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Case study

The effectiveness of use of the composite binder as a dry mix

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ABSTRACT

The results of studies on the effectiveness of the use of synthetic aluminosilicates as structural supplements. Physico-chemical processes of hardening of cement stone and cement-based composites. Conducted X-ray diffraction and differential thermal analyses (XRDA and DTA) of the cement stone samples. The properties of dry adhesive mixture based on cement with the use of aluminosilicate supplements.

1. Introduction

For finishing and restoration of buildings and structures, dry mixes are widely used. In this regard, one of the priorities of modern construction materials science is the development of effective dry mixes with low cost, which enhance the performance properties of coatings. The solution to this problem is based on the intentional shaping of the material structure as a heterogeneous multiphase system of complex hierarchy. One of the ways to control the structure and properties of such a system is the addition of various modifying additives in the formula of different dry mixes (Strokova et al., 2010; Goregliad and Sapacheva, 2011; Kuo et al., 2006; Vejmelková et al., 2012; İşçi et al., 2005; Luckham Paul and Rossi, 1999; Swaminatham and Kildsig, 2002; Loganina et al., 2014a).

Previous studies proved the effectiveness of use of synthetic aluminosilicates in the formula of dry mixes as modifying additives (Loganina et al., 2014a,b).

2. Experimental

The paper suggests the use of composite cement binder, made with the use of synthetic aluminosilicates, in slab dry mixes. The aluminosilicates were synthesized through their precipitation from the solution of technical aluminum sulfate of technical $Al_2(SO_4)_3$ with sodium silicate, followed by washing the resulting precipitate with water and drying it (Loganina and Ryzhov, 2015).

The study of the physical and chemical processes of composite cement binder solidification was carried out with the help of X-ray diffraction and differential thermal analysis (XRDA and DTA) of cement stone samples, solidified in air-dry conditions. In the experiment Volsky portland cement brand 400 was used.

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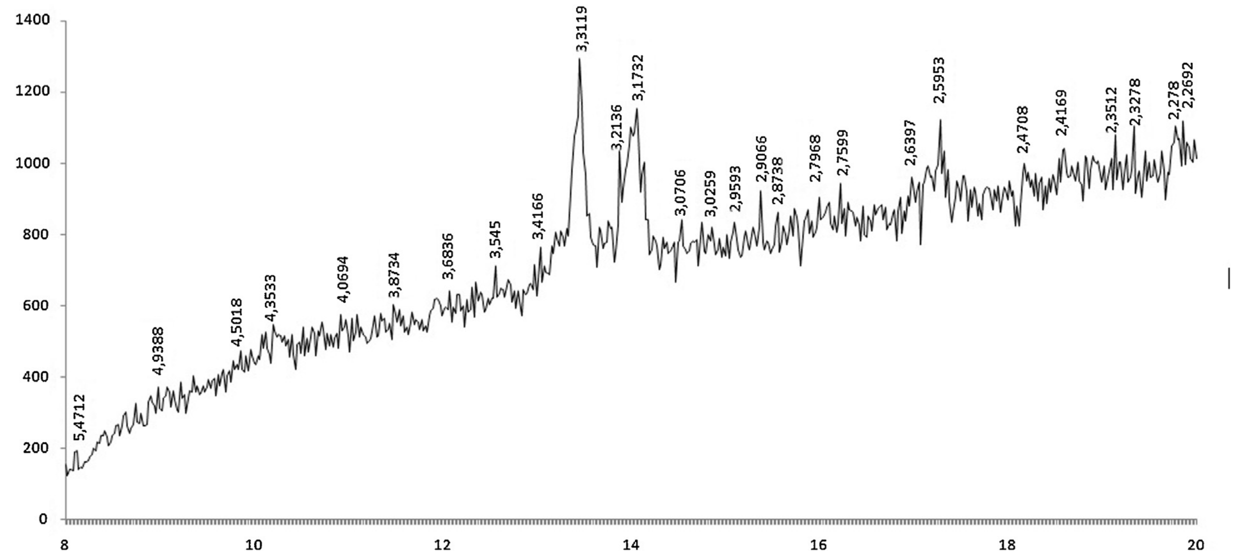

Fig. 1. X-ray of the cement stone.

3. Results

The results of the analysis of the phase composition of cement stone with/without synthesized aluminosilicate, conducted with the use of ARL 9900 X-ray WorkStation (ThermoScientific) at the Center of High Technologies BSTU. V.G. Shuhova are shown in Fig. 1 and Fig. 2 respectively.

Analyzing the data it can be asserted that the cement stone made with the use of synthesized aluminosilicate has more hydrate formations which was further confirmed by differential thermal analysis (DTA) (Figs. 3 and 4).

4. Discussion

Fig. 1 shows that the cement stone at small angles (up to 20°) has the mineralogical composition of the following compounds: hydrosilicates CSH (d = 5.4712; 4.3533; 3.54499; 2.9593; 2.9066; 2.8738; 2.7599; 2.6397; 2.5953; 2.3278; 2.278; 2.2692), ettringite (d = 4.9388; 3.8734; 2.4169), cristobalite (d = 4.0694; 2.4708; 2.3512), zeolite (d = 3.6836; 3.4166), tobermorite (d = 3.2136; 2.7968; 3.0706) (Larionova, 1971).

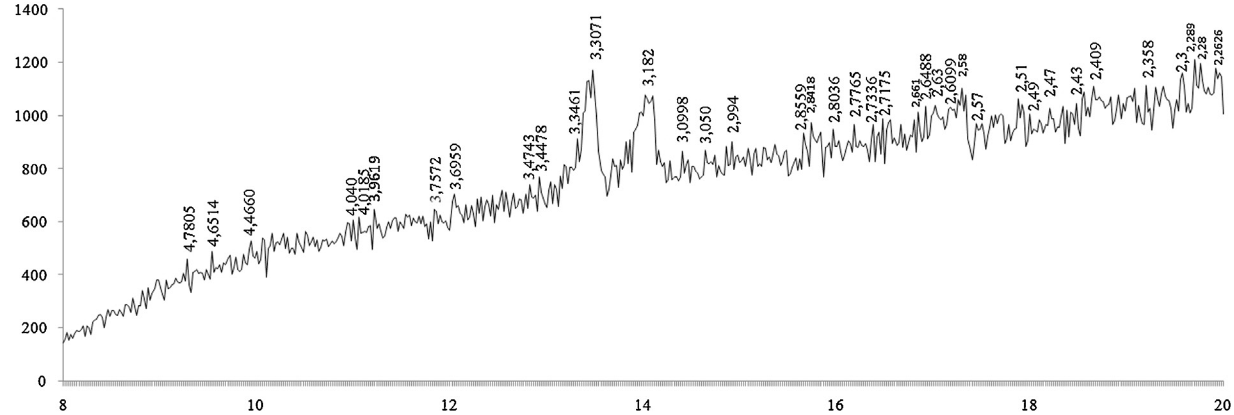

Fig. 2. X-ray of the cement stone with the synthesized aluminosilicate During the thermal analysis the temperature ranged from 30 to 1000 °C, the rate of temperature increase in the chamber was 3 °C/min, and the duration of a single experiment was about 5 h and 10 min.