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ANALYSIS OF THE INFLUENCE OF THE DESIGN PARAMETERS OF THE SOLAR CHAMBERS ON THE TEMPERATURE REGIME OF THE PROCESSED PRODUCTS

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Abstract:
On the basis of the developed mathematical model of heat transfer and the algorithm for the temperature regime of the solar chamber, the optimal constructive solution of the solar chamber from the position of the best temperature regime for heat-treated concrete or reinforced concrete has been established.

Keywords: Concrete, reinforced concrete, lightweight concrete, heavy concrete, solar chamber, mathematical model, heat exchange, temperature regime.

To determine the most preferable design characteristics of solar chambers intended for heat treatment of concrete products, as well as to assess the effectiveness of their operation in different climatic zones and at different times of the year, a mathematical model [1] of the algorithm [2] and a computer program for the temperature regime and heat exchange of solar chambers.

Comparison of the results of calculations on a computer with experimental data of different designs of Heli chambers showed the possibility of using the developed calculation method to analyze the effect of the constructive and thermal technical characteristics of Heli chambers intended for heat treatment of concrete mixtures on the temperature regime during processing of products (Fig. 1. and 2.).

To assess the validity of the assumptions made, the developed methodology for calculating the temperature regime of the concrete mixture during heat treatment inside the solar chambers, the comparison of the results of calculations on a computer with the experimental data of different solar chambers was carried out. In fig. Figures 1 and 2 show the calculated and experimental values of the temperature of concrete mixtures processed in the I15 and I25 solar chambers, depending on time. Comparison of the obtained results of calculations and experiments allows us to conclude that they are in satisfactory agreement (the maximum relative error does not exceed 7.8%) and the possibility of using the developed calculation method for analyzing the influence of the structural and thermal technical characteristics of solar chambers intended for heat treatment of concrete mixtures on the temperature regime at processing of products.

Figure 3. the effect of the thickness of the concrete base on the temperature regime of the processed products is shown, which indicates the preference for a base thickness of 5 cm, since in this case, the temperature of the concrete mixture is 5-8 ° C higher compared to the chamber with a base thickness of 15 and 25 cm. Figure 4. the comparison of the temperature regimes of the processed products in the chambers, the bases of which are made of heavy and light concrete, is given. All other things being equal, in chambers made of lightweight concrete, the temperature of products is 3-8 ° C higher than in chambers made of heavy concrete. As in the case of using lightweight concrete, the preferred thickness of the concrete base is 5 cm (see Fig. 5).

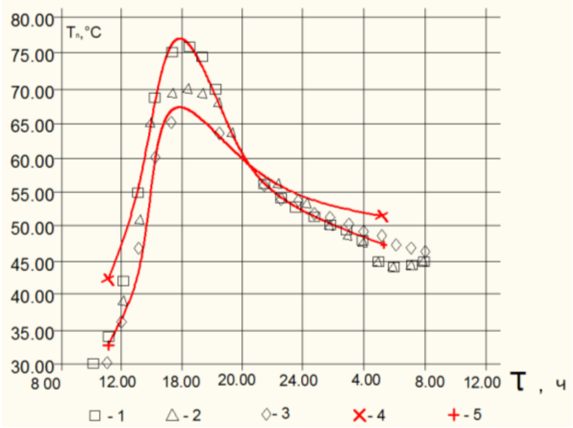


Fig. 1. Comparison of the experimental and calculated values of temperature in the concrete mixture subjected to heat treatment in the I-15 solar chamber
1, 2, 3 - experimental values of temperature in the upper, middle and lower zones of the product; 4.5 - calculated values in the upper and lower zones of the product.

