

APPROVED

Member of the Management Board
– Vice Rector for Science and Corporate Development
Of Kazakh National Research Technical
University named after K.I. Satpayev

E.I. Kuldeyev

2024



**ABSTRACT FROM THE PROTOCOL No. 6
of the extended meeting of the Department of " Civil engineering and Building Materials"
of the Institute of Architecture and Civil engineering named after T.K. Basenov
dated November 22, 2024 at 12.00**

Chairman: Head of the Department of "CEaBM", Doctor of Technical Sciences,
Associate Professor Shayakhmetov S.B.

Secretary: assistant of the department of " CEaBM ", Taubayeva A.E.

ATTENDED: (23 people):

Doctor of Technical Sciences, Professor, Head of the Department, S.B. Shayakhmetov;
Doctor of Technical Sciences, Associate Professor, D.A. Akhmetov; Doctor of Technical
Sciences, Professor, K.A. Akmalaiuly; Doctor of Technical Sciences, Professor, S.H. Dostanova;
Doctor of Technical Sciences, Professor, T.K. Kuatbayeva; Candidate of Technical Sciences,
Associate Professor, K.K. Dzholdasova; Doctor of Technical Sciences Professor M.T.
Zhuginisov; Doctor of Technical Sciences Professor E.T. Bissembayev; Candidate of Technical
Sciences Associate Professor E.E. Ussipbekov; Candidate of Technical Sciences senior lecturer
A.M. Zhangabylova; Candidate of Technical Sciences senior lecturer Sh.K.Kurmanova; senior
lecturer N.V. Kozyukova; lecturer A.K.Tolegenova; senior lecturer A.Zh. Jetpisbayeva; teacher
A.A.Yesembayeva; teacher A.M.Zhagifarov; assistant A.S. Ospanova; assistant A.B. Elubaev;
lead engineer A.K. Mukashova; engineer Kenzhekhanova Zh.

INVITED: Sartayev D.T., Doctor of Technical Sciences, Associate Professor of the
Faculty of Construction Technologies and Materials, IEC KazLAACE;

THE AGENDA:

1. The results of the pre-defense of the doctoral dissertation for the degree of Doctor of
Philosophy (PhD) Tolegenova A.K. on the educational program 8D07305 "Civil engineering and
production of building materials and structures".

Dissertation topic: "Development of the composition of the monolithic concrete using
chemical additives", approved by the Scientific Council of the Kazakh National Research
Technical University named after K.I. Satpayev dated 31.10.2019, No. 280-D.

Tolegenova A.K. studied at the Department of "Civil engineering and Building Materials"
under the educational program 8D07305 "Civil engineering and production of building materials
and structures" from 2019 to 2022. By Order No. 1621-d dated 11.10.2024, she was reinstated in
doctoral studies for pre-defense and subsequent defense of her doctoral thesis.

The dissertation was completed at the Department of "Civil engineering and Building
Materials".

Scientific consultant: Akmalaiuly Kenzhebek – Doctor of Technical Sciences, Professor,
Professor of the Department of "Civil engineering and Building Materials".

Foreign scientific consultant: Gintautas Skripkiunas – PhD, Professor, Leading Researcher at the Institute of Building Materials of Vilnius Gediminas Technical University (Vilnius, Lithuania).

Reviewers: Usipbekov E.E. – Candidate of Technical Sciences, Associate Professor of the Department "Civil engineering and Building Materials". Sartayev D.T. – Candidate of Technical Sciences, Associate Professor of the Faculty of Construction Technologies and Materials, IEC KazLAACE.

LISTENED: Report on the work done on the topic of the dissertation "Development of the composition of monolithic concrete using chemical additives" Tolegenova Aigerim Kairatovna. In her report, Tolegenova A.K. presented the relevance, purpose of the work, novelty, relevant results and work prospects.

During the discussion, the doctoral student was asked the following questions:

Doctor of Technical Sciences, Professor M.T. Zhuginisov: What does monolithic concrete mean and what is its difference from other types of concrete?

