Continuous vapor processes in newly laid concrete

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Abstract. This article presents the results of experiments on the physical processes that occur during the hardening process of concrete in dry hot-climatic seasons and the reduction of their negative effects - as well as on the physical and mechanical properties. Under the influence of solar radiation and high temperature, the amount of water in the newly laid concrete mixture begins to evaporate rapidly. As a result of intensive evaporation of water in the concrete mixture from the bottom to the top, interconnected pores are formed, as a result of which the concrete has a defective structure, and this situation leads to a decrease in concrete strength. As a result of dehydration of the concrete mixture, the cement hydration process slows down and may even stop. If the hardening of the concrete is not adequately controlled, its strength may be only 50% of the design strength. The duration of keeping newly laid concrete under polymer films is determined by the construction laboratory, taking into account specific climatic conditions. Covering the concrete surface with inventory thermal insulation coatings (ITVP). These covers are made by pulling two-layer polyethylene film on wooden or metal frames. They can also be folded and assembled. The effectiveness of this method is not very high, it is considered a waste product.

1 Introduction

Under the influence of solar radiation and high temperatures, the water in the newly laid concrete mix begins to evaporate rapidly [1, 2, 3, 11, 14]. As a result of the intensive evaporation of water from the bottom of the concrete mixture upwards, interconnected pores are formed, resulting in a defective structure of the concrete, which leads to a decrease in the strength of the concrete. As a result of the dehydration of the concrete mix, the process of cement hydration slows down and may even stop. If the hardening of the concrete is not adequately controlled, its strength can only reach 50% of the design strength. Foreign scientists (V.Lerch, D.Tinza, S.Friedman, and others) also note that cracks appear on the surface of hardening concrete in the first hours in dry-hot climates, and the quality of concrete decreases sharply. International standards also pay special attention to the process of plastic sinking "Concrete works in hot climates" [3, 4, 9, 11].

According to the results of research (A. Lykov's theory), uneven distribution of water in the concrete and the evaporation of water from the capillary-porous body under the

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influence of high temperatures result in large allowable subsidence deformations. Therefore, cracks in concrete, as well as other defects, can occur [4, 5, 6, 8, 11]. Rapid dehydration of hardening concrete in low humidity environments adversely affects the hydration mechanism of the cement stone, resulting in large plastic, general subsidence, and crack formation in the structures. In natural conditions with high temperature and low relative humidity, delayed or untimely start of maintenance of concreted concrete, as well as failure to perform at the required level, leads to deterioration of the physical and mechanical properties of hardened concrete following the requirements [15-20].

2 Method

In the experimental work, a concrete mix was used, taking into account the water-cement ratio. The spread of the concrete mixture on the cone subsidence was 1-3 cm, and the following fillers were used: Portland cement, a product of the Akhangaran plant, its grade M400, crushed stone, mainly from local plants, Oktash quarry plant, crushed granules 5-20, quartz sand Mkr = 3, 4 at the level of demand. At the time of the experiments, the maximum ambient temperature was 34-36 ^{0}C, and the relative humidity was 37-32% on average [4.5].

The main part of the experiments was carried out in producing concrete and reinforced concrete products at the "Experimental Test Plant of Building Structures" in Aktash, Namangan region, under the Ministry of Agriculture and Water Resources. Using the effects of natural solar energy [3]. Under the influence of solar radiation and high temperatures, the water in the newly laid concrete mix begins to evaporate rapidly [1]. As a result of the intensive evaporation of water from the bottom of the concrete mixture upwards, interconnected pores are formed, resulting in a defective structure of the concrete, which leads to a decrease in the strength of the concrete. As a result of the dehydration of the concrete mix, the process of cement hydration slows down and may even stop. If the hardening of the concrete is not adequately controlled, its strength can only reach 50% of the design strength. Krylov B.A., Hakimov Sh.A. According to the results of research (A. Lykov's theory), uneven water distribution in the concrete and its evaporation from the capillary-porous body under the influence of high temperatures results in the formation of undesired large subsidence deformations [12-15].

Experiments have shown that the strength of dehydrated concrete (when dewatering occurs before or after the concrete mix is laid) can be reduced by 20-35% or even 50%. The decrease in the strength of concrete is explained by the formation of pores in the concrete as a result of the rapid evaporation of water during the extinction of the hardening process. The filtration capacity of freshly laid concrete in dry-hot climates ($t = 43^0$C, $\alpha = 35\%$) is 70 times higher than that of hardened concrete under "normal" conditions. This indicator significantly negatively impacts the strength of concrete and its performance. During the hardening of concrete, any measures taken against dehydration significantly increase its strength.

3 Results and Discussion

Samples of 100x100x100 mm were prepared to determine the compressive strength of the concrete. The prepared samples were sprayed with pellicle-forming compositions (WSC-water-soluble and ADC-aqueous dispersion) and consumption of 350-400 g/m2.

