Evaluation of the maximum emitting layer of Rn-222 in cementitious building materials

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Introduction – Radionuclides present in construction materials are of interest in the view of environmental radioactivity. The limitations established have focused on the concentration of Ra-226 and the consequent exhalation of Rn-222. A physical/mathematical model developed at the Laboratory of Applied Nuclear Physics (LFNA/UTFPR) correlates the exhaled Rn-222 with the Ra-226 inherent to the material. The model considers the exhalation of Rn-222 by a plane surface that simulates exhalation in floors, walls and ceilings. Determination of the maximum emitting layer of Rn-222 that effectively exhales is important to support the model. The objective of this research is to determine the maximum emissive layer of Rn-222 that provides internal diffusion and exhalation of radon-222 in cementitious materials.

Methods - Cylindrical samples were made of common cement paste and cement paste with sand of high Ra-226 concentration. The samples (thicknesses 1 to 5 cm) were sealed in order to ensure the exhalation of Rn-222 through one surface. Samples and diffusion chambers containing CR-39 solid-state detectors were inserted into a glass vessel. The samples/detectors were stored for 30 days. Subsequently, the detectors were chemically etched and the nuclear tracks in the CR-39 detectors were counted.

Results – For each type of sample a curve was fitted whose threshold indicated the maximum emitting layer. The results obtained on the samples of common cement paste indicated a maximum emitting layer of 2cm. For samples of cement paste with sand with high Ra-226 concentration, no threshold was observed, indicating that the maximum emitting layer is greater than 5cm.

Conclusions - The maximum emitting layer thickness of Rn-222 of common materials determined by curve fitting was 2cm. For materials with high concentration of Ra-226 there is an indication that the emitter layer is larger than 5cm. The obtained results subsidize the physical/mathematical model developed in the LFNA/UTFPR.