Answer: **Monolithic concrete** is concrete that is laid directly on the construction site in the design position and hardens in natural conditions, forming a complete structure. Monolithic concrete is used for the construction of structures such as foundations, walls, slabs, bridges, tunnels and other building elements.

Monolithic concrete is poured at the construction site and solidified in the formwork, forming a solid structure, while precast concrete is manufactured at the factory and mounted on site. Monolithic concrete provides seamless and high strength, which is especially important for unique and massive structures, while precast concrete is faster to install, but limited to standard shapes. Monolithic structures take longer to build and depend on weather conditions, but they are better suited for complex architectural solutions.

Doctor of Technical Sciences, Professor E.T. Besimbayev: could you please explain why you have chosen to study the rheology of concrete in your dissertation, and what significance it has?

Answer: My research on the rheology of concrete is focused on understanding the properties of concrete mixtures in their fresh state. This is crucial for ensuring the workability, quality of laying, and uniformity of the final structure. Rheological studies allow us to comprehend how a concrete mixture behaves under external forces such as mixing, transporting, and placing, as well as ensuring its compliance with construction standards.

In the case of monolithic concrete construction, where the mixture is placed directly at the site, rheological characteristics determine how effectively the material fills the formwork and creates a homogenous structure without voids or defects. Incorrect rheological properties may result in reduced strength, cracks, and durability.

Thus, the study of concrete rheology is of key importance in my dissertation for the development of a monolithic concrete composition that meets modern requirements for quality, manufacturability, and cost-effectiveness.

Doctor of Technical Sciences, Professor S. Dostanova: How you optimized the concrete compositions in order to improve the characteristics of the concrete?

Answer: The optimization of concrete composition aims to improve its characteristics, including strength, durability, water resistance, frost resistance, workability, and cost-effectiveness. To accomplish these goals, several approaches are employed: composition selection using computational methods, use of modifying additives, optimization of coarse and fine aggregates, and experimental testing.

To determine the technological properties (workability and flowability), 13 different concrete mixture compositions have been developed with varying amounts of chemical admixtures such as plasticizers and air-entraining agents. The joint action of these admixtures is also taken into consideration.

Doctor of Technical Sciences, Professor S.B. Shayakhmetov: What improvement of concrete parameters were considered in the doctoral thesis?

Answer: When developing a composition of monolithic concrete with chemical admixtures as part of a doctoral thesis, the focus is typically on improving the following properties:

1. Strength characteristics: Increased compressive and flexural strength is achieved through the use of superplasticizers. These admixtures reduce the water-to-cement (W/C) ratio, ensuring a more densely packed structure.

2. Frost resistance: The addition of air-entraining agents creates a closed-cell structure, compensating for the pressure generated by freezing water. The study of the combined effect of air-entraining and plasticization admixtures on the durability of concrete under freezing and thawing cycles is also investigated.

3. Workability and adaptability: Plasticizers and superplasticizers are used to achieve high flowability without increasing water content. Admixtures that improve thixotropy are studied to facilitate pouring in complex structures.

The thesis topic proposes an integrated approach to the creation of concrete with improved performance characteristics. The main goal is to investigate the interaction between chemical admixtures and the components of the concrete mixture, which will enable us to develop a more durable, long-lasting, and cost-efficient monolithic concrete formulation for a wide variety of construction projects.

Doctor of Technical Sciences, Professor S. Dostanova: In addition to the above results, it would be good to provide in the presentation what advantages monolithic concrete with the use of chemical admixtures has.

Answer: Okay, I'll take your recommendation into account and add the advantages of the modified one to the slides. Thank you for the hint and support.

Doctor of Technical Sciences, Professor D.A. Akhmetov: In which laboratory were the strength characteristics and frost resistance carried out?

Answer: Studies to determine the technological properties of concrete mixtures and strength properties were conducted in the laboratory at the Plant for the production of reinforced concrete products in Temirbeton-1 LLP. Studies on the durability of concrete, namely frost resistance, were conducted at the Heidelberg plant in Klaipeda, Lithuania.

