**Brief information about the project**

| | |
|---|---|
| Name of the project | AP09260687 «Technology for the extraction and utilization of toxic compounds of industrial wastewater». |
| Relevance | The continuous growth and development of the chemical, pulp and paper, petrochemical, chemical and pharmaceutical industries lead to a constant increase in environmental pollution with dangerous organic compounds. One of the highest environmental loads is experienced by water resources, with an increasing number of highly toxic compounds entering the waters of water basins used by humans for household needs. Therefore, one of the primary tasks of modern science is to solve the problem of water pollution with highly toxic organic compounds, which requires detailed physical and chemical research and the development of new technological solutions. |
| Purpose | Objective of the project – the creation of a new 2-zone filter-reactor for purification of waste waters from highly toxic organic substances |
| Objectives | 1) Synthesis of nanostructured Fe-, Mn-, Co-containing mono-, bimetallic and magnetic catalytic systems using organic and inorganic carriers (polystyrene, $Al_2O_3$, $SiO_2$, polyethylenimine).<br>2) Synthesis of nanostructured biocatalysts based on horseradish peroxidase using organic and inorganic carriers (polystyrene, chitosan, $Al_2O_3$, $SiO_2$, polyethylenimine).<br>3) Research of the destruction of highly toxic organic compounds (phenol, pyrocatechin, cresol), using enzymes to identify the characteristic principles of biocatalytic reactions;<br>4) Research of the influence of parameters and methods of synthesis of catalytic and biocatalytic systems on the activity of oxidation of highly toxic organic compounds (phenol, pyrocatechin, chrysol);<br>5)Analysis of the results of destruction of phenolic compounds;<br>6) Optimization of biocatalysts and nanocatalysts;<br>7) Creating a prototype of a 2-zone filter-reactor;<br>8) Development of technological modes of operation of a 2-zone filter-reactor;<br>9) Optimization of the 2-zone filter-reactor |
| Expected and achieved results | Highly efficient, selective technologically and economically advantageous catalysts for wastewater treatment from phenols have been developed. A highly efficient, environmentally friendly, cost-effective nano- and biotechnology for wastewater treatment from phenols has been created. The proposed catalytic technology for wastewater treatment from waste water is highly efficient and environmentally friendly. The implementation of this technology is ensured by the availability of industrially |

| | |
|---|---|
| | available nanostructured polymers and carriers for the production of nanocatalysts, an environmentally friendly and cheap oxidizer, simple hardware design, low temperature of the processes of nano- and bio-catalytic neutralization from VOS and the absence of aggressive components in reaction products. The combined use of both nano and biocatalysts in one reactor unit will significantly increase the efficiency of water purification from highly toxic organic compounds and will become a significant prerequisite for the creation of effective technology and industrial implementation. |
| Research team members with their identifiers (Scopus Author ID, Researcher ID, ORCID, if available) and links to relevant profiles | 1. Muktaly Dinara PhD, h-index – 2. Scopus author ID: 557195522581. ORCID ID: https://orcid.org/0000-0002-1139-5488.<br>2. Hideki Kurakawa - is a Professor and Dean Of the graduate school of science and technology at Saitama University. h-index – 14. Scopus author ID: 7202656488 https://orcid.org/0000-0001-9113-0680.<br>3. Shakiyeva T.V. candidate of chemical Sciences, h-index – 4. Scopus author ID: 55911739700. ORCID ID: ID: https://orcid.org/0000-0002-9664-442x<br>4. Dossumova B.T. candidate of chemical Sciences, h-index – 3. Scopus author ID: 57210592713. ORCID ID: https://orcid.org/0000-0003-4126-2907.<br>5. Sassykova L.R., candidate of chemical Sciences, h-index – 15. Scopus Author ID: 56178673800. ORCID ID: https://orcid.org/0000-0003-4721-9758<br>6. Baizhomartov B.B. PhD, h-index – 3. Scopus author ID: 55911449500. ORCID ID: https://orcid.org/0000-0002-3221-114x.<br>7. Dzhatkambaeva U.N. master's degree, h-index – 3. ORCID ID: https://orcid.org/0000-0001-8216-3206<br>8. Ilmuratova M.S. h-index – 1. Scopus Author ID:57262368200. ORCID ID: https://orcid.org/0000-0001-7773-6057 |
| List of publications with links to them | 1 T.V. Shakiyeva, L.R. Sassykova, B.T. Dossumova, D. Muktaly, B.Baizhomartov, H.Kurokawa: Natural waters and industrial waste water, waste water with phenol-containing compounds, methods of water purification //Rasayan J. Chem., 16(3), 1591- 1598(2023) http://doi.org/10.31788/RJC.2023.1638403<br>2 L.R. Sassykova, T.V. Shakiyeva, B.T. Dossumova, M. S. Ilmuratova, D. Muktaly, Zh. M. Zhaxibayeva, A.R. Sassykova3 and B. Baizhomartov. Catalysts, magnetic composites for removal of phenol-containing compounds from wastewater. //Rasayan J. Chem., 16(3), 1605-1612(2023) http://doi.org/10.31788/RJC.2023.1638420<br>3 Binara T. Dossumova, Tatyana V. Shakiyeva, Dinara Muktaly, Larissa R. Sassykova, Bedelzhan B. |

| | |
|---|---|
| | Baizhomartov and Sendilvelan Subramanian. Synthesis, Characterization of Magnetic Composites and Testing of Their Activity in Liquid-Phase Oxidation of Phenol with Oxygen // ChemEngineering. –2022, 6, 68.– P. 1065-1071, Процентиль 75. (https://doi.org/10.3390/chemengineering6050068)<br>4 Ilmuratova M. S., Sassykova L.R., Shakiyeva T.V., Muktaly D. Methods for treating wastewater from organic pollutants // OIL AND GAS.– 2023. – V. 3 (135). – P. 164-182. (in the Kazakh).<br>5 Dossumova B.T., Sassykova L.R., Shakiyeva T.V., Muktaly D., Batyrbayeva A.A., Kozhaisakova M.A. Catalysts based on iron oxides for wastewater purification from phenolic compounds: synthesis, physicochemical analysis, determination of catalytic activity //ChemEngineering https://doi.org/10.3390/chemengineering8010008 |
| Patents | - |

Figure – Laboratory installation of a 2-zone filter reactor for phenol oxidation