

HYDRATION OF CEMENT PASTE MONITORED USING ULTRASONIC WAVE PROPAGATION

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Abstract

Concrete setting and hardening processes are the most critical phases during construction works, influencing properties of a concrete structure. The initial set is important as it provides an estimate when concrete has reached a point that it can no longer be vibrated without damaging concrete. The point at which final set occurs is important since it provides an estimate when the development of concrete strength and stiffness starts.

In this paper ultrasonic measurements used to characterize a hydration process of cement based materials are presented. A technique is based on the system for measuring ultrasonic pulse velocity (UPV). The system is connected to a PC and data are continuously recorded in certain time intervals. To obtain more information about wave propagation characteristics the technique of the acoustic emission (AE) is used. An acoustic emission sensor is attached to the surface of tested specimen along with a receiver probe of the UPV setup. This probe is registering acoustic signals which are emitted from the transmitting sensor. Entire waveform of the signal is recorded and the AE parameters are obtained from the signal. These parameters are used to characterize different processes of the hydration in the tested sample.

Measurements are performed on cement paste with Cement type CEM I and varying water-cement ratios. Ultrasonic wave parameters analyzed are ultrasonic pulse velocity, maximum amplitude and energy of the waveform.

Obtained results show that maximum amplitude has greater sensitivity to transformation of the cement paste from viscous to solid state than velocity of the ultrasonic pulse. Energy of the transmitted wave shows different trend than ultrasonic pulse velocity and amplitude which is dependant on the water-cement ratio of the cement paste.

Key words:

Cement hydration, ultrasonic testing, acoustic emission, wave parameters, concrete properties prediction