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ON THE METHOD OF ENSURING THE QUALITY OF CONCRETE MIX AND CONCRETE ON THE LINES OF FORMLESS MOLDING OF REINFORCED CONCRETE PRODUCTS

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Abstract. This article presents the results of the production of reinforced concrete products by the formless molding method. On the basis of the experimental studies carried out, the relationship between the required mobility of the concrete mixture and the value of OC was established. The above research results make it possible to determine the OK of a concrete mixture during mixing and, as a result, to correct the composition of concrete without interruption during the mixing process.

Keywords: energy efficiency, reinforced concrete products, concrete mix mobility, process automation, adjustment of concrete composition.

Introduction Currently, the production of reinforced concrete products by the method of formless molding is widely spread abroad, as well as in our country. The essence of the method of non-formwork production of reinforced concrete structures is that the structures are made on long stands by continuous molding of a solid strip of a given section, followed by cutting into elements of the required length [1-3,8-9]. The advantages of this technology are: a high level of mechanization of work, the possibility of obtaining high-quality products from high-strength concrete with an economical consumption of steel, guaranteed specified dimensions, good front surfaces, and a complete rejection of the use of forms. One of the features of this technology is the need to use hard concrete mixes with an extremely low water-cement ratio.

Technological equipment used in the production of reinforced concrete products using the formless molding method are usually foreign. Therefore, when performing commissioning in the conditions of the Republic of Uzbekistan, problems arise with ensuring the required level of quality of concrete mix and concrete, since foreign companies producing these lines are focused exclusively on the use of aggregates and cements with stable characteristics. In this regard, it becomes necessary to take appropriate measure to ensure the required level of quality of concrete mix and concrete [4-5, 10-12].

The use of domestic components of concrete mixtures leads to an increase in the consumption of cement - since this is practically the only way to ensure the required strength and structural characteristics of concrete. Experimental studies of the authors have shown that the overconsumption of cement is at least 15-20%.

Development of technology on continuous forming lines is a rather complicated process. Small changes in the OK value of 1÷1,5 cm, which are quite acceptable with the

aggregate-flow technology, with no formwork molding, are determining the quality of manufacture, for example, floor slabs, which are the most common product range on these lines. In the process of forming hollow core slabs and girders, if the OC values do not match, either concrete flows into the holes of hollow core slabs, or the walls are destroyed during the manufacture of girders [13-14].

In our studies, the standard technique for measuring OK was carried out on two concrete samples taken from the mixer, and took an average of 10 minutes. This process requires stopping the concrete mixer, which is unacceptable in a production environment. In this case, the problem arises of the need to adjust the composition (for example, by introducing water if the OK is below the required value) under conditions of continuous mixing. Essentially, a different technique is required, which allows the composition to be adjusted during the mixing of the concrete mixture.

Numerous experimental studies have shown that, on specific materials and specific equipment, the consumption of cement, sand, crushed stone, as well as the value of w / c concrete mixtures intended for the production of hollow-core floor slabs, while ensuring the required mobility of the mixture, change insignificantly: the value of the OC of the concrete mixture changes significantly, the amount of mixing water and the current strength of the mixer electric motor (Table 1).

Table 1

Amperage	Amperage (A)	OK (cm)	Water (l/m³)
Maximum	28,45	1,0	125
Minimum	25,05	4,0	130
Difference	3,40	3.0	5

The analysis of the results obtained also shows that one of the effective methods for ensuring a constant improvement in the quality of the results of the selection of the concrete composition (at a constant W / C value) should be recognized as a visual assessment of the state of the product (strip) after the completion of the forming process. Tests of 14 samples with different amounts of mixing water in the concrete mixture have confirmed a high degree of correlation between the indicators of visual assessment of the quality of forming floor slabs and changes in the current strength of the mixer motor with the ability to quickly adjust the technological production limits.