The solidification medium of the samples was $t = 43^0$C, $\alpha = 35\%$. Hardening samples were taken under moist sand for reference.

Samples were tested after 1, 3, and 28 days. The design mark of the concrete is 300, and the research results are given in Table 1. The compressive strength of concrete depends on the method of care. t = 43^0C, α = 35%, design grade of concrete-300.

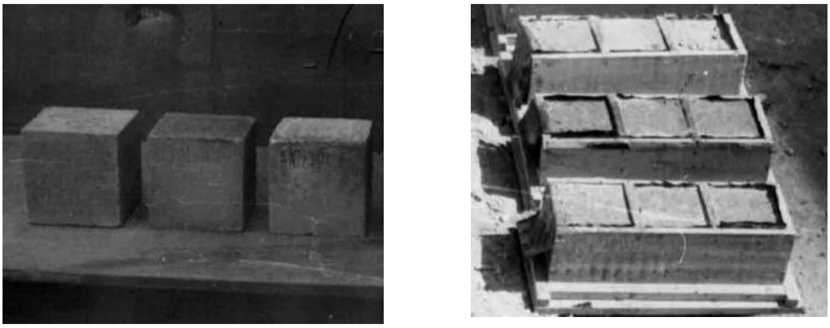

Fig.1. General view of the cubic samples

Table 1. The compressive strength of concrete depending on the treatment method

№	Concrete care	R_b, MPa, duration		
		1	3	28
1	WSC	12.3	20.1	31
2	ADC	13.5	20.3	30.5
3	A layer of moist sand	13.4	20.1	26.4
4	Careless	12.3	1.1	23.7

As seen from Table 1, when using curtain-forming compositions, the strength of the concrete is higher than the design strength, and the strength of the concrete solidified under the moistened sand is lower than the strength of the design.

In addition, spray the curtain-forming ingredients on the newly laid concrete surface. To protect freshly lost concrete from dehydration, quick-setting, and good wet conditions, its surface is sprayed with curtain-forming ingredients. These compositions form a moisture-proof pellicle (pellicle) on the concrete surface quickly. Its advantage over other methods is that these compositions can be sprayed within 10-15 minutes after laying on the concrete surface. It is especially advisable to cover large structures with an open surface modulus (ratio of surface area to its volume) (roads and airfields, canal tiles, etc.), as well as to cover their surfaces with such materials when performing concrete work in areas where there is a shortage of water.

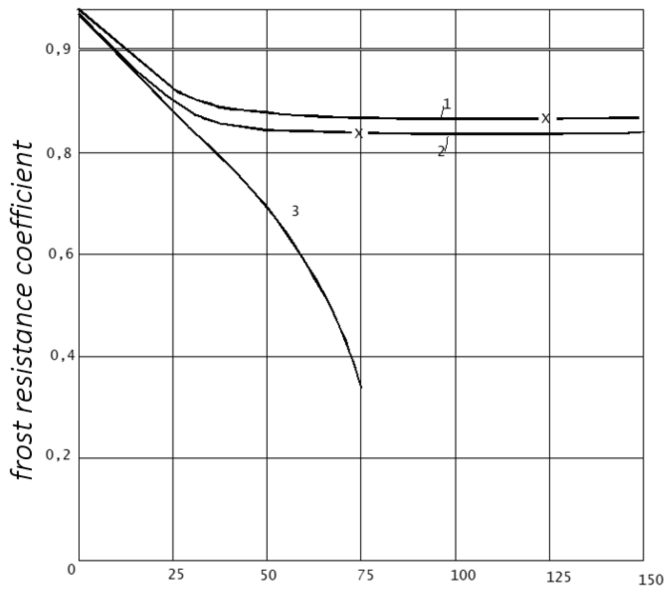

Fig. 2. Frost resistance of concrete hardened under curtain-forming compositions. 1 when WSC (water soluble content) is used: 2 is when ADC (aqueous dispersion content) is used; 3 is sample without maintenance.

Note: concrete mix composition 1: 2.91: 4.08, W/C = 0.54; The main indicators of a special climate camera are: $t=43 \pm 3^0C$; $\alpha=35\%$.

To determine the frost resistance of freshly poured concrete when using curtain-forming compositions, a concrete mix was prepared, and several studies were conducted. The experiments were mainly carried out as an experiment in producing concrete and reinforced concrete products at the "Experimental Test Building Structures Plant" in the town of Oktash as a test of the cold resistance of newly laid concrete [3].

The pellicle coating was left at different distances from the concrete surface, thereby achieving its hermetic coating. During the experiment, for comparison, one sample was closed tightly across the surface, i.e., d = 0 mm, and the remaining samples were solidified without any care (d = ∞).

