

Brief information about the project

Name of the project	AP09258741 «Development of a scientifically grounded technology for natural origin antioxidants obtaining from low-mineralized silt sulphide mud of the Tuzkol deposit and coals of the Kiyakty deposit» (0121PK00261)
Relevance	<p>Kazakhstan has significant reserves of brown coals and low-mineralized sludge sulfide mud. Their use as a fuel is not very effective due to low calorific value, high emissions of carbon dioxide, the formation of significant volumes of ash and slag waste. At the same time, the composition of these solid combustible minerals includes unique natural organic substances – humic acids (HA), the content of which, depending on the origin of coals, can be 20-30 %, and in some cases up to 80-90 %.</p> <p>Currently, it is possible to isolate biological active components from peloids and coal and create drugs based on them for their independent use. The prerequisites for such a solution are numerous studies on the composition of the peloid and coal and their biological activity, revealing the role of HA as a key factor of therapeutic action. The lack of data in information sources about the identification of humic substances (HS) of peloids and coal for redox processes determines the relevance and novelty of this study.</p>
Purpose	<p>The purpose of the project is to develop scientific and technical solutions for the production and use of humic peloid preparations with high antioxidant and ecological and economic efficiency from sludge sulfide low-mineralized mud of the Tuzkol deposit and coals of the Kiyakty deposit.</p>
Objectives	<ol style="list-style-type: none">1. Develop methods of synthesis, determine the content and identify humic substances (fulvic, hylatomelanin, humic acids) of low-mineralized silt sulphide mud (peloids) from the Tuzkol deposit and coal from the Kiyakty deposit. Develop a methodology and determine the degree of oxidation of humic substances in peloids and coal.2. Determine the elemental composition and structural characteristics of the components of humic substances in peloids and coal.3. Determine the structural characteristics of the components of humic substances in peloids and coal by IRS, NMR, and EPR.4. Determine the antioxidant properties of humic substances in low-mineralized silt sulphide mud and coal by the amperometric method. Determine the total content of antioxidants in the series of humic substances of peloids at a concentration of 1.0 wt.%.5. Assessment of the bioavailability of individual fractions of humic substances of low-mineralized silt sulphide mud and coal using model experiments and determine the degree of dialysis of humic substances in peloids and coal at various pH values of the medium.6. Establish the regularities of changes in the degree of dialysis of humic substances of peloid and coal from the pH values of the medium. Calculate the rate of change in the content of antioxidants at various concentrations of the fraction of humic

	substances of peloids and coal.
Expected and achieved results	<p>Methods of synthesis will be developed, the content and identification of humic substances (fulvic, humato-melanic, humic acids) of low-mineralized silt sulphide mud (peloids) from the Tuzkol deposit and coal from the Kiyakty deposit will be developed. A methodology to determine the degree of oxidation of humic substances in peloids and coal will be developed. The elemental composition and structural characteristics of the components of humic substances in peloids and coal will be determined. The structural characteristics of the components of humic substances of peloids and coal will be determined by IRS, NMR, EPR. The antioxidant properties of humic substances of low-mineralized silt sulphide mud and coal will be determined by the amperometric method. The total content of antioxidants in the series of humic substances of peloids and coal at a concentration of 1.0 wt.% will be determined. The bioavailability of individual fractions of humic substances of low-mineralized silt sulphide mud and coal will be evaluated on model experiments and the degree of dialysis of humic substances in peloids and coal will be determined at different pH values of the medium. Regularities of changes in the degree of dialysis of humic substances in peloid and coal from the pH values of the medium will be established. The rates of change in the content of antioxidants at various concentrations of the fraction of humic substances of peloids and coal will be calculated.</p>
Research team members with their identifiers (Scopus Author ID, Researcher ID, ORCID, if available) and links to relevant profiles	<ol style="list-style-type: none"> 1. Kairbekov Zh. - Doctor of Chemistry, Professor. Scopus Author ID 55910705200. Researcher ID Web of Science: A-5389-2015. ORCID: 0000-0002-0255-2330. 2. Akhmetov T. Z. - Doctor of technical Sciences, Professor. Scopus author ID: 15519514800. 3. Malolentev A.S., Doctor of technical Sciences, Professor. Scopus Author ID 7003481604. ORCID: 0000-0003-1952-9660. 4. Yessenaliev M.Z. - Candidate of chemical sciences, docent. Scopus author ID: 6507284187. ORCID: 0000-0002-0817-2048 5. Dzheldybaeva I.M. - PhD. Scopus Author ID: 56600659100. Researcher ID Web of Science: CPH-4244-2022. ORCID: 0000-0002-1524-4046. 6. Suimbaeva S.M. - PhD. Scopus author ID: 57201691853. Researcher ID Web of Science: EBK-0532-2022. ORCID ID: 0000-0003-3990-4974. 7. Oteuli Sh.A., PhD. Scopus author ID: 57208145480 8. Dzhumagulova Zh.T., bachelor.
List of publications with links to them	<ol style="list-style-type: none"> 1. Suimbayeva 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" Kemerovo, Russia, 2021– P. 84. (in Russ.). 2. Kairbekov Zh.K., Dzheldybaeva I.M., Abilmazhinova D., Maloletnev A.S., Suimbayeva S.M. Physicochemical and antioxidant properties of humic acids of low-mineralized peloids

