

Brief information about the project

Name of the project	AP19677222 «Development of new active and selective catalysts for hydrogenation process of diene and acetylene hydrocarbons and their mixtures» (0123PK00494)
Relevance	One of the most important processes in modern petrochemical industry and organic synthesis is hydrogenation of unsaturated compounds. Traditionally, platinum-based heterogeneous catalysts have been used in industry. Thus, by hydrogenating phenylacetylene, styrene is obtained, which is used in the production of polystyrene, benzene-cyclohexane, and by hydrogenating of phenol cyclohexanol and cyclohexanone are obtained, which are intermediate products for the synthesis of caprolactam and adipic acid. Since DAH is poisoned by olefin polymerization catalysts, it is exposed to rapid oxidation and resin formation, which significantly reduces the quality of the feedstock, the selective hydrogenation of these products is relevant issue.
Purpose	Project goal is to develop active and selective hydrogenation catalysts for conjugated diene and acetylene hydrocarbons and their mixtures based on skeletal nickel catalysts.
Objectives	<ul style="list-style-type: none">- To select the optimal multicomponent skeletal nickel catalysts for the selective hydrogenation of isoprene and piperylene and their mixtures.- To study the effect of the nature of modifying additives on the activity, selectivity and isomerizing capacity of the nickel catalyst in the hydrogenation reactions of mixtures of phenylacetylene-isoprene, hexyn-2-isoprene, cyclopentadiene-isoprene and isoprene-hexene-1.- To identify the flow direction of reactions and study of kinetic patterns of hydrogenation of mixtures of isoprene with mono- and disubstituted acetylenes on skeletal nickel catalysts.- To determine the hydrocarbon and chemical composition of the catalyst during the reaction of hydrogenation of isoprene, piperylene and their mixtures, as well as mixtures of isoprene with phenylacetylene, hexine-2, cyclopentadiene and hexene-1 by gas-liquid chromatography method.- To determine selectivity and isomerizing capacity of skeletal nickel catalyst in hydrogenation reactions of diene and acetylene hydrocarbons and their mixtures according to liquid chromatographic analysis;- Investigation of the structure and physico-chemical properties of multicomponent skeletal nickel catalysts (by methods of BET, TPD and X-ray diffraction analysis).- Hydrogenation of isoprene-hexine-1 mixture on modified skeletal nickel catalysts from Ni-Al-Me alloys (Me - Ti, Mo, Mo-Cu). Study of the influence of the degree of leaching of Ni-Al-Mo-Cu alloy on the activity and selectivity of the obtained catalysts in the hydrogenation of isoprene-hexine-1 mixture. Determination of lower and upper limits of optimal leaching degrees. Study of the stability of the optimally leached catalyst in the hydrogenation of isoprene-hexine-1 mixture.

	<p>- Conducting of extensive tests on the skeletal nickel catalyst from Ni-Al-Mo-Cu alloy during hydrogenation of isoprene-hexine-1 mixture. Determination of catalyst selectivity in the course of extensive tests. Development of laboratory regulations for the hydrogenation of isoprene-hexine-1 mixture.</p>
<p>Expected and achieved results</p>	<p>Effective catalysts based on modified skeletal nickel catalysts will be developed for the selective hydrogenation process of isoprene, piperylene and their mixtures, as well as mixtures of isoprene with phenylacetylene, hexyne-2, cyclopentadiene and hexene-1. The hydrocarbon and chemical composition of the catalyst during the hydrogenation reaction of diene and acetylene compounds (DAC) will be determined. The effects of the nature of the modifying additives on the activity, selectivity and isomerizing capacity of the nickel catalyst in the DAC hydrogenation reactions will be studied. The structures and physico-chemical properties of multicomponent skeletal nickel catalysts will be investigated (by methods of BET, TPD and X-ray diffraction analysis). The reaction direction and kinetic patterns of hydrogenation of mixtures of isoprene with mono- and disubstituted acetylenes and cyclopentadiene on skeletal nickel catalysts will be revealed. Isoprene-hexine-1 mixtures will be hydrogenated on modified skeletal nickel catalysts from Ni-Al-Me alloys (Me - Ti, Mo, Mo-Cu). The effects of the degree of leaching of Ni-Al-Mo-Cu alloy on the activity and selectivity of the obtained catalysts in the hydrogenation of isoprene-hexine-1 mixture will be investigated. The lower and upper limits of optimal leaching degrees will be determined. The stability of the optimally leached catalyst in the hydrogenation of isoprene-hexine-1 mixture will be investigated. Extensive tests will be carried out on the skeletal nickel catalyst made of Ni-Al-Mo-Cu alloy during hydrogenation of isoprene-hexine-1 mixture. The selectivity of the catalyst in the course of extensive tests will be determined. Laboratory regulations for the hydrogenation of isoprene-hexine-1 mixture will be developed.</p>
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List of publications with links to them	<p>1. Kairbekov Zh.K, Dzheldybaeva I.M., Kairbekov A.Zh., Suimbaeva S.M. Hydrogenation of diene hydrocarbons on skeletal nickel catalysts // Theoretical and experimental Chemistry: materials of the VII International Scientific and Practical Conference, dedicated to to the 50th anniversary of the Chemical Faculty and the 100th anniversary of the First Dean, Prof. R.G. Omarova (May 26-28, 2023): scientific electronic edition. - Karaganda: Publishing house of the NAO "Karaganda University named after Academician E.A. Buketova", 2023. pp.132-135 (in Russ.).</p> <p>2. I.M. Jeldybayeva, Zh. Kairbekov, M.Z. Yessenalieva, S.M. Suimbayeva. Catalytic activity and isomerization capacity of palladium and nickel catalysts in 1-hexene hydrogenation reaction // News of the National Academy of sciences of the republic of Kazakstan, series Chemistry and technology. - Volume 1, Number 345 (2023), 27-36. DOI: https://doi.org/10.32014/2023.2518-1491.145 (in Eng).</p>
Patents	-