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Abstract. Hot and dry climatic conditions are characterized by high summer air temperatures reaching 35–40 °C, low relative humidity below 50%, intense solar radiation, and frequent dry winds. The combined effect of these factors causes rapid moisture loss from fresh concrete, which significantly slows down or even interrupts cement hydration processes. As a result, the compressive strength of concrete may decrease by up to 50% compared to concrete cured under normal temperature and humidity conditions. Intensive early-age dehydration also leads to deterioration of the pore structure and a significant reduction in concrete durability. This review-based study analyzes the technological features of concrete works performed under hot and dry climatic conditions. The research focuses on identifying the main problems arising during concreting in such environments, assessing their influence on concrete strength, and evaluating technological solutions aimed at creating favorable curing conditions. The conclusions summarize effective measures to ensure the required quality of cement concrete pavements and propose rational methods for concrete production, transportation, placement, and curing.

INTRODUCTION

According to the definition provided in the “Guidelines for Concrete Works in Hot and Dry Climates” developed by Russia, a hot and dry climate is characterized by a prolonged hot summer period, extremely high air temperatures (absolute maximum of 40 °C and above), average maximum temperatures of the hottest month exceeding 29 °C, and average relative air humidity not exceeding 50%. Such climatic conditions are also accompanied by significant daily temperature fluctuations, intensive cyclic heating of exposed surfaces due to solar radiation, and the presence of dry winds.

Numerous studies devoted to concrete technology under the climatic conditions of Uzbekistan indicate that the construction of cement concrete pavements in hot and dry environments remains a highly relevant problem. Continuous improvement of construction technologies, their adaptation to real field conditions, and consideration of economic and organizational factors are required.

Previous research has demonstrated that elevated air temperatures combined with strong solar radiation and wind intensity cause accelerated evaporation of water from concrete during mixing, transportation, and placement. These processes significantly affect the physicochemical and mechanical behavior of concrete during hardening, leading to strength loss, increased cracking susceptibility, and reduced durability.

EXPERIMENTAL RESEARCH

The study analyzes practical experience and published experimental data related to concrete behavior under hot and dry climatic conditions. Particular attention is given to moisture evaporation intensity as a function of air temperature, relative humidity, and wind speed.

Experimental observations show that under wind speeds of 4.5 m/s, an air temperature of 20 °C, and relative humidity of 70%, the evaporation rate from concrete surfaces is approximately 0.3 kg/(m²·h). When the air temperature increases to 35 °C and relative humidity decreases to 30%, the evaporation rate rises to 1.2 kg/(m²·h), which is four times higher. Further increase in wind speed up to 10 m/s doubles this value.

The study also examines the influence of cement content on cracking resistance. Field observations from road reconstruction projects revealed that reducing cement consumption from 410 kg/m³ to 390 kg/m³ significantly decreased shrinkage cracking during the hottest construction period, although it extended the time required to reach the design strength.

RESEARCH RESULTS

The results indicate that intensive moisture loss during the early curing stage leads to severe plastic shrinkage, early cracking, and the formation of capillary pores oriented toward the evaporation surface. This negatively affects the pore structure of concrete, slows down cement hydration, and may reduce compressive strength by up to 50%. Rapid early-age drying is also identified as one of the main causes of surface scaling in cement concrete pavements.

It was established that maintaining a constant concrete mix design throughout the entire construction period is ineffective. More rational solutions include developing seasonal mix designs or regularly adjusting the base mix depending on actual construction conditions, such as air temperature fluctuations and aggregate quality.

The use of high-activity rapid-hardening Portland cement, carbonate aggregates, and modern plasticizing admixtures significantly improves concrete performance. In particular, complex chemical admixtures widely used in Uzbekistan have proven effective in enhancing workability, strength, and durability while reducing water demand.

Lowering the temperature of the concrete mixture by cooling aggregates, using chilled water, or partially replacing mixing water with ice (up to 50%) was shown to be an effective method for controlling early-age hydration and minimizing moisture loss.

CONCLUSIONS

The construction of cement concrete pavements in hot and dry climates is a complex technological process that requires a comprehensive and scientifically justified approach. High air temperatures, low relative humidity, and intense solar radiation accelerate moisture evaporation, which adversely affects cement hydration, strength development, crack resistance, and long-term durability of concrete pavements.

The study demonstrates that minimizing these negative effects is possible through the integrated application of rational material selection, optimized mix design, effective use of chemical admixtures, controlled production and transportation processes, timely placement and compaction, and advanced curing methods. The implementation of such technologies is a key factor in improving pavement quality and reducing long-term эксплуатационные costs under extreme climatic conditions.

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