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# TECHNOLOGY FOR IMPROVING THE DURABILITY OF CONCRETE IN THE DRY HOT CLIMATE OF UZBEKISTAN

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abstract

The article is devoted to the method of manufacturing concrete in the conditions of the dry hot climate of Uzbekistan, methods and tools of construction technology are used in the study of this problem. The article analyzes the characteristic features of construction technology, taking into account the influence of different local resources. Based on the results of the study, relevant recommendations and proposals have been prepared for the decision-maker (LPR).



## Introduction

These modern technologies for the manufacture of concrete, as well as concrete and reinforced concrete products and structures have been developed by many Uzbek and foreign scientists. However, their works are mainly devoted to the issues of concrete technology in the so-called “normal” conditions (ambient temperature 15-200 C and relative humidity more than 50%) or in winter concreting. At the same time, almost a quarter of reinforced concrete products are produced in areas with a dry, hot climate, which significantly affects the technology of concrete production, causing intense evaporation of moisture from the concrete mixture and changing the nature of physico-chemical processes occurring during concrete hardening. When concreting structures in the summer, the temperature difference between the outer and inner layers of concrete reaches 50-600 C, which causes a thermally stressed state and cracking of the surface. The lack of proper care of concrete contributes to rapid dehydration and loss of strength. If the effects of a dry hot climate are not taken into account, the quality and durability of structures are significantly reduced.

The natural and climatic conditions of Central Asia differ from those of Central Europe in the duration of the hot dry period of the year, the presence of an extensive zone of deserts and semi-deserts, where there is no large aggregate, and the small one does not meet the requirements of standards at all, as well as high seismicity. These factors make significant adjustments to the theory and practice of concrete and reinforced concrete production.

**Research methodology**

The territory of Uzbekistan is located between 35 and 450 north latitude, its climate is moderately warm and sharply continental. A large amount of solar heat causes a high temperature level, a very hot, dry, long summer and a short unstable winter. The amount of solar radiation in the summer months ranges from 600-800 cal / cm2 per day and the number of days with an average air temperature of more than +250c in some areas exceeds 140 (Tashkent-142, Termez-166, Bukhara-169, while in Moscow - only 46).Most of the precipitation falls during the cold season. During the summer months, the average rainfall in Tashkent is 17. Relative humidity in summer averages 30-50%. During the daytime, it drops to 10-15%, and at night it rises to 50-70% Summer drought is accompanied by intense heat; the average July temperature in Tashkent is -26.9; Termez is 30.70 C. The average maximum outdoor temperatures are 29.5-39.8, and the absolute maximum reaches 42-500c. In the warm half-year, an area of slightly reduced pressure is created over the semi-desert and desert spaces of Uzbekistan, which causes the formation of a hot dry wind, the average speeds of which in July are 1.2-2.4 m/s. The winds blowing from the valley are relatively strong. Sometimes there is a gusty and warm wind in the foothills-a hairdryer (6,37). The terrain has a great influence on the climate of Uzbekistan; as you climb into the mountains, the temperature drops by about 10c for every 200m.

Since weather conditions are predetermined by long-term climatic indicators of the area, it is advisable to take them into account differentially when determining concrete technology. In this regard, the territory of the Central Asian republics from the point of view of the identity of the conditions for the production of concrete works can be divided into four climatic zones.

1. Mountainous, covering the Pamir and Tien Shan regions and characterized by a cool climate with mild summers and harsh winters.

2. The zone of foothill oases, including the Fergana Valley, Tashkent and Samarkand regions of Uzbekistan.

3. A zone of deserts with a cold winter covering the western part of Uzbekistan.

4. A zone of deserts with a warm winter, located in the south-west of Uzbekistan.

High air temperatures and intense solar radiation combined with winds cause rapid evaporation of moisture from the concrete mixture during its manufacture, transportation and laying, which significantly affects the nature of the physico-chemical and mechanical processes occurring during concrete hardening. In this regard, it is necessary to distinguish between the concepts of dry hot climate and dry hot weather.

In conditions of dry hot climate, especially in the manufacture of products in open workshops and landfills without heat treatment, shrinkage phenomena due to contracting and drying of cement dough occur most intensively. There is a decrease in the volume of concrete, accompanied by the formation of a significant number of pores in it and an increase in internal stresses that reduce the load-bearing capacity of the structure. When selecting the composition of concrete, serious attention should be paid to the possibility of forming a dense skeletal part due to the correct determination of the proportion of coarse (gravel or crushed stone) and fine (sand) aggregate. With the right ratio of sand to cement, these stresses are partially perceived by a rigid skeleton that reduces destructive processes. The lower the proportion of sand, the lower the water demand of the concrete mixture. Aggregates used in concrete must meet the requirements of the relevant GOST standards.

**Results**

When constructing monolithic concrete structures without heat treatment of aboveground parts subjected to partial cyclic heating, it is recommended to use Portland cement containing at least 50% tricalcium silicate C3S and not more than 8% tricalcium C3A. Cement plants in Uzbekistan produce several types of binders, Portland cement, fast-hardening Portland cement, sulfate-resistant Portland cement, putzollan Portland cement, etc.

