engines from different types of renewable raw materials with properties that ensure reliable and long-lasting operation of aircraft was performed.

References:

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