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Ultrasonic monitoring of hardening concrete

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Monitoring results of velocities and attenuations of compressional and transverse ultrasonic waves in hardening concrete using short pulse through-transmission are presented. A fluid concrete is a highly attenuating heterogeneous medium, composed of several phases and granular classes. Different attenuation mechanisms are considered in order to account for experimental results: high impedance mismatch between air layers and solid-fluid clusters at early ages, Energy loss by viscous dissipation and wave scattering by heterogeneities (Rayleigh scattering at low frequencies, single or multi diffusion scatterings at intermediate and high frequencies) during the beginning of hardening. At early ages, the medium may be described as composed of a succession of large slabs of fresh concrete separated by very thin slabs of air. Attenuation is then computed from the effective transmission coefficient of this medium. This model is in good agreement with experiments. During the beginning of hardening, the medium may be seen as composed of big particles immersed in an effective medium formed by the ensemble of the particles of lesser granular sizes and water. Then, the Rayleigh scattering model at low frequencies and the multiple diffusion model predictions at intermediate frequencies are in good agreement with experiments.