ANNOTATION

For dissertation work on the topic:

«Fine-grained self-compacting concrete with a complex chemical additive»

submitted for the degree of Doctor of Philosophy (PhD) in
Educational program **8D07305 - "Civil engineering and production of building materials, products, and structures"**

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The relevance of the topic is due to modern requirements for the production of construction works and the building materials and products used. Also, the direction and trends of world construction and the development trends of the construction industry in the Republic of Kazakhstan position this industry as a platform for the widespread use of industrial waste.

Two key factors influence the development and improvement of the technological process for the production of concrete mixtures, the formation of reinforced concrete structures from them: on the one hand, obtaining strong and durable concrete, on the other hand, reducing labor and energy costs in its production. For a long period, these two factors remained contradictory, since in order to obtain high-strength, durable concretes, their compositions were designed with a low water-cement ratio, which leads to the production of rigid concrete mixtures that require increased energy costs both during mixing and during laying and vibration compaction in forms.

The latter significantly increases the complexity of the technological process. At the same time, the possibility of obtaining highly mobile concrete mixtures was provided mainly by increasing the mixing water consumption, which, in turn, leads to a decrease in the strength and durability of concrete.

At present, any research project should be aimed at optimizing the production process or the construction process in such a way that the implementation of the results of scientific work is possible and cost-effective, which is reflected in this work.

The experience in the development of self-compacting concrete confirms the data that self-compacting concrete, in particular fine-grained self-compacting concrete, is an important direction for study and further implementation in the construction industry. World experience shows that the development of self-adhesive concrete is a necessity to meet the growing needs of the construction industry.

The implementation of the research work will allow the development of a technologically applicable and stable composition of fine-grained concrete, on the basis of which recommendations for the laying and application of Regulatory and technical manuals in the construction industry were described. In this work, the composition of fine-grained self-compacting concrete with a complex chemical

additive based on local raw materials, which is effectively used, has high physical, mechanical, and functional properties, has been developed, and its properties have been experimentally substantiated.

Laboratory experiments were carried out using various compositions and quantities of a complex chemical mixture in fine-grained self-compacting concrete. Analysis methods were carried out by determining the physical and mechanical properties of concrete, such as compressive strength, bending strength, and water absorption, as well as determining its technological properties, such as hardening time, flow, splitting resistance, etc.

A technical and economic analysis of fine-grained self-compacting concrete made from a complex chemical mixture was carried out, including an assessment of the economic efficiency of the production and use of the product. This allows you to evaluate the economic efficiency of the implementation of the developed concrete in practice.

In addition to the traditional support of the agricultural sector, the most serious attention should be paid to the deep processing of agricultural products, the development of the food and textile industries, the production of building materials, and other industrial sectors."

Based on the foregoing, any research project should be aimed at optimizing the production process or the construction process in such a way that the implementation of the results of scientific activity is possible and cost-effective, which is reflected in this work.

In addition, the experience of developing self-compacting concretes in the territory of the Republic of Kazakhstan confirms the thesis that self-compacting concretes, particularly fine-grained self-compacting concretes, are an important area for study and further implementation in the construction industry.

The purpose of the dissertation work is to obtain fine-grained self-compacting concrete with a complex chemical additive, as well as use the industrial waste from the Republic of Kazakhstan as a modifier and water-retaining additive.

Research objectives, their position in the implementation of research work in general

In accordance with the goal, this work provides the solution to the following tasks:

– Analysis of foreign and domestic experience in the study of fine-grained self-compacting concrete;

– Study of the theoretical and methodological base for obtaining fine-grained self-compacting concrete;

– Obtaining a self-compacting concrete mixture that meets the requirements of regulatory documents and the desired physical and technical characteristics;

– Study of the technological process of production of fine-grained concrete mix;

– Obtaining positive results of production approbation of the composition of the B30 class fine-grained self-compacting concrete, grade M400;

– Substantiation of the economic efficiency of the use of fine-grained self-compacting concrete.

Scientific results (scientific provisions) submitted for defense:

The following are submitted for defense:

– Development of the composition of fine-grained SCC grade M400, class B30.

– Empirical studies are aimed at an experimental proof of the possibility of obtaining fine-grained SCC on the studied raw materials according to the designed concrete compositions.

– Developed and tested under production conditions, the composition of fine-grained SCC grade M400 class B30.

– Research and development of rational technological parameters for the production of fine-grained SCC based on optimally developed compositions;

– Results of pilot industrial implementation and feasibility study of the proposed technical solutions.

