ISSN: 2350-0328

International Journal of Advanced Research in Science, Engineering and Technology

Vol. 6, Issue 5 , May 2019

Technological Features of Magnetic Activation of Cement Paste

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ABSTRACT: The results of the study of the strength of cement stone prepared on the basis of hardening test in a constant magnetic field. The difference in the strength of cement stone depending on the technological method of activation of the cement test, consisting in a different arrangement of samples in a magnetic field relative to the poles of the magnet.

KEYWORDS: cement dough; magnetic field; treatment modes; magnetic activation; compressive strength; liquid phase; Portland cement; mixing water.

I.INTRODUCTION

In building materials science are promising technological methods of directional impact of external physical fields (electric, magnetic, electromagnetic, thermal, radiation, mechanical, sound, etc.) on the components of the concrete mixture or the mixture as a whole. The feasibility of these techniques is due to the simplicity of management, the ability to secure improvement in physical and mechanical properties of the cement compositions of construction and low energy consumption.
One of the important methods of management of structure formation of a cement stone, improvement of characteristics of concrete is the directed change of physical and chemical properties of water of mixing. Cement dough in its physical structure is a pasty aqueous suspension consisting of a liquid phase and solid particles in the form of clinker grains and hydrated formations. In this case, the liquid phase is a saturated aqueous solution of an alkaline composition and is the main structural unit of the test, providing its adhesion ability to wetting and adhesion to the filler [1,2].

II. RELATED WORK

When conducting research, it is accepted that the cement paste (highly concentrated dispersion system) as an object of magnetic treatment reacts not only to the nature of electromagnetic effects, but also to the accepted parameters and processing conditions for a specific type of activation. Magnetic effects on pre-mixing the cement paste at steady-state conditions of the object to be processed is achievable in continuous magnetic activation and a discrete magnetic activation of cement paste with different time modes of pre-treatment before processing.
The effect of increasing the strength of the activation object is manifested to greater extent in the technology of discrete magnetic processing in later periods of hardening of activated samples. The increased value of the strength of cement with discrete magnetic treatment associated with rupture of the membranes of the products of hardening on the surface of the grains.

III. METHODOLOGY

The molecules of the liquid phase of the dough, penetrating into the micro cracks of cement grains, cause them to split and grind. The data of literary sources testify [1, 2] about influence of an alternating magnetic field on processes of hardening of a cement stone. It is noted that a constant magnetic field should be applied after the beginning of setting, since the magnetic field orients the dipole moments of the liquid phase, reduces diffusion, contributing to the formation of contacts of chemical nature [1].
We believe that the strength of the cement paste during magnetic treatment will also depend on the location of the cement paste samples on the poles of the magnet.

ISSN: 2350-0328
International Journal of Advanced Research in Science, Engineering and Technology
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The strength of the cement stone formed from the cement paste hardening in a magnetic field is investigated. Portland cement M500 is accepted as a binder. For the preparation of samples were taken sample cement, constituting 100 g, the amount of mixing water is 40 ml. Manufactured forms with five cells filled with cement dough was placed for processing on one of the poles of the magnet. Activation was carried out in modes in which one object was at the North pole and the 2nd object of activation was at the South pole. It was found that the dependence of the change in the strength of the cement stone from the time of holding the test to the treatment are different. The most significant time of exposure is 80 minutes.

In this interval of the test activation time when the mold is located at the North pole, the strength of the samples significantly exceeds the strength of those samples that were processed at the South pole.

A further increase in the test holding time to magnetic treatment in both cases is accompanied by an increase in the strength of the activated samples. The fact of growth of strength of cement stone at insignificant endurance - 30 min and time of the beginning of term of setting (100 min) is noted.

