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Measurements of concrete composition via fast neutron transmission spectrometry

Within all nuclear installations concrete is a key material both for structural integrity and for the shielding of radiation. Concrete is typically a mixture of cement, sand, large aggregate and water, although various additives may also be introduced. Developing methods to independently verify the composition of shielding materials, such as concrete, is of high priority for the regulation of existing and future nuclear installations. Of particular importance to the neutron shielding properties of concrete is the water content, which has further significance as nuclear installations age.

We report on the development of radiation-based methods to non-destructively measure the composition of concrete and other materials. Measurements of the energy spectra of neutrons transmitted through well-characterised samples were made at the n-lab (Department of Physics, University of Cape Town) with beams of 14 MeV neutrons from a D-T sealed tube neutron generator and neutrons produced from an AmBe radioisotopic source. Modern methods of spectrum unfolding allow energy spectra to be determined without the need for ns-pulsed neutron beams. The measurements were supported by radiation transport calculations using FLUKA. We present analyses of measured neutron energy spectra, and FLUKA calculations, which offer new opportunities to non-destructively determine the composition of concrete samples of unknown origin.

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