

Brief information about the project

Name of the project	AP 26199999 Development of magnetic composite nanosorbents for the removal of pollutants from aquatic environments
Relevance	The relevance of the project is driven by growing environmental challenges associated with the contamination of water and soil resources by toxic organic and inorganic substances, including heavy metal ions. Existing purification methods are often insufficiently efficient, cost-effective, or environmentally safe, which necessitates the development of new functional materials with enhanced sorption properties. Magnetic composite nanosorbents based on magnetite (Fe_3O_4), stabilized with natural (humic acids) and synthetic (polyvinyl alcohol) polymers, represent a promising solution due to their high sorption capacity, selectivity, and the possibility of easy recovery from the medium using a magnetic field. Studying the influence of synthesis conditions on nanoparticle properties, as well as establishing relationships between structure, magnetic, and sorption characteristics, will enable the targeted design of highly efficient next-generation sorbents. Thus, the project is aimed at developing scientifically grounded approaches to the synthesis and application of magnetic nanosorbents, which is of great importance for addressing environmental safety, water purification, and sustainable natural resource management.
Purpose	Development of magnetic composite nanosorbents in a polymer matrix of humic acids (HA) and polyvinyl alcohol (PVA), investigation of their physicochemical and sorption properties with respect to toxic organic and inorganic compounds in aqueous media.
Objectives	1. Synthesis of magnetic composite nanosorbents: Fe_3O_4 stabilized on natural (humic acid) and synthetic (polyvinyl alcohol) polymers using various methods. 2. Study of the influence of various synthesis parameters (concentration of initial reagents, temperature, pH of the reaction medium, etc.) on the size of iron oxide nanoparticles stabilized on polymer matrices, using methods such as chemical precipitation, mechanochemical methods, and the application of a magnetic field. 3. Investigation of the physicochemical properties (phase state, structure, and size distribution) of the obtained magnetic composite nanosorbents. 4. Study of the magnetic properties of the synthesized nanosorbents (characterization of the magnetic parameters of the resulting polymer composites, including coercive force, saturation magnetization, etc.). 5. Analysis of the formation of the stoichiometric structure of magnetite within the polymer matrix. 6. Investigation, examination, and comparison of the sorptive properties of the obtained composites using model toxicants (both organic and inorganic, as well as heavy metal ions). 7. Assessment of the potential application of the obtained sorbents. 8. Development of an equipment and technological scheme and technological regulations for the production of magnetic composite nanosorbents. 9. Issuance of recommendations for the utilization of the results from the synthesis of magnetic composite nanosorbents modified with polymers.
Expected and achieved results	Magnetic composite nanosorbents based on Fe_3O_4 , stabilized with natural (humic acid) and synthetic (polyvinyl alcohol) polymers, have been obtained using various methods. The obtained sorbents were modified in a vortex magnetic reactor VEG-80 under an electromagnetic field to enhance their sorption

	properties. The sorption properties of the magnetic composite nanosorbents were studied using model toxicants, and the sorption behavior of the obtained materials was compared. The morphology, phase composition, structure, particle size, and oxidation state of the metal in the synthesized stabilized magnetic composite nanosorbents were investigated. The sorption properties of the composite sorbents toward toxic organic compounds and inorganic ions will be further studied. The most promising sorbents for each case will be selected. The applicability of the obtained magnetic composite nanosorbents will be evaluated. An equipment and process flow diagram, as well as technological regulations for the production of magnetic composite nanosorbents, will be developed. Recommendations will be provided for the application of the synthesized magnetic composite nanosorbents modified with natural (humic acid) and synthetic (polyvinyl alcohol) polymers.
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Usage	For the purification of liquid media from contaminants in various industrial sectors. This includes the production and use of solvents, dyes, fuels, and acids, as well as applications in waste processing facilities and the textile industry.
Priority compared to real-world alternatives	The priority of the project lies in the development of magnetic composite nanosorbents with enhanced sorption and magnetic properties through the combination of natural and synthetic polymers. Unlike existing analogues, the project предусматривает a comprehensive study of the influence of synthesis conditions on the structure and properties of materials, as well as their relationship with purification efficiency. An additional advantage is its focus on practical application, including the development of a technological scheme and the possibility of easy recovery of sorbents using a magnetic field.
List of publications with links to them	no
Patents	no