The Chairman: If we have no questions for the doctoral student, I will give the floor to the first reviewer. Please feel free to comment or ask questions.

Sartayev D.T., Candidate of Technical Sciences, Associate Professor of the Department of "Construction Technologies and Materials" at KazLAACE, read his review (a review is attached)

Usipbekov E.E., Candidate of Technical Sciences, Associate Professor of the Department of Construction and Building Materials, read his review.

Answer: Okay, I'll take all the comments into account. I will work on correcting grammatical and stylistic errors, as well as improving the design of the dissertation in accordance with the recommendations. Thank you for your valuable comments and constructive criticism.

The Chairman gives the floor to the doctoral student's supervisor, Professor K.A. Akmaliev.

PhD, Professor K.A. Akmaliev: Tolegenova Aigerim entered the doctoral program in 2019 at the Kazakh National Technical Research University named after K.I. Satpayev under the Educational program 8D07305 "Civil engineering and production of building materials and structures". According to the doctoral student's individual curriculum, she performs work on schedule and submits reports on her research activities on time. In addition, she has articles published in the Scopus database and in publications recommended by the CQAFSHE.

Regarding the importance of her research work, it is worth emphasizing her significant contribution to the science and practice of construction. The development of an optimal composition of monolithic concrete with chemical admixtures contributes to the creation of stronger, more stable and durable structures, which is especially important for buildings and

structures with increased operational requirements. The use of improved concrete characteristics minimizes the risk of structural failure under the influence of external factors such as frost, aggressive environments and mechanical stress.

The research conducted as part of the dissertation aims to develop an innovative approach to the design and use of monolithic concrete with chemical admixtures. This approach aims to improve not only the material's properties, but also the overall efficiency, stability, and reliability of the construction.

The value of the dissertation lies in its contribution to the development of a scientifically-based approach to creating monolithic concrete with improved properties. This approach opens up new possibilities for constructing reliable and durable structures.

By optimizing the composition of concrete using chemical admixtures, strength, water resistance, frost resistance, and resistance to aggressive environments can be increased, as well as cracking can be significantly reduced. This not only improves the quality of the final product but also reduces the cost of construction and maintenance due to the economic consumption of materials and increased service life of the structures.

Furthermore, the results contribute to environmental sustainability by offering solutions for reducing the carbon footprint of the construction industry and efficiently utilizing secondary resources. These achievements can serve as a foundation for the introduction of innovative technologies in the construction industry and the development of new regulatory standards.

Research conducted on the basis of the doctoral student's work has been completed. The main results and conclusions of the dissertation were determined based on the doctoral student's original research papers. I believe that she has answered all the questions and consider the goals of the research project to have been achieved. As her supervisor who has worked with her for three years, I have confidence in the quality of her work and recommend granting her access to the defense of her thesis.

Chairman: Does anyone have any comments or comments about the doctoral student's work?

Doctor of Technical Sciences, Professor S.H. Dostanova: This is a very extensive work, and it is clear that a lot has been done and a lot of results have been achieved. As a recommendation, we can add the advantages of this thesis and how the results affect the construction industry of the Republic of Kazakhstan. During the pre-defense, Tolegenova A.K. clearly and confidently answered questions and provided convincing evidence of her results. The content of her work fully meets the requirements for obtaining a PhD (Doctor of Philosophy) degree.

Ph.D. Professor S.B. Shayakhmetov: I would like to emphasize the importance of the doctoral student's research. Research on the thesis is of great importance for improving the quality and durability of monolithic concrete by optimizing its composition using chemical admixtures. This allowing possible to improve the strength characteristics, workability and frost resistance of concrete, as well as reduce the risk of cracking and increase its resistance to aggressive environments. Economic efficiency is achieved by reducing cement consumption and using alternative materials, which also reduces the carbon footprint. The scientific novelty of the work is to study the influence of rheological and physico-chemical processes on the properties of concrete, which opens up opportunities for the development of modern materials that meet the high requirements of the construction industry and environmental sustainability. It is also worth noting that the doctoral student actively applied international experience and scientific methods in this work. She has independently conducted research both at our institute and abroad, which underlines her desire to gain deep and comprehensive knowledge in her field. Publications in scientific journals attest to her outstanding scientific contribution and recognize her authority in the global scientific community.

