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Determining the moisture content in limestone concrete by gamma scattering method: a feasibility study

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Abstract

The use of a theoretical model based on the concept of the isolated atom has facilitated the study of the relationship between coherent and incoherent scattered gamma radiation and chemical composition, leading to the application of the measurement of scattered intensity ratio as a means of determining the moisture content of concrete. From the typical mixing proportions and oxide composition of the main constituents of limestone concrete the fractional weights of the constituent elements are obtained. The coherent, incoherent, coherent-to-incoherent intensity and the effective atomic number (Z_{eff}) of limestone concrete for 0%, 2%, 4%, 6% and 8% of water have been calculated at different scattering angles of 36.40^o, 49.40^o, 62.74^o, 77.4^o, 93.60^o and 112.81^o for 59.54 keV gamma energy and at two scattering angles of 21.60 and 43.60 degrees for 661.6 keV. The experimental set- up consists of a collimated ^{137}Cs radioactive source and a collimated planar HPGe detector coupled to a PC based plug-in-card multichannel analyser providing energy dispersive analysis of the scattered spectrum. The scattered intensity and effective atomic number found to vary linearly with the amount of water present in the concrete specimen and the results show that the scattering method is highly sensitive to changes in moisture content in limestone concrete and < 1% change can be easily detected using this method.