The graph of the relationship j = f (δ) obtained from the experimental results is shown in Figure 1 below. Curve 1 shown here is the amount of water that continuously evaporates from the freshly poured concrete, mainly depending on the thickness of the cavity layer when it is hermetically sealed. This is, in turn (j) for concrete; if the sample surface is set in a dense state, then it differs insignificantly when δ= 20-25mm and averages 0.043 and 0.072 kg / m2h (Figure 2). An increase in the void layer on the concrete surface leads to the occurrence of continuous evaporation from the concrete. That is when the layer thickness is δ=60-65mm j =0.32 kg/m2 hours, δ=200-205mm is j=0.44 kg/m2 hours. In this case, the rate of continuous evaporation from the concrete that hardens in the open is around j=0.99 kg/m2h.

The correlation for the results obtained is: $(\Delta l/l)_{max} = f\ (j)$. As shown in Figure 1, this quantity j=0.043 and j=0.072 kg / m2h, can produce a small value $(\Delta l/l)_{max}$, if j ≥ 0.32 kg / m2h, the plastic deposition can reach a significant amount, based on the results of their study and experiments on the plastic deposition and continuous evaporation of concrete. In fact, we know that δ= 0mm, $(\Delta l/l)_{max}$= 0.2 mm/m, and δ= 20-25mm $(\Delta l/$

$l)_{max}$= 0.45mm / m (Fig. 1) [1.2.3.4.5]. Based on the results of the experiment, based on the 2nd curve shown in Fig. 3, we can say that the rate of water loss in the last period in hardened concrete at δ= 0 and 20-25mm is between 3 and 5.5% of the total concrete water content, if δ= 40- At 45mm, ΔW / W = 17… 18%, thus it was observed that the dehydration rate continued.

Thus, we determine that the thickness of the air gap between concrete and helioplasting is, on average, 20-25 mm, taking into account the physical processes occurring in concrete, based on the results of experiments, when the thickness of the air gap is tightly closed around the surface. To determine this rule, we cast a sample prism, put it under a 2-layer pellicle coating for a day, changing the thickness of different cavity layers, part of the normal temperature in the shop room, part of the open polygon, the surface part of which is tightly closed polymer pellicle coating 28 and during the day we ensured that it hardened in the shop room. As a result, we found that they are prismatic.

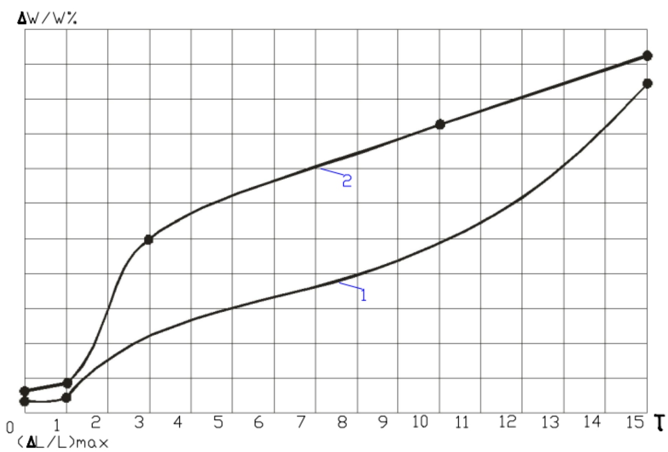

Fig. 3. The amount of continuous evaporation in freshly poured concrete is -1; and water loss during recent continuous solidification (ΔW / W) - 2; based on the indicators, a graph showing the dependence of the cavity on the concrete surface on the layer thickness.

When the evaporation (dehydration) of the concrete is continuous, j ≥0.32 kg/m2 hours is required, indicating that it continues to sink plastic, the maximum amount being in the range of 1.75-2.77 mm/m. If the air gap layer δ = 40 - 45mm, continuous evaporation in freshly poured concrete will be in the range of the smallest and largest critical values in the transition area, and as a result, the maximum plastic subsidence value of the concrete will be around 0.8 mm/m on average. Fig. 3 confirms that the "plastic sinking" rate formed by the continuous evaporation of concrete is in direct contact. Based on the conditions of the experimental data, we know that the maximum amount of "plastic settling" of concrete varies slightly j ≥ 0.32 kg / m2 per hour. This is seen when comparing Fig. 2 [1-3].

This difference $(\Delta l/l)_{max}$ in the max index can be explained as follows: The difference from open concrete samples that are in direct contact with the environment is that continuous evaporation is in direct interaction with the relative humidity in the environment. that is, it is constantly linked to wind speed and air temperature. Therefore, mainly in dry and hot climates, the "plastic sink" side edges of the concrete barrier, the upper part of which is covered with a pellicle coating, according to the results of the impact of two physical processes: The thermal expansion due to the high temperature that occurs under the pellicle is characterized by the occurrence of "plastic sinking" processes that occur as a result of the low specific humidity of the musculature during the solidification process.

