

Project name, IRN	BR28712729 – Study of Structural, Thermal, and Flame-Retardant Characteristics of Vinyl Ester Composites with Modified Minerals and Prediction of Their Properties.
Completion date	20.06.2025–01.07.2027
Project supervisor	Bekeshev Amirbek Zarlykovich
Report	<p>The aim of the program is to modify the surface of inorganic minerals (for example, basalt ochre and diorite) and use them as flame-retardant additives for the production of high-performance composites based on vinyl ester resin. Within the project, methods such as liquid exfoliation, hydrothermal synthesis, and mechanical grinding will be applied, and a predictive model of composite properties will be developed using machine learning methods. The results are expected to optimize the composition of the composites and enhance their thermal stability, flame resistance, and mechanical strength.</p> <p>The research is practice-oriented and focuses on the development of eco-friendly, safe, and durable materials that meet modern industrial and construction requirements.</p> <p>The expected results of the project include the development and experimental testing of flame-retardant vinyl ester composites with modified minerals that possess enhanced thermal stability and mechanical strength. A predictive model of flame resistance will be created using machine learning methods. As a result of the research, at least six articles will be published in Q1–Q3 journals indexed in <i>Web of Science</i> and <i>Scopus</i>, seven articles in journals recommended by CQHESE, one monograph or textbook will be prepared, and one foreign patent or three patents of the Republic of Kazakhstan will be obtained.</p>
Purpose	Project goal. To improve the effectiveness of the flame-retardant mechanism of vinyl ester composites based on modified minerals and to develop a predictive model using machine learning methods.
Expected results	<ol style="list-style-type: none"> 1. Development and experimental testing of flame-retardant vinyl ester composites with modified minerals possessing improved thermal and mechanical properties. 2. Creation of a predictive model of flame resistance and thermal stability of composites using machine learning methods. 3. Publication of at least 6 scientific papers in Q1–Q3 journals indexed in <i>Web of Science</i> and <i>Scopus</i> (percentile ≥ 50). 4. Publication of at least 7 papers in journals recommended by CQHESE. 5. Preparation of 1 monograph or textbook on the research topic. 6. Obtaining 1 foreign patent or 3 patents of the Republic of Kazakhstan for the research results.

Research group

List of published works