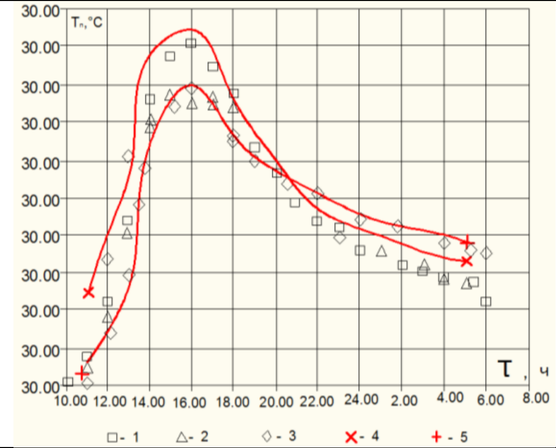


Fig. 2. Comparison of experimental and calculated values of temperature in a concrete mixture subjected to heat treatment in an I-25 solar chamber.
1, 2, 3 Experimental temperature values in the upper, middle and lower zones of the product; 4.5 - calculated values in the upper and lower zones of the product

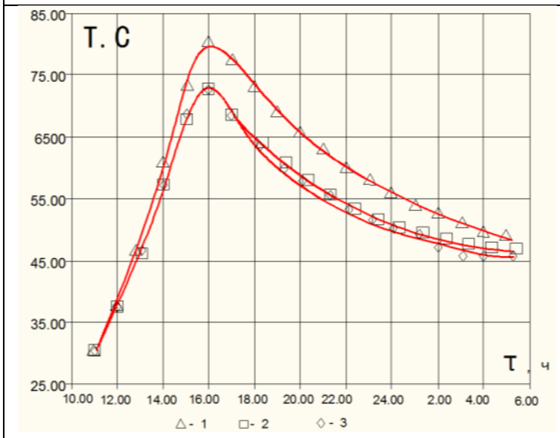


Fig. 3. Influence of the thickness of the concrete base of the solar chamber on the temperature regime of the concrete mixture subjected to heat treatment
1,2,3 - temperature in the middle zone of the product with the thickness of the concrete base of the solar chamber: 5 cm, 15 cm, 25 cm, respectively

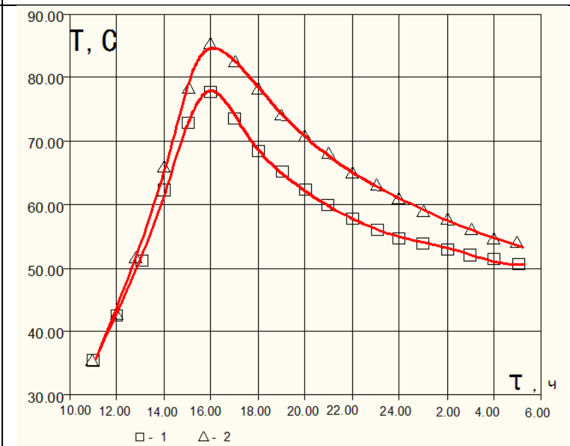


Fig. 4. Influence of the material of the concrete base of the solar chamber on the temperature regime of the concrete mixture subjected to heat treatment
1 - heavy concrete base;
2-concrete base made of lightweight concrete.

In fig. 6. shows the influence of the location of the heat-insulating layer on the surface of the wall and the base of the solar chamber on the temperature regime of the processed products. All other things being equal, the location of the heat-insulating layer on the inner surface of the solar chamber leads to an increase in the temperature of the processed products by 4-16 ° C.

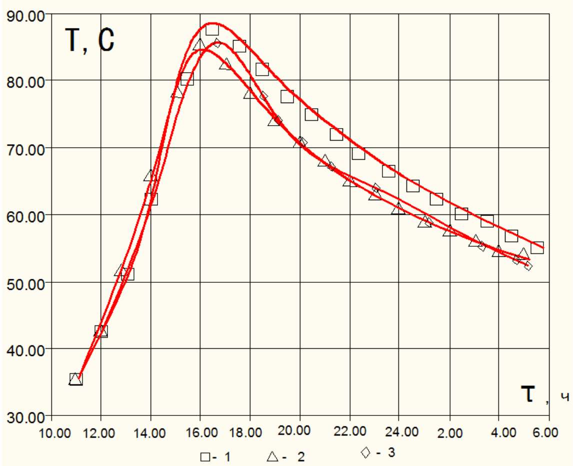


Fig. 5. Influence of the thickness of the concrete base of the solar chamber made of lightweight concrete on the temperature regime of the concrete mixture subjected to heat treatment
1,2,3 - temperature in the middle zone of the product with the thickness of the base of the solar chamber; 5cm, 15cm, 25cm respectively

