Preliminary identification of contaminating α- and β-emitting radionuclides in nuclear facilities to be decommissioned through Digital Autoradiography

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In previous publications[1,2], we presented how Digital Autoradiography (DA) could be of the most useful help in a preparation to decommissioning context: with this technique, a radiological mapping of the facility to dismantle can be obtained at a rate of around 2 weeks/100 m². The technique is sensitive to all types of radioactivity (including α and 3H- or 14C-emitted β) and to both labile and fixed radioactivity. The method (radiosensitive screens exposure followed by a scanning step at the laboratory in a small-size device) neither involves nuclear material transportation, neither produces wastes, nor requires operators' presence during signal acquisition. The purpose is to accurately locate possible contamination spots, in order to relevantly perform targeted sampling and thus limit destructive analyses runs at the laboratory.

In the latest developments, additional methods were implemented to analyze various nuclear samples (wastes, blocks, rubbles, pieces of furniture, drilled cores…) through this technique, to preliminary check for contamination, and to evaluate contamination location, homogeneity, and activity. These methods have proven themselves relevant and useful to build appropriate analyses and optimized decontamination protocols at the LASE (Laboratory of Analyses and Operators' Support).

In this paper, we propose a new autoradiographic tool providing the identification of the contaminating radionuclide of a sample or an area, based on the stacking of several screens. The decrease of the signal screen after screen could be considered specific to one radionuclide. Modeling results obtained through Monte Carlo N-Particle transport code (MCNP) were in excellent agreement with experimental results obtained with sealed sources. Moreover, a method was developed to scan all the screens in the stack in only one run (instead of as many runs as screens) to shorten analysis duration. In the case of non-penetrating radiations (α particles, 3H- or 14C-emitted β particles, 55Fe X-rays), a simple measurement consisting of the comparison between the response of two different types of screens enabled the identification of the radionuclide. Examples of application of this non-destructive method to provide preliminary and essential information at lowest costs at the LASE are presented.

Keywords: digital autoradiography, dismantling, phosphor screen, stacking, tritium, alpha, beta

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[3] R. Haudebourg, P. Fichet, and F. Goutelard, *Digital Autoradiography as a novel complementary technique for the investigation of radioactive contamination in nuclear facilities under dismantlement*, in *ANIMMA*, 2015, Lisbon.