

ANNOTATION

Dissertations of **Makulbekova Gulnaz Orazbekovna** on the topic
«Developing technology of receiving heat-insulating, fireproof and environmentally safe expanded clay granulates on the basis of local mineral raw material and wastes of coal mining»,
submitted for the degree of Doctor of Philosophy (PhD)
in the specialty 6D073100 - "Life safety and environmental protection"

Relevance of the research topic. One of the main directions of energy saving is to improve the thermal protection of the building. According to various sources, the housing industry consumes 85% of energy resources. Centralized heating is typical for the cities of Kazakhstan, today a significant part of it remains unsatisfactory.

Insufficient attention is paid to the reliability of thermal insulation materials and enclosing structures that are not related to climatic, logistical and economic conditions in certain regions of the country.

Prerequisites for ensuring the safety of life are the use of waste accumulated over many years in the production of artificial porous fillers and the creation of lightweight concrete with low thermal conductivity on their basis, increasing the thermal efficiency of modern construction buildings.

In this regard, it is relevant to conduct an experimental study of the thermophysical properties of thermal insulation porous expanded clay concrete, to determine the patterns of heat transfer resistivity of porcelain stoneware to the material, to develop recommendations for their operation.

Connection with the research work plan.

The dissertation work was carried out in accordance with the plan of state budgetary research works of the M. Auezov South Kazakhstan University, B-TF-06-04-01 - in the direction of "Development of technologies for obtaining target products from substandard raw materials and chemical production waste".

The purpose and objectives of the study.

The purpose of the study is to study clay raw materials and industrial waste as sources of environmental pollution, to develop a technology for their creation, as necessary, to substantiate the environmental hazard of waste and to prevent their negative impact on the natural environment.

To achieve this goal, the following tasks were solved:

- experimental study of chemical composition, physico-mechanical and mineralogical features, microstructures of clay rocks of deposits of Turkestan region, industrial waste;
- study of the regularity of mass formation, depending on the proportion of various production wastes, temperature and firing time of the charge mixture;
- experimental installation of effective technological and thermal indicators of the process of obtaining expanded clay granules;

- experimental study of the porosity coefficient, volume weight, moisture absorption, total porosity and physico-mechanical properties of the obtained expanded clay samples;

- experimental study of the dependence of sorption humidity, vapor absorption, moisture permeability, moisture absorption, thermal conductivity in dry and wet conditions of light-porous expanded clay concrete.

Objects of research. Bentonite colloidal clays of Kyngyrak-Keles, consisting of montmorillonite mineral groups and prone to porosity during firing, internal fossil waste of the coal industry, mixtures of various industrial wastes.

Scientific novelty of the study:

- it has been established that the mineralogical compositions of industrial promising clay raw materials consist of 62% montmorillonite, 20% kaolinite and hydrosilicates, the tendency to porosity by pyroplastic properties ranges from 150-200;

- it was found that the chemical composition of primary clay raw materials and industrial waste, determined using modern methods of physico-chemical analysis: the content of silicon oxide 63%, aluminum 13% and iron 5.5% fully meets the requirements of GOST 32496-2013 for expanded clay raw materials;

- it has been established that kyngyrak-Keles clays are among the finely dispersed clays with fractions below 0.001mm in granulometric composition in the range of 53.5-63.84;

- morphological features of the structure are characterized by microaggregates of 10-15 microns, consisting of leaf-like associations of complex structure. In this case, it was shown that in the formed isometric and weakly planar ultramicroaggregates, clay particles meet with mutual basal planes;

- as a result of experimental studies, effective technological modes of the process of obtaining light-porous expanded clay granules have been established: processing time 30-45 minutes; drying temperature 130-300 ° C, thermal annealing temperature 1080-1180 ° C;

- it has been experimentally established that the bulk mass of expanded clay granulates decreases to 35%, the porosity coefficient increases by 175% with the addition of coal mining waste within 1-10;

- concrete samples were selected from artificial porous fillers based on the obtained expanded clay granules and the main thermophysical properties were determined: sorption humidity 8.8-11.1%; vapor absorption coefficient $\mu = 0.075 \text{ mg/m}\cdot\text{h}\cdot\text{Pa}$; capillary absorption rate $0.036 \div 0.019 \text{ g/m}\cdot\text{h}^*0\%$; the identified indicators fully meet the requirements of SP 50.13330.2012 "Thermal protection of buildings;

- a single-layer wall panel with a thickness of 34 cm based on porous expanded clay concrete with a density of 900 kg/ m³ provides an economical

level of the required heat transfer resistance at a normalized humidity of 15% $R_{0ec} = 0.986 \text{ m}^2 \cdot ^\circ \text{C} / \text{W}$, i.e. it is established that the required heat transfer resistance exceeds the value by 10%.

Practical significance of the work. A raw material mixture has been developed for the production of thermal insulation expanded clay, protected by the patent of the Republic of Kazakhstan No. 6237 for a utility model.