Putsollan Portland cement can be used for concretes of underwater structures, as well as for the construction of underground structures exposed to fresh water or in conditions of high humidity in a closed manner.

Slag Portland cement grades below 400 can be used on a par with conventional Portland cement in the construction of closed structures that are not affected by climatic factors.

For the production of concrete and reinforced concrete products subjected to heat and humidity treatment at atmospheric pressure and temperatures up to 1000C, Portland cement, slag-Portland cement, putzollan Portland cement and their varieties are used as binders, as well as other types of binders that meet special technical conditions and ensure the specified properties of concrete.

In Uzbekistan, complete additives consisting of two or more substances are used as plasticizing additives. Experimental work of Uzbek scientists has shown that CaCI2, NaCI, FeCI3 additives combined with NaNO are very effective in the construction of buildings made of monolithic concrete. Complex additives are recommended to be administered in the quantities indicated in the table.

| **Type of construction** | **Maximum permissible dosage of additives, % by weight of cement** | | |
|---|---|---|---|
| | **$CaCI_2$ +NaNO** | **NaCI+NaNO** | **$FeCI_3$+NaNO** |
| Non-reinforced | 2,0+2,0 | 3,0+3,0 | 2,0+2,0 |
| Low-reinforced ones | 1,5+1,5 | 2,0+2,0 | 1,0+1,0 |
| Heavily | reinforced 1,0+1,0 | 1,5+1,5 | 1,0+1,0 |

In the PPE facility under construction (Special Industrial Zone) "Jizzakh", the transportation of concrete mix is carried out by tilting trolleys, buckets. The container for transporting the mixture has a large capacity, the belt conveyors are covered with special boxes that protect the mixture from direct sunlight and wind exposure. When laying a concrete mixture, systematic control of its mobility is carried out. The temperature of the concrete mixture at the time of laying it in conventional structures does not exceed 30-350C. When laying the mixture in massive structures, the temperature is lower - no more than 200C. This requirement does not apply to the method of laying preheated concrete mix. In dry hot weather, due to the rapid loss of mobility of the concrete mixture during its laying and compaction, the intensity of the work of vibrators and vibrating equipment increases significantly, which requires additional equipment.

To accelerate concrete work, as well as to improve the quality of the surface layer of concrete (when concreting floors, road surfaces, hydraulic structures, etc.), the laid concrete is evacuated. The treatment of the concrete surface by vacuuming creates the most favorable conditions for concrete hardening, as it prevents the evaporation of the mixing water. However, it should be borne in mind that cements with low water separation are less amenable to vacuuming than cements with low water retention capacity. Therefore, the vacuum treatment of concrete made on cements with water-retaining additives is allowed only after preliminary verification and the establishment of the optimal evacuation mode by experiment.

Concrete care is a time–consuming and complex technological operation, the costs of which depend on local conditions (availability of water, appropriate materials, etc.), as well as on the type and composition of concrete, the type of binder used and

other factors and significantly affect the cost of 1 m3 of monolithic concrete. On very hot days (daytime temperature 42-450C), it is advisable to carry out concreting work at the end of the afternoon and at night, which will significantly improve the conditions for laying concrete. It is recommended to finish concrete surfaces immediately after the concrete compaction is completed. To protect the concrete surface from rapid drying and crack formation, it is recommended to keep them under the coating for another 2-3 days without additional moisture after the completion of subsequent care. The concrete surface can be covered with special film-forming compounds (mainly light tones), if this is permissible for aesthetic and sanitary reasons. The application of such compositions is especially advisable when concreting extended structures with a large module of the open surface (road coverings, airfields, channel lining, etc.), as well as when performing work in arid terrain. Film waterproofing compensates for adverse climatic effects on concrete, and in some cases increases the strength characteristics by 15-20% compared to concrete that hardened under normal conditions.

**Conclusion**

The most rational method of concrete care in anhydrous desert areas is the use of ready-made polymer films of predominantly light tones. The surfaces of the structures must be covered immediately after finishing. At the same time, it is recommended:

- weld individual pieces of polymer films into larger panels and cover the surfaces with them over the entire area;
- fix the edges of the panels with boards, sprinkle with sand or soil;
- ensure a tight fit of the panels to the surface of smoothed concrete without folds and wrinkles;
- protect the film from mechanical damage;
- upon completion of concrete maintenance, remove the film in the evening.

The terms of holding concrete under polymer films are assigned by construction laboratories for specific climatic conditions.

Thus, for the conditions of Uzbekistan, it is most effective to use preheating of products until they reach a decaying strength equal to 30-40% of the design, followed by exposure under a film coating. This allows, through the use of environmental heat at the second stage of care, to dramatically increase the productivity of construction enterprises and thereby reduce the cost of production. The productivity of enterprises due to the acceleration of turnover from 1.5 to 2.4 times a day can increase by 50%, and the economic effect due to the reduction of energy consumption can reach 10.5-20.3 thousand soums per 1 m3 of products.

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