As a result, studies of the influence of a change in current strength on the quality of vibration shaping of floor slabs (for a specific enterprise and installation) established:

- at a current of 27.05A - there is a low quality of products due to the high mobility of the mixture;
- ≥ 28.20A - the quality of products is low due to insufficient mobility of the mixture;
- from 27.15 to 27.80 A - product quality is good.

It has been experimentally established that according to the magnitude of the current strength of the electric motors of the concrete mixer, it becomes possible to set the time of completion of the mixing process (Fig. 1).

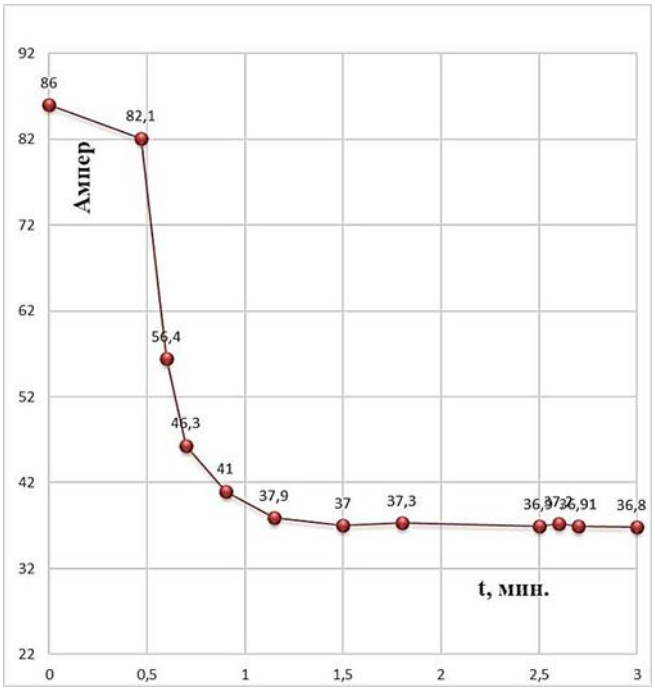

Fig. 1. Dependence of the current strength on the mixing time for a concrete mixture with OK = 3.0 cm (planetary concrete mixer 2250 / 1500l).

The graph (Fig. 2) shows the S-shaped dependence of the "process saturation" of the preparation of the concrete mixture. So, with stirring for more than 90 seconds, the current strength does not practically change. Stabilization of the current strength characterizes the minimum energy consumption when the required mobility is achieved. For other OK values, similar dependences were obtained.

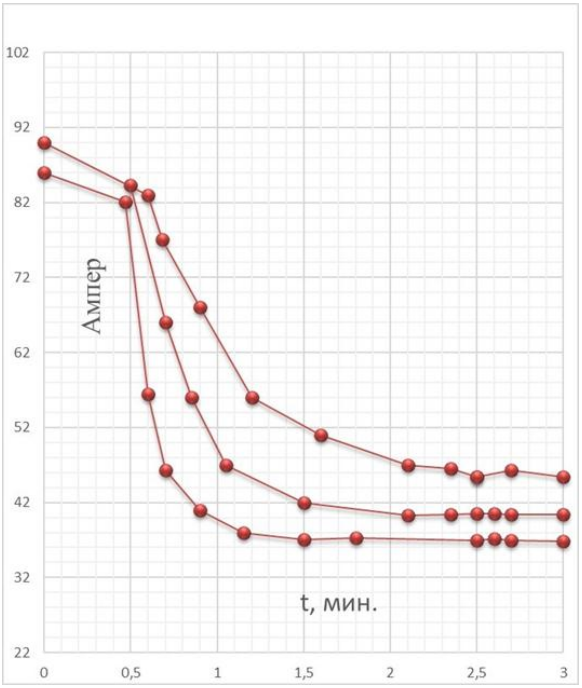

Fig. 2. Dependence of the current strengths on the mixing time

Figure 3 shows an almost linear relationship between the values of NP (A) and OK (cm).

Of course, the data shown in Fig. 1-3 are valid only for a specific batching plant, specific materials and concrete compositions. When changing the mixing conditions, characteristics of the starting materials and other factors, the nature of the graph remains.

