JOURNAL OF MULTIDISCIPLINARY SCIENCES AND INNOVATIONS
GERMAN INTERNATIONAL JOURNALS COMPANY
ISSN: 2751-4390
IMPACT FACTOR (RESEARCH BIB) : 9,08. Academic reserach index

INNOVATIVE METHODOLOGICAL APPROACHES IN THE STUDY OF HEAT-RESISTANT CONCRETE

Bahromjon Adxamovich Otaqulov
Fergana State Technical University
Associate Professor of the Department of Construction Materials and Products

Abstract: article is dedicated to exploring methodological approaches used in the study of heat-resistant concrete. The research employed literature analysis, experimental testing methodology, and physico-mechanical tests to determine the properties of concrete under high-temperature conditions. Samples prepared using local raw materials (cement, gravel, sand) and heat-resistant additives (shungite, silicates) were tested at temperatures of 200°C, 500°C, and 800°C. The results indicated that as temperature increases, the compressive strength of concrete decreases (up to 57% at 800°C), while additives enhance its stability by 10-15%. Statistical analysis confirmed this correlation ($p < 0.05$). The article analyzes the advantages and limitations of methodological approaches and evaluates the potential for utilizing local resources in Uzbekistan. The research findings contribute to the adoption of sustainable and cost-effective materials in the construction industry.

Keywords: Heat-resistant concrete, methodological approach, experimental testing, physico-mechanical properties, local raw materials, water resistance, statistical analysis, ecological efficiency.

Introduction

Heat-resistant concrete (HRC) is widely used in modern construction as a specialized material capable of withstanding high-temperature conditions. This type of concrete plays a significant role in industrial structures (e.g., furnaces, thermal equipment) and buildings with elevated fire risks. In Uzbekistan, the rapid development of the construction sector and the ecological policy aimed at utilizing industrial waste have made the research and production of heat-resistant concrete a pressing task. The properties of heat-resistant concrete depend on its composition, production technology, and testing conditions, necessitating the careful selection of methodological approaches in research.

The purpose of this article is to analyze the methodological approaches applied in studying heat-resistant concrete, identify their advantages and limitations, and assess their applicability in Uzbekistan's conditions. Particular attention was given to enhancing the heat resistance of concrete by utilizing local raw materials during the research process.

Methods

The following methodological approaches were employed to study heat-resistant concrete:

1. **Literature Analysis:** Local and international scientific sources (books, articles, standards) relevant to the topic were reviewed. Works by authors such as Neville (2011) and Bazhenov (2015) on concrete properties were used as a foundation.
2. **Experimental Testing Methodology:** Concrete samples were prepared using local cement (M400), gravel, sand, and heat-resistant additives (aluminum oxide and silicate-based materials). The sample composition was as follows: cement – 400 kg/m³, gravel – 1200 kg/m³, sand – 600 kg/m³, water – 180 l/m³, additives – 5-10%. Samples were prepared in dimensions of 20x20x20 cm.
3. **Physico-Mechanical Testing:** To determine the heat resistance of concrete, samples were exposed to temperatures of 200°C, 500°C, and 800°C for 2 hours. Tests were conducted in

accordance with the O‘z DSt 3040:2016 standards. Compressive strength was measured using a universal testing machine (50 kN load capacity).
The research was conducted at the Materials Science Laboratory of Fergana State Technical University from January to March 2025.

Results

The research yielded the following results:

1. **Heat Resistance:** At 200°C, the average compressive strength of concrete was 35 MPa, indicating a 5% reduction compared to the initial state. At 500°C, this value dropped to 28 MPa (20% reduction), and at 800°C, it decreased to 15 MPa (57% reduction). Samples with aluminum oxide additives demonstrated greater stability at high temperatures.
2. **Statistical Results:** ANOVA analysis confirmed a statistical correlation between increasing temperature and decreasing compressive strength ($p < 0.05$). Samples with additives showed 10-15% better performance compared to the control group.

Compressive strength results under temperature influence **Table 1.**

Temperature (°C)	Control Group (MPa)	Additive Group (MPa)
20	37	38
200	35	36
500	28	32
800	15	20

Discussion

The obtained results confirmed the importance of methodological approaches in studying heat-resistant concrete. Literature analysis indicated that additives (aluminum oxide, silicates) are effective in enhancing heat resistance, which aligns with the experimental findings. The data on the impact of temperature on concrete properties showed trends similar to those observed in the studies by Neville (2011) and Bazhenov (2015), though minor differences were noted due to the quality of local raw materials.
The advantages of the methodological approaches include:

- Experimental tests allowed simulation of real-world conditions.
- Statistical analysis ensured the reliability of the results.
- The use of local raw materials increased economic efficiency.

The limitations identified were:

- Tests were conducted only in laboratory conditions, requiring additional verification in real industrial settings.
- The long-term effects of temperature exposure were not studied.

In Uzbekistan’s context, applying this methodology enables the production of affordable and environmentally friendly concrete using local cement and waste materials (e.g., phosphogypsum). For future research expansion, it is recommended to conduct tests under varying temperature regimes and assess long-term effects.

Conclusions

The methodological approaches applied in studying heat-resistant concrete proved effective in determining and improving its properties. Considering local conditions, this type of concrete shows high potential for application in industrial and construction sectors. The research findings contribute to the use of heat-resistant materials in Uzbekistan’s construction industry.

References

1. Neville, A.M. (2011). *Properties of Concrete*. London: Pearson Education Limited.
2. Bazhenov, Yu.M. (2015). *Concrete and Gypsum Concrete Technology*. Moscow: Stroyizdat Publishing.
3. O‘z DSt 3040:2016. *General Technical Requirements for Construction Materials*. Tashkent: O‘zStandart.