Thus, this scientific work has a high academic value and makes a significant contribution to the development of environmentally sustainable technologies in the field of construction and production of building materials.

The Chairman: I would like to invite Doctoral Student Tolegenova A.K to present her speech.

PhD student: Thank you to all the participants for participating in the pre-defense and for your valuable opinions and suggestions.

Conclusion of the report of the meeting:

1. Relevance of the research topic and its relation to general scientific and government programs:

The research on "Developing of the composition of monolithic concrete using chemical additives" is relevant and meets the requirements of modern scientific and government programs aimed at developing the construction industry and improving the environmental situation.

2. Results of pre-defense:

Doctoral student Tolegenova Aigerim Kairatovna presented the results of her research, which show the effect of chemical complex admixtures to improve the properties of monolithic concrete. The work received positive reviews and was highly appreciated by scientific consultants and reviewers.

3. Scientific novelty of the work:

It has been established that the use of a complex admixture improves the rheological properties of concrete mixtures during the process of liquefaction and thickening under shear, depending on the presence of plasticizing and air-entraining admixtures. These conclusions were drawn based on analysis and the results obtained.

New technical solutions have been proposed to increase the durability of heavy concrete by using complex chemical admixtures. Formulations using these admixtures have been developed.

The addition of plasticizers and air entrainers improves the mechanical properties and pore structure of concrete, increasing its resistance to freeze-thaw cycles. This, in turn, makes it possible to optimize the concrete mixture composition and predict its performance under conditions of repeated cycles in high humidity environments.

4. The fundamental importance and adequacy of the conclusions drawn in the dissertation.

The durability of cement-based materials depends on the structure of capillary pores formed during the hardening process. To improve this, the ratio of components in the mixture is optimized by adding plasticizers and increasing entrained air content. The use of carboxylate ethers reduces the amount of water required by 22,8%, improving concrete mix workability and reducing deposit formation. By incorporating air into the cement mix, consistency can be increased by 34%, and water requirements can be reduced by up to 8,9%. However, increasing air content decreases compressive and flexural strength, as well as density of the hardened solution. A balance must be struck between fluidity, strength, and durability.

The use of plasticizing and air-entraining agents in combination demonstrates a synergistic effect, enhancing the closed porosity and frost resistance of concrete. This reduces the formation of scale to minimal levels. Rheological studies have shown that the addition of plasticizers, such as polycarboxylic ether, can significantly decrease the yield strength and plastic viscosity of cement mortar, improving thixotropy. Air-entrained agents further reduce plastic viscosity, resulting in a uniform material consistency. The combined use of these admixtures allows for the regulation of the drainage capacity of the solution, lowering its coefficient to zero and increasing the resistance of the material to freezing and thawing.

For further research, it would be necessary to study in more detail the technological properties of self-compacting concrete mixtures, such as consistency, thixotropy, and pumpability when using concrete pumps. Conducting tests on fluidity, sedimentation, and structural parameters of concrete would allow for a better understanding of the impact of a combination of plasticizers and air-entraining agents on the performance of concrete mixtures.

Additionally, exploring the relationship between entrained air content and technological properties is an important area for developing universal guidelines for the use of modified concrete formulations.

5. Scientific and practical significance of the results.

The results of this work can be applied in the design and construction of concrete and reinforced concrete structures. In addition, complex admixtures can help ensure the production of concrete mixes without water drainage, which is useful for various applications such as high-strength concrete and 3D printing.

6. Publication of the main results and conclusions of the dissertation:

1 Akmalaev K., Tolegenova A., Jetpisbayeva A. Features of structure formation of polymercement stone. Proceeding of VI International annual conference «Industrial technologies and engineering», Volume I (2019) Шымкент, Казахстан, с. 12-15.

