

Brief information about the project

Name of the project	AP09057905 «Development of technology for the production and use of specific organic substances from coal and oil shale deposits of RK, as a source of naturally occurring catalysts and antioxidants» (0121PK00054).
Relevance	<p>Humic acids (HA) from brown coals and oxidized coals owing to the great variety of its properties can be used as surface-active substances - slurry and suspensions viscosity reducing agents, antiscaling compounds, coagulants, tannins, dyes, for wastewater treatment in the nuclear industry, extraction of rare metals, sedimentation of coal slurries, titanium hydroxide, zirconium, etc. But the main sphere of application of humates is their use in drilling of oil producing wells for stabilization of clay muds, as well as to produce products used in agriculture, mainly as plant growth stimulants.</p> <p>The ever-growing demand in Kazakhstan, CIS countries and abroad for humic acids (HA) leads to the further development of the processes of intensification of humic substances extraction from peat, coal, sapropel and oil shale. Mechanical effects are widely used for this purpose, such as grinding units of different designs, vibro-milling (VM), low-frequency acoustic treatment (LFA), ultra-sonic treatment (UST), isostatic high-pressure carbon treatment (HPCT).</p> <p>For several years, we have been conducting scientific and research work focused on the investigation of the theoretical background of catalytic processes of raw hydrocarbons processing, we have developed extensive expertise and proposed practical solutions for implementation. The proposed project is an extension of these theoretical and practical studies. The lack of data sources on the impact of humic substances from coal and oil shale on the oxidation and reduction processes provides the relevance and innovation of this study.</p>
Purpose	The goal of the project is to develop scientific bases for the production of catalysts comprising humic (fulvic) acids from coal and oil shale deposits of the Republic of Kazakhstan to recover vat dyes with sodium sulphite derivatives, as well as for producing "in vitro" humic type compounds with high antioxidant properties.
Objectives	<ul style="list-style-type: none"> - To develop methods of humic acids extraction from brown coals of the Oi-Karagai field and oil shale of the Kenderlyk field. To identify the main characteristics of HA: elemental-amino acid composition, hydrocarbons content, functional groups. - To determine the parameters of humic substances structure by physicochemical methods: IRS, NMR, EPR. To obtain samples of catalysts based on humic compounds, including those on supports and hybrid ones for homogeneous processes. - To identify the effect of humates nature (solid, in solution) on kinetic characteristics of model catalytic systems based on compounds Co (II) and Fe (III, II). - To determine the kinetic performance of chemical reduction of Co(II) compounds in the presence of HA. Selection

	<p>of optimal conditions for application of active components and fixation of HA on solid supports. To identify the kinetic performance of HA during the reduction of model systems (nitro compounds).</p> <ul style="list-style-type: none"> - To identify the optimal conditions for the operation of catalysts based on humic (fulvic) acids in the reduction of vat dyes and model compounds. - To perform quantitative analysis of antioxidant activity of humic substances from coals and oil shale "in vitro" according to the results of the amperometric method.
<p>Expected and achieved results</p>	<p>Methods of humic acid extraction from the Oi-Karagai field and oil shale of the Kenderlyk have been developed. The main characteristics of HA are determined: elemental and amino acid compositions, hydrocarbon content and functional groups. The parameters of the structure of humic substances were determined by physico-chemical methods: ICS, NMR, EPR. Samples of catalysts based on humic compounds, including on carriers and hybrid ones for homogeneous processes, were obtained. The effects of the nature of humates (solid, in solution) on the kinetic characteristics of model catalytic systems based on compounds Co (II) and Fe (III, II) have been determined. The kinetic characteristics of the chemical reduction of Co(II) compounds in the presence of HA have been determined. Selection of optimal conditions for the application of active components and the fixation of HA on solid media. The kinetic characteristics of GC during the restoration of model systems (nitro compounds) are determined. Optimal conditions for the functioning of catalysts based on humic (fulvic) acids in the reduction of cubic dyes and model compounds have been determined. The antioxidant activities of humic substances of coals and oil shales were determined in "in vitro" conditions based on the results of the amperometric method.</p> <p>According to the results of the study, a PATENT for a utility model No.8559. 2023/0633.2 dated 06/08/2023 was obtained, 1 methodological instruction was issued (ISBN 978-601-04-6243-4), and an act of implementation was obtained (RSE "Institute of Plant Biology and Biotechnology" of the Committee of Science of the Ministry of Internal Affairs of the Republic of Kazakhstan).</p>
<p>Research team members with their identifiers (Scopus Author ID, Researcher ID, ORCID, if available) and links to relevant profiles</p>	<ol style="list-style-type: none"> 1. Dzheldybaeva Indira Mukhametkerimovna, PhD. Scopus Author ID: 56600659100. Researcher ID Web of Science: CPH-4244-2022. ORCID: 0000-0002-1524-4046. 2. Suimbaeva Saltanat Malikovna, PhD. Scopus author ID: 57201691853. Researcher ID Web of Science: EBK-0532-2022. ORCID ID: 0000-0003-3990-4974. 3. Abil'mazhinova Didar Zamanbekovna PhD-doctoral student. Scopus author ID: 58021595400. ORCID: 0000-0001-7362-4963 4. Seisenova A.B., PhD-doctoral student. Scopus author ID: 58418726600 5. Kapizov O.S., PhD-doctoral student. 6. Zhanybekova A.G, master. 7. Kazi Marlen Rustambekovich, Bachelor's degree.

List of publications with links to them

1 Dzheldybaeva I.M., Kairbekov Zh., Suimbayeva S.M. Investigation of physico-chemical properties of humic substances of coal // Reports of the National Academy of Sciences of the Republic of Kazakhstan. 2021. – No.5. – P. 109-118. <https://journals.nauka-nanrk.kz/reports-science/article/view/2282/2573> (in Russ.).