Recommendations for improving fire resistance and thermal insulation properties of residential buildings, refined by experimental studies, have been developed.

The results of the conducted research on the production of highly porous expanded clay granules and their use as a thermal insulation filler, the ways of calculating the composition of the charge, the main recommendations can be used by teachers of engineering and technical universities, researchers from various industries, design institutes, research and educational institutions.

The main provisions submitted for protection:

-physico-mechanical parameters and mineralogical compositions characterizing the degree of applicability of clay raw materials; chemical composition and microstructural features of the selected clay raw materials;

- production waste patterns of porosity of the free mass that depend on the size, temperature and time of thermal firing;

- effective technological and thermal engineering indicators of the process of obtaining expanded clay granules;

-porosity coefficient, volume weight, moisture absorption, total porosity and physico-mechanical properties of expanded clay granulate samples;

- sorption humidity, vapor absorption, moisture permeability, moisture absorption, thermal conductivity in dry and wet conditions of light porous expanded clay concrete;

- thermal performance of exterior walls based on porous expanded clay concrete.

The personal contribution of a doctoral student consists in direct participation in the generalization and analysis of literary and patent materials on the topic of dissertation research, the choice of methods of analysis, conducting theoretical and experimental research and experimental tests.

Approbation of experimental results. The main results and hypotheses of the dissertation are presented and discussed at the following international and republican scientific conferences: Proceeding V International Conference "Industrial Technologies and Engineering" ICITE - 2018, Volume I. M. Auezov South Kazakhstan State University. Shymkent, Kazakhstan November 28, 2018; Materials XV ISPC ACHIEVEMENT OF HIGH SCHOOL -2019. 15 - 22 November 2019г. Volume 8. Sophia. "Byal GRAD-BG ODD"; Materials of the XV ISPC Areas of scientific thought -2019. Volume 8. Sheffield. Science and education LTD. 2019, The VII International Science Conference «Science, actual trends and perspectives of development», November 01 – 03, Budapest, Hungary, 2021; Eurasian Education Science Innovation Journal, PROCEEDINGS OF THE

XI INTERNATIONAL SCIENTIFIC PRACTICAL CONFERENCE «MACHINE LEARNING TODAY, PROSPECTS AND THREATS» XI ISPC MLTPT 2022, Volume 10, 2022; The VII International Science Conference «Science, actual trends and perspectives of development», November 01 – 03, Budapest, Hungary, 2021; The VIII International Science Conference «Theoretical foundations of modern science and practice», November 08 – 10, Lisbon, Portugal, 2021; The XV International Science Conference «Trends in the development of science and practice». – Madrid: Spain, 2021; The I International Scientific and Practical Conference «An overview of modern scientific research in various fields of science», October 17 – 19, Amsterdam, Netherlands, 2022; "SCIENCE AND EDUCATION - 2020." Proceedings of inter.scintific-practical conf. - Nur-Sultan, 2020; Republican scientific journal "Zhalpy gylymnyng bilimning zharshysy." (Vedomosti of general science and education) - Nur-Sultan: 2 (02), 2020; The XIV International Science Conference «Theoretical and practical foundations of science». – Rome; Italy, 2021.; Republican scientific journal "Zhalpy gylymnyng bilimning zharshysy." (Vedomosti of general science and education) - Nur-Sultan: 2 (02)/2020; The I International Scientific and Practical Conference «An overview of modern scientific research in various fields of science», October 17 – 19, Amsterdam, Netherlands, 2022.; The I International Scientific and Practical Conference «An overview of modern scientific research in various fields of science», October 17 – 19, Amsterdam, Netherlands, 2022.; «Auezov Readings-19: Independent Kazakhstan – 30 years» ISPC WORKS. – Shymkent: M.Auezov SKU, 2021.; The I International Scientific and Practical Conference «An overview of modern scientific research in various fields of science», October 17 – 19, Amsterdam, Netherlands, 2022.; The I International Scientific and Practical Conference «An overview of modern scientific research in various fields of science», October 17 – 19, Amsterdam, Netherlands, 2022.

During a scientific internship at the Dnieper Agrarian Economic University, the work was carried out at the Department "Technology for the Storage and Processing of Agricultural Products" and received a positive assessment.

Publication on the topic of the work. The obtained scientific results on the dissertation work amounted to 23 scientific papers, including: 3 articles in publications included in the list submitted by the Committee for Control in the Field of Education and Science of the Ministry of Education and Science of the Republic of Kazakhstan, 1 article in journals included in the international database Scopus and 18 articles in international conferences and collections of foreign conferences. Received 1 patent for utility model No. 6237.

The structure and scope of the dissertation. The dissertation work consists of a manual, 6 main chapters, 45 figures, 33 tables, conclusions, a list of 121 used literary and patent sources and appendices. The volume of work is 148 pages, including 118 pages of the main text.