

Brief information about the project

Name of the project	AP26199715 Development of resource-saving technology for obtaining motor fuels and other organic compounds by hydrocracking of used motor oils under hydrogen pressure
Relevance	The project is aimed at developing a technology for processing used motor oils by hydrocracking under hydrogen pressure to obtain high-quality motor fuels and valuable organic compounds. In addition, it is aimed at developing effective catalysts based on metallurgical waste and natural zeolites, which combine the directions of ensuring environmental safety, saving resources, recycling waste and obtaining high-quality motor fuels. Finding an affordable and cost-effective thermocatalytic method for processing motor oils used in the production of gasoline, kerosene and diesel fuel makes research on this topic very relevant from a theoretical and practical point of view.
Purpose	To develop a resource-saving, environmentally efficient technology to produce high-quality motor fuels and other valuable organic compounds by hydrocracking of used motor oils (UMO) under hydrogen pressure; waste from the processing of ores from metallurgical industries and modified catalysts based on natural zeolites will be studied as a catalyst; to determine the patterns and chemistry of the chemical transformation of hydrocarbons
Objectives	Development of catalysts to create an effective technology for obtaining motor fuels and other organic compounds by hydrocracking reprocessing of used motor oils under hydrogen pressure: - preparation of modified catalysts based on ore processing residues of metallurgical industries and natural zeolites for hydrocracking processes of reprocessing used motor oils into motor fuels and other organic compounds; - study of surface and structural properties of modified catalysts based on ore processing wastes of metallurgical industries and natural zeolites using modern physico-chemical analysis methods (IR-spectroscopy, electron microscopy, X-ray spectrum, X-ray phase analysis, etc.). II. Systematic research, comprehensive discussion and optimization of hydrocracking processes of reprocessing of used motor oils under hydrogen pressure into motor fuels and other organic compounds in the presence of modified catalysts based on metallurgical production wastes and natural zeolites: - systematic study of the influence of technological parameters of the catalytic hydrocracking process of spent engine oils on the composition, quality and yield of liquid fuel; - determination of the optimal conditions for the hydrocracking process of used motor oils with modified catalysts based on production waste and natural zeolites (hydrogen pressure in the system - P_{H_2}, temperature of the technological process - T, nature and amount of UMO and catalysts, process duration - τ, etc.); - determination of the chemistry and laws of chemical transformation of hydrocarbons in the process of hydrocracking of used motor oils under hydrogen pressure in the presence of

	modified catalysts based on ore processing wastes of metallurgical industries and natural zeolites; III. Analysis of products obtained in the processes of catalytic hydrocracking processing of spent engine oils into motor fuel and other organic compounds: -study of the hydrocarbon composition of liquid distillates with a boiling point of 30-350 °C using modern physico-chemical methods (chromatography-mass spectrometry, gas-liquid chromatography, etc.); - determination of the main physical and chemical indicators of the quality of liquid fuel (octane and cetane numbers, sulfur content, viscosity, density, ignition, turbidity and freezing points, etc.); IV. Development of a resource-saving technology of the process of obtaining motor fuels and other organic compounds by hydrocracking reprocessing of used motor oils under hydrogen pressure: - extended laboratory testing of resource-saving technologies and catalysts under study; - creation of an effective resource-saving technology of the process of obtaining motor fuels and other organic compounds by hydrocracking reprocessing of used motor oils under hydrogen pressure, development of laboratory technological regulations.
Expected and achieved results	Modified catalysts based on ore processing waste from metallurgical plants and natural zeolites were prepared for the hydrocracking of used motor oils into motor fuel and other organic compounds. Preliminary laboratory testing of the hydrocracking processes of used motor oils using the prepared catalysts was conducted. Using modern physicochemical methods, the surface and structural properties of modified catalysts based on ore processing waste from metallurgical plants and natural zeolites were studied. The hydrocracking processes of used motor oils into motor fuel and other organic compounds were systematically studied and optimized using modified catalysts based on ore processing waste from metallurgical plants and natural zeolites under hydrogen pressure. During the catalytic hydrocracking of used motor oils, the influence of process parameters on the composition, quality, and yield of liquid fuel was systematically studied. Optimal conditions for the hydrocracking process of used motor oils in the presence of industrial waste and catalysts based on natural zeolites were determined. The laws and chemistry of hydrocarbon chemical transformations during the hydrocracking of used motor oils under hydrogen pressure using modified catalysts based on metallurgical ore processing waste and natural zeolites were determined. Products obtained during the catalytic hydrocracking of used motor oils into motor fuel and other organic compounds were analyzed; a resource-saving technology for producing motor fuel and other organic compounds by hydrocracking used motor oils under hydrogen pressure was developed.

	The key physicochemical parameters of liquid fuel quality (octane and cetane numbers, sulfur content, viscosity, density, flammability, turbidity, freezing points, etc.) were determined. Extensive laboratory testing of the resource-saving technologies and catalysts studied was conducted. A resource-saving technology for producing motor fuel and other organic compounds by hydrocracking used motor oils under hydrogen pressure was studied, and laboratory process guidelines for this process were developed. At least three (3) articles and/or reviews in the project's scientific focus in peer-reviewed scientific journals indexed in the Science Citation Index Expanded database in Web of Science and/or with a CiteScore of at least the 50th (fifty) percentile in the Scopus database; - at least one (positively approved) patent for an invention; - at least two (2) articles or reviews in peer-reviewed foreign or domestic journals recommended by the State Committee for Scientific and Technological Development; One of the published articles must be published in the interdisciplinary (interdisciplinary or interdisciplinary practical applications) category on the tasks of enterprises in the real sector of the economy of Kazakhstan. For domestic journals from the 1st list of the Russian Journal of Journalism that are not included in the interdisciplinary category, journals from the 1st and 2nd lists of the Russian Journal of Journalism indexed in two or more categories are taken into account.
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Usage	The target consumers of the results (catalysts and technologies) obtained under the project are likely to be industrial laboratories and pilot plants of oil refining complexes, complexes for the processing of used motor oils and other lubricants and oil waste; enterprises engaged in the recycling of used lubricants and ore processing waste; catalyst production, etc.
Priority compared to real-world alternatives	The fundamental differences between our proposed research work under the project and research work on known analogues are as follows: - the yield of the target fractions (gasoline, kerosene, diesel and vacuum gas oil) in analogues is given only by the total conversion value (54-83% (mass)); in the proposed method, the selectivity for the liquid product - gasoline, kerosene and diesel fuel is ~92%. - the selectivity for the gasoline fraction in the analogue is only 25%, in the proposed method, the selectivity for the gasoline fraction is around ~43-44%. - if the temperature in the system in analogues is 440-500 °C, then in the proposed technology the temperature is 400-430 °C; - if the hydrogen pressure in the system in analogues is 14-15 MPa H₂, then in the proposed technology the hydrogen pressure is 4-6 MPa H₂. The comparison shows that the temperature in the proposed technological system is reduced to 40-70 °C, and the hydrogen pressure in the system is reduced by 2-2.5 times according to the proposed technology. Since the yield of the gasoline fraction in the developed technology is about 40%, it is possible to obtain chemical reagents necessary for petrochemical synthesis from light liquid products.
List of publications with links to them	No
Patents	No