The scientific novelty of the topic is justified by the lack of application of fine-grained SCC at the construction sites of the Republic of Kazakhstan, the reason for this is the lack of compositions and production technology that can be used by manufacturers of ready-mixed concrete and reinforced concrete products. Ready-mixed concrete manufacturing plants do not have the opportunity to carry out the production and use of fine-grained SCC without the involvement of foreign specialists. The scientific novelty of this project is also the 100% use of local raw materials in the selection of the composition. In the course of the work, the theoretical and methodological foundations for obtaining fine-grained SCC were systematized, and the composition of a fine-grained self-compacting concrete mixture was developed using a modifier and a water-retaining additive. In order to implement the practical application of the developed composition, the technological process for the production of concrete mix in the factory and landfill conditions was analyzed and updated, and technical recommendations for manufacturers were developed.

Production significance of the dissertation

The results of the dissertation work allow expanding the raw material base for the production of fine-grained SCC in all regions of Kazakhstan.

The implementation of the results of the dissertation work makes it possible to design and organize the construction of a fine-grained SCC production shop, which is characterized by high energy efficiency through the use of developed mixtures containing chemical additives, which are modifying components.

The implementation of the proposed technology in the production of fine-grained SCC allows to reduce energy costs for heat treatment by up to 20-25%. In addition, an environmental and economic effect is achieved through the development of self-sealing mixtures containing chemical additives and disposed of in a rational way in the production of a highly demanded fine-grained SCC.

Experience in implementing the results of work in production

The dissertation research results are used in the educational process at the Kazakh National Research Technical University named after K.I. Satpaev. For undergraduate and graduate students of the educational program "Production of building materials, products and structures" lectures are given on the disciplines "Concrete technology", "Resource and energy-saving technologies of building materials", "Heat-insulating and acoustic materials", "Technology of production of building materials based on recycled raw materials", "Modern technologies of building materials and materials science". Also, the experience of introducing the results of work into production is confirmed by the act of implementation in Temirbeton LLP, Almaty, on the basis of the plant. The results of laboratory studies of the SCC have been confirmed during pilot tests. The physical and mechanical characteristics of the finished product meet the requirements of regulatory documents. Ecological and economic effects in the implementation of research results into practice amounted to 4,475 tenge per 1 m^3.

Validity and reliability of scientific provisions, conclusions, and recommendations. Laboratory studies were carried out in accredited laboratories equipped with modern equipment. The results of laboratory studies of ceramic masses, substantiated in accordance with the conclusions and recommendations, are confirmed by pilot tests.

The author's personal contribution lies in the analysis and generalization of the available experience on the subject, and calculation of the composition of concrete, considering the lack of approved methods for calculating the composition of fine-grained SCC (Production Approbation Act, Appendix 1).

Publications and approbation of work

1. Akmalaiuly Kenzhebek, Tolegenova Aigerim, Jetpisbayeva Ainur. Forming the structure of composite binders. III международная конференция-симпозиум. «Внедрение достижений науки в практику и устранение в ней деятельности коррупции». Ташкент, Узбекистан 30 ноября 2019 г.

2. Akmalaiuly Kenzhebek, Tolegenova Aigerim, Jetpisbayeva Ainur. Features of structure of formation of polymer cement stone. Proceeding of VI International Conference «Industrial Technologies and Engineering» ICITE – 2019 Shymkent, Kazakhstan October 24-25. 2019. Volume 1, S. 12-15. ISSN 2410-4604

There are 3 publications on the topic of the dissertation:

1. Jetpisbayeva A.Zh., Akhmetov D.A., Pukharenko Y.V., Vatin N.I., Akhazhanov S.B., Akhmetov A.R., Utepov Y.B. The Effect of Low-Modulus Plastic Fiber on the Physical and Technical Characteristics of Modified Heavy Concretes Based on Polycarboxylates and Microsilica. Materials 2022, №15 (2648), 16 p., ISSN 1996-1944, CiteScore-4.2; Procentil-65, Q2

2. Jetpisbayeva A.Zh., Akhmetov D.A., Pukharenko Y.V., Vatin N.I., Akhazhanov S.B., Akhmetov A.R., Utepov Y.B. Effect of low-modulus polypropylene fiber on physical and mechanical properties of self-compacting concrete. Case Studies in Construction Materials 2022, №16 (2648), 10 p., ISSN 22145095, CiteScore-5.1; Procentil-86, Q1.

3. K. Akmalaiuly, D. Akhmetov, A. Jetpisbayeva, Kwang-Don Kim Effect of fine fillers from industrial waste on the quality of self-compacting concrete. QazBSQA Хабаршысы 2023, №1 (87),. ISSN 2788-6948

The structure and scope of the dissertation. The dissertation work, in accordance with the content and objectives of the study, consists of an introduction, five sections, a conclusion, a list of references from 118 titles, and 1 appendix. The volume of work is 118 pages of typewritten text, 27 figures and 44 tables.