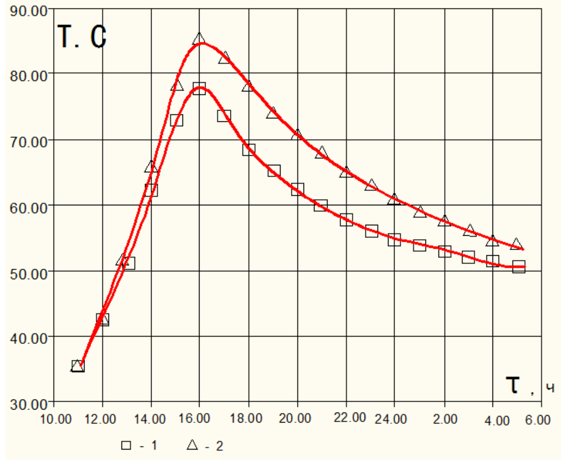


Fig. 6. Influence of the location of thermal insulation in the design of the solar chamber on the temperature regime of the concrete mixture subjected to heat treatment.
1 - thermal insulation is located on the outer surface; 2- thermal insulation is located on the inner surface;

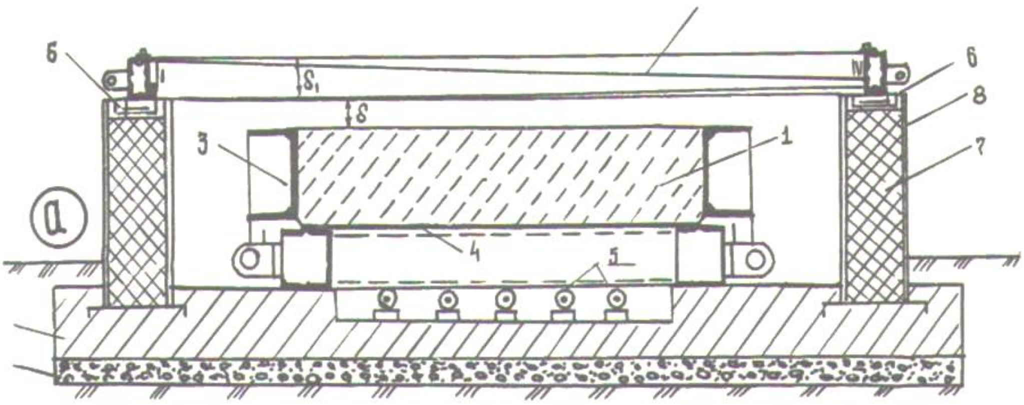
Figure 7 shows the effect of the thickness of thermal insulation on the temperature conditions of the processed products. The above data indicate that an increase in the thickness of glass wool insulation over 80 mm does not lead to a significant change in the temperature of the processed products.

