STUDIES OF THE KINETICS OF STRUCTURE FORMATION SLAG - ALKALINE ARBOLITE

Kosimov O.B.
Aubakirova T.S.
Mirzakobilov N.H.
Jizzakh Polytechnic Institute,
M.Auezov South Kazakhstan University, Shymkent, Kazakhstan
Taslima.aubakirova@inbox.ru
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ABSTRACT

An important distinguishing feature of the arbolite structure is that in the total volume of the arbolite mass, the organic aggregate occupies 80-90% and has anisotropic properties inherent in wood. when used as an alkaline component - a complex alkaline component –KSK - I, the period of formation of the coagulation' structure (the period of intensive absorption by the filler of alkali from the solution mixture) It is 240 min. The obtained data on the processes of structure formation of slag-alkaline arbolite, the time of preliminary holding of which before heat-and-humidity treatment was 14 hours, shows that there is no significant difference from the processes of structure formation of arbolite, sustained 2 hours before heat-and-humidity treatment, is not observed. Therefore, the optimal regime of heat-humidity treatment of the skag-alkaline arbolite is – regime including of temperature raising in the chamber during 2 hourds till 343-353 K, isothermic expression at this temperature 6 hour and cooling in during 0.5-1 hour till environmental temperature.

The specific features of slag-alkaline binders distinguish them from the range of other binding systems and require a special approach to all stages of interaction that takes place during the hardening process, including at elevated pressures and temperatures.

Studies show that the type of slag and the alkaline component have a significant influence on the course of the structure formation process.

The structure of arbolite is formed at all stages of its production technology: when preparing the filler, dosing the components, mixing them, laying and compacting the arbolite mixture, as well as when hardening products made of this material /1/.

In the process of forming (compaction), it is necessary to strive for maximum

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density, i.e., filler packaging that provides the greatest number of contacts, as well as the greatest strengthening of structuralelements and connections between them.

The studies carried out by us on the study of the processes of structure formation of slag-alkaline arbolite were carried out under normal conditions and under conditions of heat treatment:

1. - ESF - KSK-1;
2. - ESF - KSK-2;
3. - ESF - electric steelmaking slag - KSK-2;
4. - ESF aged - WS-2.

All compositions are based on kenaf bonfires.

It is known that the change in the speed of ultrasound propagation - the hardening of concrete (an increase in its strength) is accompanied by a natural increase in speed .

To conduct research using the ultrasonic pulse method, which allows us to trace the kinetics of the formation of the arbolite structure, a calibration dependence "ultrasound velocity -strength of arbolite" was constructed. 30 series of arbolite samples were tested, both hardened in natural conditions and heat- treated.

According to the test results, the calibration dependence "the speed of ultrasound propagation - the compressive strength of arbolite" was constructed.

The analysis of experimental data showed that in all conditions of hardening of arbolite, the nature of the change in the calibration dependence is approximately the same.

The study of hardening processes has shown that the most effective control of the structure formation process is carried out at its initial stages, during the period of prevalence of coagulation-type structures in systems.

An important distinguishing feature of the arbolite structure is that in the total volume of the arbolite mass, the organic aggregate occupies 80-90% and has anisotropic properties inherent in wood

/1,3,4/. Due to the specific properties of arbolite, the kinetics of the formation of the arbolite structure from the moment of closure can be traced using conventional, standard devices.

Since, arbolite in its structure is close to coarse-porous light concrete on porous aggregates, there is no generally accepted theory of strength of arbolite to date, let's consider the hardening process of slag- alkaline arbolite, based on theories concerning concrete on mineral porous aggregates, but taking into account the nature of the organic aggregate and factors affecting the strength of arbolite.

Our studies have shown that the periods of structure formation of slag-alkaline arbolite differfrom the periods of formation of the structure of slag-alkaline light concrete on porous mineral aggregates

/1,2,4/.

Despite the lack of systematized data on the problem under study, the available results suggested that the study of the complex influence of the above factors on the kinetics of the structure formation of slag-alkaline arbolite will make it possible to outline ways of their directional regulation in the direction of improving physical and mechanical properties. The analysis of the features of hydration and structure formation of slag-alkaline arbolite indicates that the hardening processes significantly depend on the nature of the alkaline component.

Thus, the conducted studies have shown that when used as an alkaline component - a complex alkaline component –KSK - I, the period of formation of the coagulation' structure (the period of intensive absorption by the filler of alkali from the solution mixture) It is 240 min. (stage I). In systems prepared on KSK - 2, the formation of the coagulation structure takes place within 120 minutes, and in compositions prepared on a mixture of electrothermophosphoric and electrostall–melting slags and KSK - 2, the duration of the period of development of the structure is also 120 minutes. The data obtained indicate that the processes of structure formation in the systems under consideration proceed approximately the same way.

