DISSERTATION ABSTRACT

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The subject of the doctoral dissertation: **Effect of nanometric mine clay particles on thermal resistance of cement composites**

Thermal resistance of cement composites is a key property of building materials in view of the safety of the structure. It consists of the resistance of individual components of the cement composite and their individual characteristics. In recent years, nanotechnology has become increasingly popular in the construction sector, particularly in the development of building materials. Nanomaterials incorporated into cement composites can significantly affect their properties, including thermal resistance. Due to their small size, these particles can alter the microstructure of the cement matrix, resulting in a significant improvement in durability.

Available literature addresses the subject of fire resistance of cement composites; however, such tests are not standardized. Due to differences in research methodologies, it is challenging to make a clear assessment of how a particular admixture affects the behavior of the cement composite. Further investigation is needed on the impact of nanomaterials, particularly nanoclays, on high-temperature exposure. The dissertation allows to choose the direction of research and systematize knowledge in this area.

In this study, the impact of nanometric mining clay particles on the thermal resistance of cement composites was evaluated. The literature section characterizes the mining clay and the use of clay in industry was presented. The next part examines the literature on the effect of elevated temperature on the properties of concrete. It also presents what nanotechnology is and how carbon dioxide emissions are generated in the cement industry.

The doctoral dissertation includes a wide range of preliminary and main research, as presented in chapters 4-5. Preliminary research began with getting acquainted with the material: mining clay and comparing it with halloysite nanoclay from Sigma Aldrich company. For this purpose, the specific surface area was determined using the Blaine method and the granulometry of grain distribution was determined using the laser diffraction method. The compositions of both materials were examined using X-ray fluorescence (XRF) and energy dispersive spectroscopy

(EDS) analysis as well as X-ray diffraction (XRD). Derivative Thermogravimetry (TGA/DTG) measurements and SEM analysis using microstructure scanning electron microscope were also performed. Additionally, a toxicity test of mining clay was also carried out. At the end of the preliminary tests, cement pastes were prepared in which the cement was replaced by clay by weight. The compressive strength of cement pastes containing mining clay and halloysite nanoclay was determined. Then, main research began on cement mortars containing only mining clay as a partial replacement for cement. The development of compressive strength and flexural strength over time was investigated. The influence of the presence of clay on bulk density, water absorption and water absorption coefficient was also determined. Moreover, the samples were heated at temperatures of 300, 450, 600 and 800 °C to determine changes in compressive strength, bending strength, mass, heat conduction coefficient and water absorption.

The conducted research and analyzes have shown that it is possible to use mining halloysite clay in the composition of cement mortars as a substitute for halloysite obtained by industrial methods. It has been shown that partial replacement of cement with mining clay in the optimal amount does not deteriorate the properties of the cement composite and even improves selected parameters. During the research, it was observed that adding mining clay to the composition of cement composites improves resistance to high temperatures. The research results obtained using the described methodology allowed for the systematization of knowledge regarding the influence of mining clay particles on the thermal resistance of cement composites.

Keywords: clay mineral, thermal resistance, cement mortar, mechanical properties, microstructure.

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22.04.2024