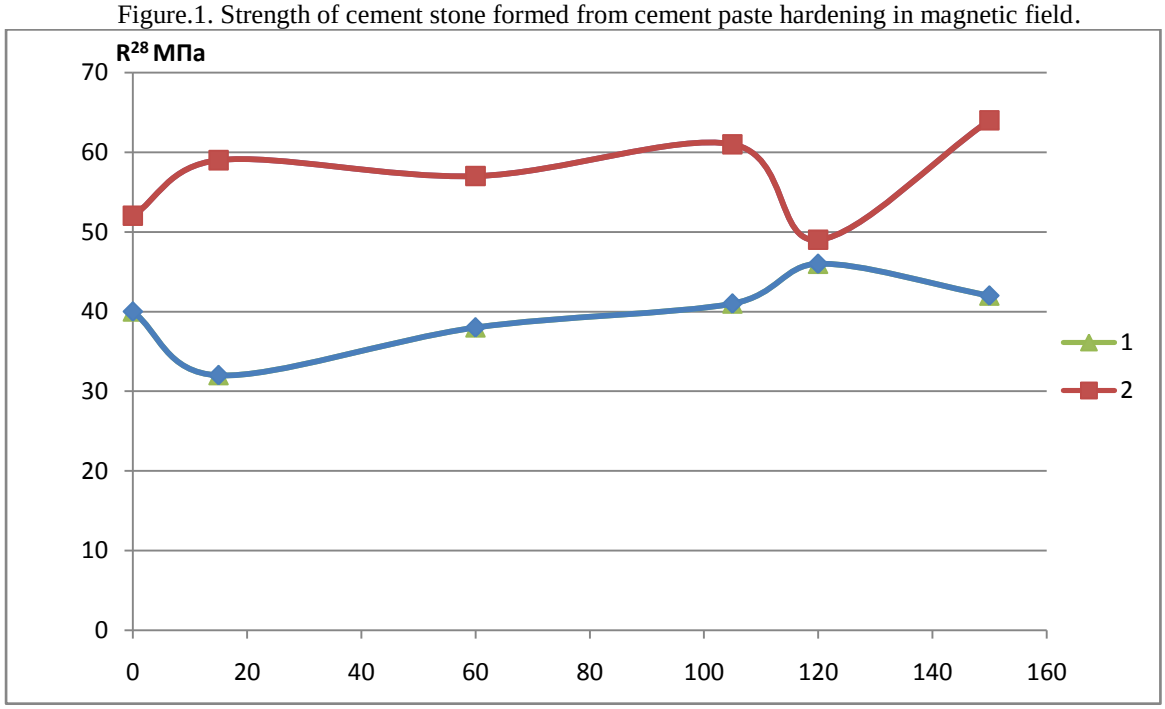
The data of studies on the activation processes at the location of objects at different poles indicate that the results of the strength of the cement stone, presumably has the existence of an internal field of sufficient intensity inseparable from the spontaneous residual magnetization.

We assume that the ferromagnetic is constantly in a state of spontaneous magnetization, as well as its microscopic areas. In the initial state, these regions are located so that the sum of their moments throughout the sample is on average zero, but they can be oriented in one direction. There are two important experimental facts confirming the existence of these areas.

IV. EXPERIMENTAL RESULTS

First, if magnetization is the result of orientation of regions in one direction, then it can be expected that the magnetization process will proceed in discrete jumps. Apparently, this is due to the appearance of the so-called Barkhausen effect, which allows us to estimate the number of atomic magnets in one microscopic region. This number is close to 1016, and the corresponding volume of each region in the crystal is about 10-6 cm3.

Figure.1. Strength of cement stone formed from cement paste hardening in magnetic field.



The holding time of the cement test before magnetic treatment, min.

1-the dependence of the strength of the cement paste hardening between the poles M400;

2-the dependence of the strength of the cement paste hardening between the poles M500;

ISSN: 2350-0328

International Journal of Advanced Research in Science, Engineering and Technology

Vol. 6, Issue 5 , May 2019

The second experimental confirmation gives the observation of powder figures, which are obtained by applying a colloidal solution of magnetic iron oxide on the carefully polished surface of the ferromagnetic. Settling, magnetic particles accumulate where the strongest magnetic fields operate, just as iron filings are distributed along the lines of force in elementary experiments on magnetism. The strongest fields in this case are concentrated on the boundaries between the domains and, therefore, with the help of this method, the boundaries between the domains (the magnetization region of the ferromagnetic in the crystal) on the surface of the sample cutoff are "manifested". For the modes of magnetic treatment of the hardening test, studies were carried out to assess the strength of the cement stone for the conditions of different location of the processing object between the poles. Portland cement M500 and M400 were used in the studies. Activation was carried out similarly to the above modes.

The results of experimental studies of the strength of cement stone were determined in 28-day natural hardening depending on the holding time of the cement test before magnetic treatment. As before, the time of the test activation was constant and equal to 15 minutes.

V.CONCLUSION

It is determined that the activation of the cement test prepared on the basis of Portland cement M500 strength of activated stone is almost higher than the strength of the control series of samples and this excess reaches a value of 1.25. Thus, the difference in the strength of cement stone depending on the geometric location of the activation object in the magnetic field is established.

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ISSN: 2350-0328

International Journal of Advanced Research in Science, Engineering and Technology

Vol. 6, Issue 5 , May 2019

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