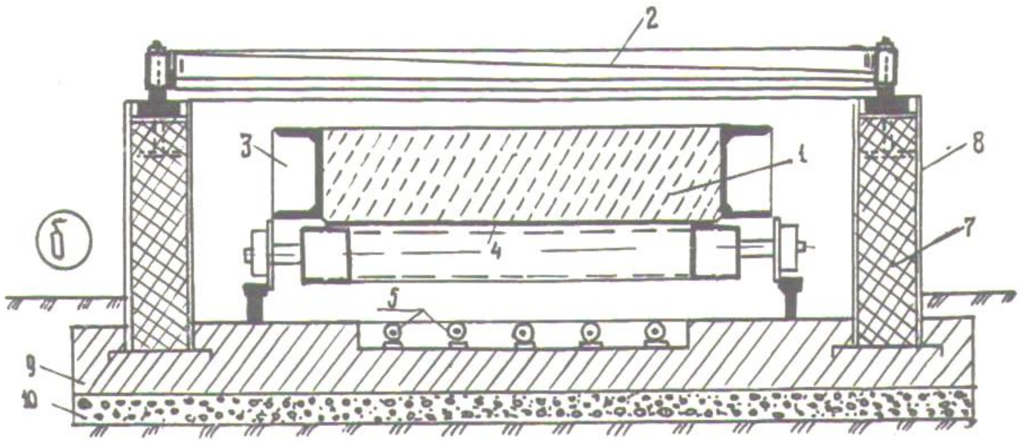
Thus, it is possible to outline the design parameters of the solar chambers that provide effective heating and an increase in the strength of concrete in them.

The solar chamber consists of heat-insulating side walls made of effective heat-insulating material such as glass wool, mineral wool with λ-0.049 W / m '; FROM; p = 150 kg / m3 and a pallet made of expanded clay concrete with a thickness of 5 cm. The solar chamber is equipped with a solar cover, which is two layers of translucent material, of which the upper layer is made with a slope to the south, which ensures the slope of precipitation and convenience during periodic cleaning during operation.

Single-row heat-insulating solar chambers can be used in the production of reinforced concrete products from heavy concrete using bench, aggregate-flow and conveyor technologies. These solar chambers can be pit type / floor type / equipped with removable solar covers and slotted tunnel type / walk-through or dead-end / equipped with stationary solar covers (Fig. 8).

In the case of combined solar thermal treatment of heavy concrete products, the proposed single-row heat-insulating solar chambers are supplied with such additional dubbing sources of thermal energy as electric heaters (including infrared), dry steam, hot oils, water and other heat carriers.





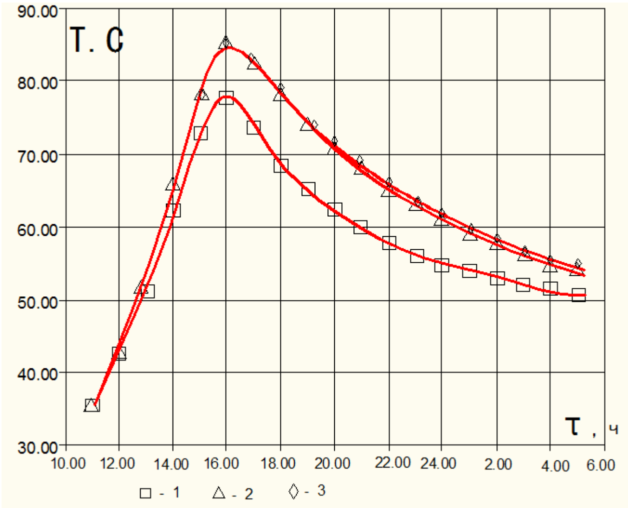


Fig. 7. Influence of the thickness of thermal insulation made of glass wool on the temperature regime of a concrete mixture subjected to heat treatment in a solar chamber
1, 2, 3 - mass average temperature of the product with insulation thickness of 2.8 and 20 cm, respectively

Fig. 8. Schematic diagrams of single-row heat-insulating solar chambers for heat treatment of heavy concrete products.
a-hole chamber of floor type with removable solar cover; b - tunnel-type slit chamber with stationary solar coating; 1. Reinforced concrete product; translucent coating type SBITAP; 3- longitudinal sides of forms; 4- pallet of forms; 5- additional-back-up source of thermal energy; 6- hydraulic shutter; 7- heat-insulating fences; 8- metal sheet with a frame; 3- chamber pan made of lightweight concrete; 10- expanded clay pillow.

LITERATURE

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