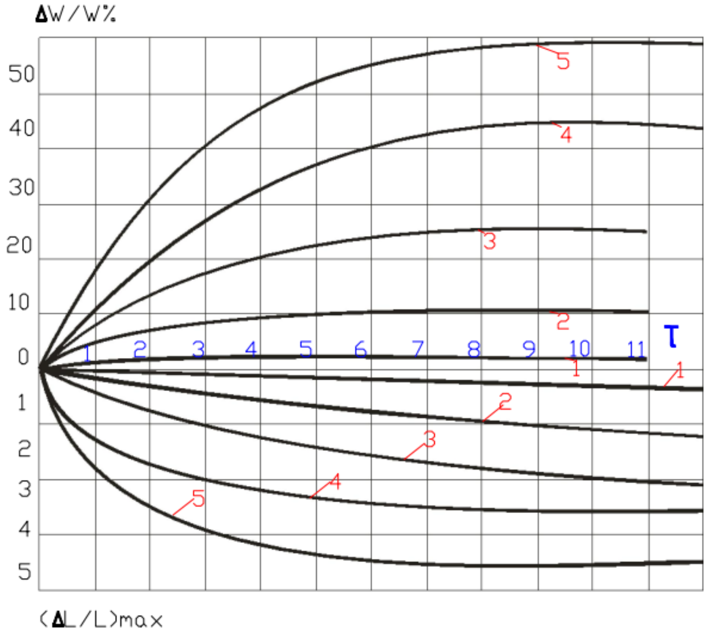

Fig. 4. Graph of "plastic deposition" and evaporation (dehydration) of hardened, freshly poured concrete under different conditions: 1. Tightly wrapped through polyethylene pellicle; 2. Two-layer $\delta = 20\ mm$ gap polyethylene coating; 3 Similarly, when $\delta = 50\ mm$; 4. Similarly, when δ = 205 mm; 5. In untreated concrete.

When installing the cavity layer on the concrete surface at different heights (thicknesses), the results of temperature measurements under the pellicle coating showed that during the stabilization of the "plastic sink", i.e., every 3-4 hours after the sample is installed for testing, the cavity layer δ= 60-65 mm we know that the ambient temperature reached t=63^{0}C, δ=60-65mm at t=63^{0}C, and δ = 500-505 mm at t = 55 ^{0}C. The decrease in temperature in the solidification medium is due to the increase in the d-layer, which in turn reduces the thermal expansion of the concrete sample several times. On the other hand, an increase in the void layer in the gap results in continuous evaporation of the concrete to water loss and consequent "plastic subsidence". Therefore, determining the amount of ($\Delta l/l$) max ratio averages 1.75-2.77 mm/m, if the concrete pellicle hardens under the coating, the thickness of the hollow layer is 60-65mm, 80-85mm, 200-205mm, respectively, and one that is not maintained in hardened concrete under different conditions, it leads to the complete formation of their internal structure, the normalization of their strength and the violation of other properties [1, 2, 5]. Thus, the results of the study of the dewatering-evaporation rate of concrete, continuous evaporation, plastic deposition, thermal expansion, and its interconnection, the strength of concrete hardening under a polymer pellicle in different conditions and different voids - layer thickness show that the concrete surface the thickness of the cavity layer, on average δ = 20 ... 25mm, does not significantly affect the internal structure of the physical processes occurring in the initial state of hardening concrete, if it is tightly closed around the concrete surface [3.4.5].

4 Conclusions

Therefore, cracks in concrete, as well as other defects, can occur [7-9].

1. Rapid dehydration of hardening concrete in low humidity environments adversely affects the hydration mechanism of cement stone, resulting in large plastic, general subsidence, and crack formation in structures.

2. To reduce or eliminate these negative effects, taking care of the newly laid concrete is recommended.

3. The hardening of concrete can be carried out in several main ways: The method of covering (covering) the concrete surface with polymer pellicles [2]. In this case:

- welding and rounding of separate pieces of polymer pellicles and covering the surface with a solid pellicle;
- Covering the edges of the pellicles with wood, sand, or soil;
-cover the pellicle on a flat surface of the concrete so that it does not collapse and hold tightly;
-protection of the pellicle from mechanical damage;
-It is recommended to remove the pellicle in the evening after the concrete maintenance.

4. The amount of water evaporation greatly affects the strength of concrete. Studies have shown that if concrete hardens under the influence of high ambient temperatures, dense layers (hydration process) are formed around the hydrated cement particles.

5. The part of the water that is not fully hydrated prevents the cement particles from entering. As a result, the hydration process of the cement can be slowed down or stopped altogether, and the potential strength of the concrete is significantly reduced.

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