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Determination of the Geopolymer Binders Setting Time for 3D Printing Technology

Szymon Gadek[1], Marek Nykiel[1], Tetiana Tepla[2], Lidia Bohun[2], Zoia Duriagina[2], Dariusz Mierzwinski[1]

[1]Department of Materials Science and Engineering, Cracow University of Technology, Warszawska 24, 31-155 Cracow, Poland

[2]Department of Materials Science and Engineering, Lviv Polytechnic National University, 79040, Lviv, Ukraine

Geopolymers, or other alkali-activated materials (AAMs), are a class of cementitious aluminosilicate binders with diverse and regulated material properties. They are synthesized by adding an alkaline solution, called an activator (often consisting of sodium hydroxide, NaOH, and sodium silicate, Na2SiO3, to aluminum- and silicon-rich raw materials. Examples of such materials include blast furnace slag, metakaolin or fly ash, which is a by-product of coal combustion.

Expanded geopolymers are a promising alternative to other expanded materials, especially in terms of their use as refractory partitions withstanding temperatures well in excess of 500ėC, which puts them above other foamed materials such as polymer composites or foam systems.

The ability to assess the setting time of foamed geopolymer mortar is an important factor influencing the economics of this process. In the case of alkaline-activated materials, special attention should also be paid to the effect of the activator and stabilizers on the setting rate of the geopolymer mortar.

Existing methods of testing the hydration of cement mortar in the case of AAM seem to be insufficient, so the paper focuses on determining the setting time of foamed geopolymers in order to use them in the process of 3D printing of semi-finished products with appropriate mechanical and physical properties. The duration and intensity of each of the heat release processes identified during the first hours of AAM setting depends on the type of activator used and the type of material used. Activation of geopolymers with a NaOH-containing solution leads to reduced heat release within the first 24 hours of the reaction compared to silicate-activated binders, which is associated with a slower reaction process A method based on a thermistor probe based on a standard thermistor with a negative temperature coefficient was used to determine the setting time.

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Biography:

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