2 Sumbayeva S.M., Kairbekov Zh., Dzheldybaeva I.M. Physico-chemical and antioxidant properties of humic acids from coal deposits of the Republic of Kazakhstan // Interd. Russian-Kazakh Symposium "Coal Chemistry and Ecology of Kuzbass" 2021, Kemerovo, Russia. – P. 84. (in Russ.).

3 Dzheldybaeva I.M., Kairbekov Zh., Sumbayeva S.M., Ermolina E.T. Applied palladium catalysts of hydrogenation fixed with potassium humate // Beremzhanovsky Congress, 2021. – P. 197-198. (in Russ.).

4 Kairbekov Zh., Kishibaev K.O., Ermoldina E.T., Dzheldybaeva I.M., Suimbayeva S.M. Modified potassium humate deposited palladium catalysts for hydrogenation of nitro- and acetylene compounds // Proceedings of the VIII International Russian-Kazakh scientific-practical conference "Chemical technologies of functional materials", Almaty, 2022. – P. 267-269. (in Russ.).

5 Sumbayeva S.M., Kairbekov Zh., Dzheldybaeva I.M. Physico-chemical and antioxidant properties of humic acids from low-sulfur shale of the Republic of Kazakhstan // Interd. Russian-Kazakh Symposium "Coal Chemistry and ecology of Kuzbass" 2022, Kemerovo, Russia. – P. 27. (in Russ.).

6 Dzheldybaeva I.M., Kairbekov Zh., Maloletnev A.S., Abilmazhinova D.Z., Suimbayeva S.M. Physico-chemical and antioxidant properties of humic substances from the coal deposits of Oi-Karagai and Kiyakty of the Republic of Kazakhstan // Solid fuel chemistry. - 2022. - No. 6. - P. 65-72 (RSCI) (in Russ.).

7 Jeldybayeva I.M., Zh. Kairbekov, K.O. Kishibayev, E.T. Yermoldina, S.M.Suimbayeva. Catalytic activity and selectivity of Palladium and Nickel catalysts in hydrogenation reactions of nitro- and acetylene compounds // Chimica Techno Acta. 2022. – P. 1-6. (Web of Science) <https://doi.org/10.15826/chimtech.2022.9.3.06> (in Eng.).

8 I. M. Dzheldybaeva, Zh.Kairbekova, A. S. Maloletnev, D. Z. Abil'mazhinovaa, S.M. Suimbaeva. Physicochemical and Antioxidant Properties of Humic Substances from Coals of the Oy-Karagay and Kiyakty Deposits in the Republic of Kazakhstan // Solid Fuel Chemistry, 2022. –V. 56. – No. 6. – P. 471–477. DOI:10.3103/S0361521921060033 (Scopus Q3 и WoS Q3) <https://link.springer.com/article/10.3103/S0361521921060033> (in Eng.).

9 Suimbayeva S.M., Kairbekov Zh.K., Maloletnev A.S., Kishibaev K.O., Dzheldybaeva I.M. Physico-chemical and antioxidant properties of humic acids from low-sulfur shales of Kazakhstan // Coke and chemistry. 2022. –No. 9. – P.15-21 (RSCI). (in Russ.).

	<p>10 Suimbaeva S.M., Kairbekova Zh.K., Maloletnev A.S., Kishibayev K.O., Dzheldybaeva I.M. Physicochemical and Antioxidant Properties of Humic Acids from Low-Sulfur Kazakhstan Shales // Coke and Chemistry. 2022. –V. 65. –No. 9. – P.386-391. (Web of Science @ Scopus) DOI: 10.3103/S1068364X2270003X https://link.springer.com/article/10.3103/S1068364X2270003X (in Eng.).</p> <p>11 Synthesis and determination of physico-chemical and antioxidant properties of humic acids of oil shale: methodological guidelines / I.M. Dzheldybaeva, Zh.Kairbekov, S.M. Suimbayeva, A.Zh. Kairbekov. – Almaty: Kazakh University, 2023. – 61 p. ISBN 978-601-04-6243-4 (in Russ.).</p> <p>12 Dzheldybaeva I.M., Kairbekov Zh.K., Suimbayeva S.M., Abilmazhinova D.Z. Research of humic acids as a catalyst of redox processes // Materials of the international scientific and practical conference "Modern trends in the development of chemical technology and engineering in food and light industry" dedicated to the 80th anniversary of Academician of NAS RK Kulazhanov K.S., 2023. – P. 13-15. (in Russ.).</p> <p>13 Kazi M., Suimbayeva S. M., Dzheldybayeva I. M., Kairbekov zh.physico-chemical properties of humic acids from combustible shale // International Scientific Conference of students and young scientists "Farabi Alemi", 2023 – 14 p.</p> <p>14 I.M. Dzheldybaeva, Zh. Kairbekov, M.Z.Esenalieva, S.M. Suimbaeva, D.Z.Abil'mazhinova. Humic Acid Modified Applied Palladium Catalysts for Nitro Compounds Reduction // Engineered Science. 2023 (Scopus Q1. Percentile 98%) DOI:10.30919/es1001 https://www.espublisher.com/journals/articledetails/1001</p>
Patents	<p>UTILITY model PATENT No. 8559. 2023/0633.2 from 08.06.2023 y. "the introduction of gum cells in the quality of biological stimulants of growth" / Dzheldybayeva I. M., Kairbekov Zh., Kairbekov A. Zh., Suimbayeva S. M., Abilmazhinova D. Z. (in Russ.).</p>