At the same time, it should be noted that when using ground electrothermophosphoric slag, aged for a year in room conditions (in containers with an open surface) and closed by KSK-2, the duration of the periods of structure formation increases by 5 times.

The first stage of the formation of the arbolite structure is associated with the completion of the dissolution of certain plant substances and the formation of a solution saturated with alkali and extractive substances as a result of this process.

Observations of the processes of structure formation occurring in the system under study showed that immediately after the end of the process of absorption of alkali by the filler from the binder and the formation of extractive substances of the filler solution saturated with alkali and soluble substances (PB) filler as a result of dissolution by this alkali, the course of the hydration process slows down slightly, which is obviously due to the influence of the products of this process on the rate of hydration of the astringent system (stage 2).

As it is known /1, 4/, the medium of uncured concrete is characterized by a large attenuation of ultrasonic waves of high frequencies, compared with already hardened concrete. The appearance from thefirst minutes after the closure and a sharp change in values in the interval 1-2 indicates rapid adsorption ofalkali from the solution by the filler and the formation of a coagulation structure as a result of this process. Subsequent changes in values in the range 2-3 already indicate the chemical interaction of the products of this process with the ions of the liquid phase, in contrast to systems based on Portland cement, in which, as is known /1,3/, soluble organic substances reduce the degree of hydration of the binder. The products of this process in slag-alkaline systems interact with ions of the liquid phase, which leads to the appearance of neoplasms of a colloidal degree of dispersion.

The process of formation of crystallohydrate nuclei is gradually underway. (W stage)
.

The physicochemical interaction occurring in the contact zone makes a significant contribution to the bond strength of the cement stone with the aggregate in concrete /1,5/.

The strongest bonds are chemical bonds that can ultimately form between the aggregate and the binder stone. At the same time, stable products of chemical interaction appear, sealing the contact zone.

It should be noted that the high porosity of the fillers contributes to the intensive evaporation of moisture from the system, which creates a moist environment that ensures the passage of hardening processes under conditions approximately similar to the conditions of the heat-humidity treatment.

Based on this, the influence of heat-and-moisture treatment modes on the processes of structure formation of slag-alkaline arbolite, namely, the influence of the time of preliminary exposure of arbolite before heat-and-moisture treatment, the heating time of the arbolite mixture and the duration of isothermal exposure, were investigated.

The analysis of the data obtained indicates that the development of the processes of structure formation of slag-alkaline arbolite under heat treatment significantly differs from the processes of structure formation of arbolite that hardened under normal conditions. Unlike conventional concretes, in which the most intensive development of the processes of structure formation and the increase in the strength of concrete under conditions of heat and moisture treatment, arbolite is characterized by a slight decrease in the course of the processes of structure formation.

It is known that the optimal holding time of arbolite before heat treatment, regardless of the water-cement ratio, is within 12 hours.

The obtained data on the processes of structure formation of slag-alkaline arbolite, the time of preliminary holding of which before heat-and-humidity treatment was 14 hours, shows that there is no significant difference from the processes of structure formation of arbolite, sustained 2 hours before heat- and-humidity treatment, is not observed. In both cases, there was a decline in the processes of structure formation during isothermal heating, and the final daily strength remains approximately the same and isin the range of 1.0-1.5 MPa.

Analyzing the research results, it should be noted that the most effective is the preliminary exposure of arbolite to heat treatment for 2 hours.

When applying the "peak" mode,-i.e. when reducing.the time of isothermal heating to zero, the hardening process occurs differently. With the warming-up of the arbolite mixture, the processes of structure formation intensify and some stabilization is observed. corresponding to the peak of heating, then a slight decline is observed, and then after the end of the temperature descent, the processes of structure formation are activated again and are characterized by intensive structure formation in the following days up to 28 days of age.

Taking into account the massiveness of the product,-obviously, the isothermal heating time of 2 hours can be considered optimal. These data are in good agreement with the results of studies conducted by V.I. Gotz for heavy and light slag-alkaline concretes.

Taking into account the increased porosity of arbolite products, their heating time of 2 hours is quite sufficient for the passage of the processes of structure formation.
Therefore, the optimal regime of heat-humidity treatment of the skag-alkaline arbolite is – regime including of temperature raising in the chamber during 2 hourds till 343-353 K, isothermic expression at this temperature 6 hour and cooling in during 0.5-1 hour till environmental temperature.

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