of the Tuzkol Deposit // News of the Academy of sciences of the Republic of Kazakhstan, Series chemistry and technology. – 2021. – No. 3 (447). – P. 48-53. (CCFEAS RK) <https://journals.nauka-nanrk.kz/chemistry-technology/article/view/2130/2330> (in Eng.).

3. Kairbekov Zh.K., Suimbayeva S.M., Kairbekov A.Zh., Dzheldybayeva I.M. Technologies for obtaining antioxidants of natural origin from peloids and coals of the Republic of Kazakhstan // Materials of the international symposium "Science, education, innovation: global trends and regional aspects" dedicated to the 80th anniversary of the birth of Academician of the National Academy of Sciences of the Republic of Kazakhstan E.E.Ergozhin, 2021. (in Russ.).

4. Kairbekov Zh., Kairbekov A.Zh., Sumbayeva S.M., Dzheldybayeva I.M., Abilmazhinova D.Z., Sailaubai A.K. Physico-chemical properties of low-mineralized silt sulfide mud (peloids) // Beremzhanovsky Congress, 2021. – P. 199-200. (in Russ.).

5. Dzheldybayev I.M., Kairbekov Zh., Maloletnev A.S., Abilmazhinova D.Z., Suimbayeva S.M. Physico-chemical and antioxidant properties of humic substances from the coals of the Oi-Karagai and Kiyakty deposits of the Republic of Kazakhstan // Chemistry of solid fuels. 2022. – No. 6. –P. 65-72 (RSCI) (in Russ.).

6. I. M. Dzheldybaeva, Zh.Kairbekov, A. S. Maloletnev, D. Z. Abil'mazhinova, 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. Vol. 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.).

7. Kairbekov Zh., Dzheldybayeva I.M., Sumbayeva S.M., Sabitova A.N. The current state and prospects of coal processing in the Republic of Kazakhstan // Chemistry and chemical technology. Modern problems: a collection of review articles by chemists. – Issue 7 / under the general Ed. of Z.A. Mansurov. – Almaty: Kazakh University, 2022. – P. 115-145. ISBN 978-601-04-5761-4 (in Russ.).

8. Kairbekov Zh.K, Dzheldybayeva I.M. , Kairbekov A.Zh., Abilmazhinova D.Z., Suimbayeva S.M. Study of antioxidant properties of humic acids of therapeutic mud (peloids) by amperometric method // Proceedings of the VIII International Russian-Kazakh scientific-practical conference "Chemical technologies of functional materials", Almaty, 2022. – P. 269-271. (in Russ.).

9. Kairbekov Zh., Dzheldybayeva I.M., Kairbekov A.Zh., Suimbayeva S.M. Study of antioxidant properties of humic acids of peloids of Tuzkol deposit (Kazakhstan) // XI International Russian-Kazakh Symposium "Coal chemistry and ecology of Kuzbass" 2022, Kemerovo, Russia. – P. 28. (in Russ.).

10. Synthesis and determination of physico-chemical and antioxidant properties of humic acids of peloids: methodological

	<p>guidelines / Kairbekov Zh.K., Suimbayeva S.M., Dzheldybayeva I.M., Abilmazhinova D.Z. – Almaty: Kazakh University, 2023. – 56 p. ISBN 978-601-04-6240-3. (in Russ.).</p> <p>11. Kairbekov Zh.K., Suimbayeva S.M., Dzheldybayeva I.M., Kairbekov A.Zh., Abilmazhinova D.Z. Bioavailability of humic acids of low-mineralized sulfide mud // Proceedings of the IX International Russian-Kazakh Scientific-practical Conference Novosibirsk, May 25-27, 2023- P.39-41. (in Russ.).</p> <p>12. Zh.K. Kairbekov, S.M. Suimbaeva, I.M. Dzheldybaeva, M.Z. Esenalieva, A.Zh. Kairbekov. Antioxidant activity and bioavailability of humic acids of low-mineralized sulphide mud // Engineered Science. 2023, 25, 941. (Scopus Q1, Percentile 98%) https://dx.doi.org/10.30919/es941</p>
Patents	<p>UTILITY model PATENT No. 6759 with priority dated 10/20/2021 "Method of obtaining a humic preparation" / Sabitova A.N., Kairbekov Zh., Musabayeva B.H., Sharipkhan Zh.Sh., Bayakhmetova B.B., Gaisina B.S., Suimbayeva S.M. Publ. 12/15/2021. (in Russ.).</p>