The analysis of experimental studies given in the form of graphs allows to establish a reliable correlation between the required mobility (LM) of the concrete mixture, determined by the magnitude of the current strength of the mixer electric motor, and the value of the OK, and this, in turn, means the possibility of measuring the OK by the value of the LF. The above research results make it possible to determine the OK of the concrete mixture during the mixing process and, therefore, to correct the composition of the concrete without interruption during the mixing process.

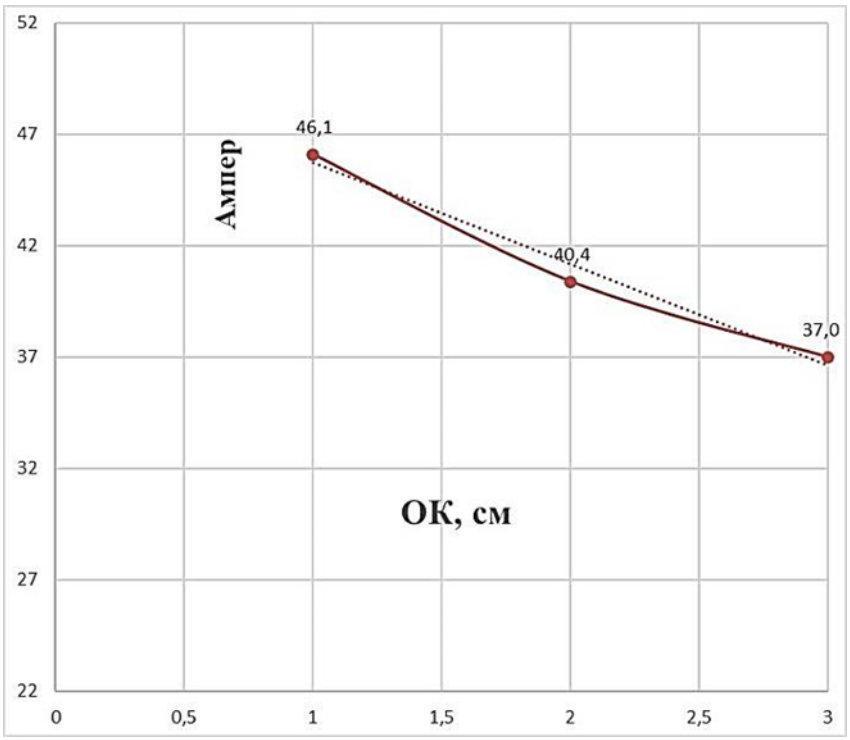

Fig. 3. The relationship between the values of the current strength (A) at the optimal time for mixing concrete mixtures (from Fig. 2)

It should be emphasized that the NP indicator is quite sensitive to the influence of a number of different factors, but it summarizes their effect on the concrete mixture. This means that before the start of each shift, the BSU operator should rebuild the schedule shown in Fig. 2. Obtaining this schedule does not require a significant investment of time. The operation can be performed during the preparation of the first batch. When performing repeated batches, it is necessary to control the value of NP, and if this indicator coincides with the indicator of previous batches, the operator has the right to consider that the concrete mixture is the same in terms of OK as in previous batches. The possibility of adjusting the molding mode is also available for the operator of the molding machine, who, based on visual control of the molding process, can improve its quality by changing the ratio of the frequency of vibration impacts and the speed of movement of the molding machine.

Thus, the development of a mechanism for making changes in the characteristics of the petroleum product during the mixing process makes it possible to prepare a computer program for automating the process of adjusting the composition of the concrete mixture in the manufacture of a wide range of reinforced concrete structures on the lines of continuous formless vibro-forming. At the same time, to determine the required amount of mixing water, additionally introduced into the concrete mixture when adjusting its composition, it is recommended to use the following formula:

$$B = [(NP\ f - NP\ оп) \times 5]/ 3.4,\ l/m3 ,$$

where, NP f - the actual value of the current strength, A; NP op - optimal current strength (according to the graph in Fig. 3), A.

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