Fossil coals of Myanmar's Kalewa and Tigyit deposits as sources of raw materials for activated carbon technology

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Abstract

Relevance of the research topic. The scale of man-made pollutants entering the biosphere at the present time, despite the measures taken to reduce them, causes harm to the Earth's population, due to the constantly growing production, commensurate with the consequences of the use of weapons of mass destruction. Among the ensemble of such substances, organic substances are the most dangerous due to the relative ease of their entry into the organisms of living beings, which leads to the possibility of various diseases, pathologies and even fatal consequences.

To combat toxic emissions and discharges, a number of methods are used to purify them from harmful components, the final stage of which, providing deep (sanitary) extraction of the target components, is most often the treatment of the corresponding streams and media with activated carbons. The latter are relatively expensive materials on world markets, which significantly limits their widespread use, especially in developing countries such as Myanmar.

In this regard, according to available publications, intensive research is underway in many countries aimed at assessing the feasibility and effectiveness of producing activated carbons based on readily and widely available local raw materials in the form of fossil coals and waste from agro-industrial complexes. The low cost of such raw materials and the proven possibility of obtaining sufficiently high-quality adsorbents based on many of its representatives represent very serious motives for conducting research on this plan.

The Republic of the Union of Myanmar does not have its own production facilities for carbon adsorbents, but has 16 proven deposits of low-sulfur fossil coal with a total resource of 258 million tons, the proven reserves of hard coal in which are estimated at 4.62 million tons. It should be emphasized that these

deposits in most of them are extremely poorly studied, and the extracted coal is used exclusively for energy purposes.

However, the value of fossil coals is determined not only by their energy use, but also by the possibility of accumulating coal methane during their extraction, extracting a number of rare and dispersed elements from them, as well as producing various high-value products based on them, including activated carbons, which can, in particular, solve Myanmar's numerous environmental protection problems. environment, including, in the future, minimizing and eliminating the main drawback of coal–fired thermal energy - pollution of the biosphere by its flue gases, as well as the accumulation of coal methane.

The fact that the quality of the carbon adsorbents obtained depends on the type and composition of the raw materials is widely known. In this regard, the assessment of the possibility and expediency of processing fossil coals from two of the most accessible and exploited deposits in Myanmar for activated coals is a very urgent task for the state's economy.

The purpose of the work is to develop theoretical provisions and scientifically based technological solutions aimed at solving the problem of organizing production based on domestic coal deposits of activated carbon, which is significant for the Myanmar economy, in accordance with directions 1, 4-6, 8, 9, 12 of the passport of scientific specialty 2.6.7. "Technology of inorganic substances".

Research objectives:

• Analysis of the current state of issues of thermal processing of fossil coals to produce carbon adsorbents and the use of activated carbons in solving problems of protecting the biosphere (paragraph 1 of the directions).

• Study of the fundamental suitability of the fossil coals of the Kaleva and Tiji deposits for the specified purpose by petrographic, thermographic and chemical studies (paragraphs 1, 6).

• Substantiation of rational conditions for pyrolysis of the named raw materials, its chemical activation and steam activation of the target pyrolysis products with an assessment of the yield and structural and adsorption properties of the materials obtained, the reduction of material balances, the identification of the composition of by-products and directions of their use (para. 1, 4, 6, 8, 9).

• Identification of the comparative effectiveness of the use of the obtained carbon adsorbents in solving environmental problems (paragraphs 4.5).

• Approximate technical and economic assessment of activated carbon production based on fossil coals from both deposits (item 8).

Scientific novelty. In accordance with the research directions of the passport of the scientific specialty 2.6.7. "Technology of inorganic substances" for the first time:

• the results of chemical, petrographic and thermal studies have contributed to the field of scientific knowledge about fossil coals by evaluating the characteristics of the coal deposits of Kaleiva and Tijit, indicating the feasibility of their research as raw materials for the production of carbon adsorbents (paragraph 6 directions),

• using thermographic analysis in protective and oxidizing atmospheres, reasonable limits have been established for studying the thermal effects on the named raw materials and carbonized products of its pyrolysis during pyrolysis of the named fossils and activation of its target products by water vapor in the atmosphere of their degradation products (paragraph 6 of the guidelines),

• patterns of influence of raw material factors and parameters controlling the processes of pyrolysis of fossil coals of these deposits (heating intensity, maximum temperature and duration of isothermal treatment during it), their chemical activation (using NaOH, KOH, ZnCl2, K2CO3) and activation of pyrolysis products by steam on the yield and structural and adsorption properties of the target products (para. 1, 4, 6, 8),

• the conditions for obtaining activated carbons of chemical activation with KOH and steam activation based on the fossil coals of the Kaleiva and Tijit deposits,

which surpass known analogues in the depth of water purification (including drinking water) from phenol and ethylbenzene, respectively, are substantiated (paragraphs 5, 9),

• the totality of the results obtained revealed rational combinations of the values of the parameters governing the mentioned thermal transformations with the indicators of yield and structural and adsorption properties of their target products (paragraphs 6, 7),

• kinetic dependences of the efficiency of extraction of organic impurities by the obtained activated carbons from industrial effluents on their dose (in relation to multicomponent wastewater of issue No. 1 of Moskoks JSC) and fixation of floating films of diesel fuel by them (item 5 directions) have been established,

• the kinetic and equilibrium characteristics of the processes of using the obtained activated carbons during the extraction of volatile organic solvent vapors from air streams (using the example of n-butanol) are evaluated (clause 5),

• the results of the research have expanded the scientific understanding of the processing of fossil coals into carbon adsorbents and potentially increased the range of activated carbons (item 12 directions).

Theoretical and practical significance:

• the nature of the influence of the used raw materials on the operating parameters of its pyrolysis, chemical activation and steam activation of pyrolysis products has been established,

• reasonable conditions for the implementation of these operations are substantiated, providing rational combinations of yield and structural and adsorption properties of the target products,

• the tested indicators of the porous structure, absorption properties and technical characteristics of the obtained adsorbents are evaluated, indicating, along with the results of their applied use, the likely competitiveness of these absorbers,

• for activated coals produced on the basis of fossil coals from both deposits, an estimated technical and economic estimate of the cost of their production was carried out at a capacity of 50 tons per year for the target product,

• it shows the fundamental possibility and expediency of implementing the developed technologies in Myanmar, which in the future will be able to meet national needs and expand the range of activated carbons on the world market.

The main provisions submitted for defense:

• the results of chemical, petrographic and thermographic studies of raw materials, focused on the theoretical justification of the expediency of its use for the production of carbon adsorbents, methods and sequence of technological operations and processes of processing raw materials, assessment of the areas of temperature effects on it during pyrolysis and steam activation (paragraphs 1, 4, 8 research areas),

• experimentally substantiated conditions and patterns of the processes of pyrolysis of raw materials, its chemical activation and steam activation of carbonized pyrolysis products, providing a rational combination of yield and structural and adsorption properties of the target products (paragraphs 4, 6, 9),

• technical and absorption properties of the obtained target products, characterizing them as unique adsorbents in some cases (paragraphs 5, 6),

• comparative estimates of the effectiveness of the use of the obtained adsorbents in the processes of purification of industrial effluents and technological solutions from organic impurities, fixation of film spills of diesel fuel on the surface of water and extraction of vapors of volatile organic solvents from their mixtures with air (paragraphs 5, 6),

• the results of an approximate estimate of the production cost of 50 tons per year of the obtained activated carbons in Myanmar.