2 Akmalaev K., Tolegenova A., Jetpisbayeva A. Formation of the structure of composite binders, III Международная конференция-симпозиум Внедрение достижений науки в практику и устранение в ней деятельности коррупции, (2019) Ташкент, Узбекистан, с. 13-18.

3 Akmalaiuly K., Tolegenova A., COMPLEX CHEMICAL ADDITIVE FOR CONCRETE, Вестник КазННТУ 2020 №5, 692-695 с. <https://official.satbayev.university/download/document/16739/%D0%92%D0%95%D0%A1%D0%A2%D0%9D%D0%98%D0%9A-2020%20%E2%84%965.pdf>

4 Tolegenova A.K., Akmalaiuly K., Skripkiunas G. Study of the effectiveness of the use of complex additives Master Rheobuild 1000 and Master Air 200, № 6 (2021): Известия НАН РК. Серия геологии и технических наук, с.141-146. <https://doi.org/10.32014/2021.2518-170X.130>.(Scopus Q3, Percentile 43%).

5 Tolegenova, Aigerim, Gintautas Skripkiunas, Lyudmyla Rishko, and Kenzhebek Akmalaiuly. 2022. "Both Plasticizing and Air-Entraining Effect on Cement-Based Material Porosity and Durability" Materials 15, no. 13: 4382. <https://www.mdpi.com/1996-1944/15/13/4382>(Scopus Q2, Percentile 64%).

6 А.К. Толегенова, А.С. Еспаева, З.Н. Алтаева, Исследование совместного влияния отходов добычи природного камня-ракушечника и химических добавок на технологические свойства бетонной смеси, Вестник КазГАСА 2(88) 2023 г. https://vestnik.kazgasa.kz/frontend/web/uploads/personal-documents/1687275342_G9FcWB.pdf

7 Tolegenova A., K. Akmalaiuly, Z. Altayeva, A. Yespayeva, Y. Kuldeyev, Influence of plasticizing and air-entraining admixtures on concrete properties, Вестник КазГАСА 4 (90) 2023 г. https://vestnik.kazgasa.kz/frontend/web/uploads/personal-documents/1703950212_RbhbeL.pdf

8 Tolegenova, Aigerim, Skripkiunas, Gintautas, Rishko, Lyudmyla, Akmalaiuly, Kenzhebek, Air-Entraining Effect on Rheological Properties of Cement-Based Mixtures, Advances in Materials Science and Engineering, 2024, 5018973, 16 pages, 2024. <https://doi.org/10.1155/2024/5018973> (Scopus Q2, Percentile 54%).

9 К.Акмалайулы, А. Толегенова, Г. Кожкомбайева, Corrosion Resistance of Reinforcement in Reinforced Concrete Products, Труды Университета №3 (96) 2024 (Вестник КарГТУ), 211-216 с. DOI 10.52209/1609-1825_2024_3_211 <http://tu.kstu.kz/archive/issue/103>

1. **The content of the dissertation corresponds to the educational program.**
2. The content of the dissertation fully corresponds to the presented educational program 8D07305 "Civil engineering and production of building materials and structures".

3. Compliance with the requirements for doctoral dissertations (PhD).

4. The dissertation of doctoral student Tolegenova Aigerim Kairatovna on the topic "Development of the composition of monolithic concrete using chemical additives" meets the requirements established for obtaining a PhD in philosophy.

VOTED:

For – unanimously. Against – no. There were no abstainers.

DECIDED:

To admit doctoral student Tolegenova A.K. of the Educational program 8D07305 "Civil engineering and production of building materials and structures" to the defense of doctoral dissertations, as having completed the educational process, fully fulfilled the requirements of curricula and programs in accordance with the Rules of credit technology of education in the NJSC "Kazakh National Research Technical University named after K.I. Satpayev" (doctoral studies), approved by the decision of the Board of NJSC KazNRTU named after K.I. Satpayev.

**The chairman,
Head of the Department
Doc. Tech. sciences**



Shayakhmetov S.B.

**Secretary,
Assistant**

Taubayeva A.E.