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#07-3 Neutron coincidence measurements and Monte Carlo modelling of waste drums containing reference nuclear material

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Within the CHANCE project several non-destructive technique are being considered for the assay of waste bearing drums. Such techniques include calorimetry, gamma-ray spectroscopy and neutron coincidence counting. The aim is to reduce uncertainties on the inventory of radionuclides by combining the signatures from different techniques in the data analysis.

In this framework, neutron coincidence measurements were carried out with two slab counters based on 3He detectors coupled to shift register electronics. Such a system consists of two identical slabs with 6 detectors each and is transportable, rather compact and flexible in terms of sizes and geometries that can be measured. With this system three 200 l drums containing certified reference nuclear material and different filling materials were measured. The certified nuclear material was in the form of 21 pellets of mixed oxide of U and Pu with a total mass of about 10.5 grams; in addition, a single pellet of about 10.5 grams was also available. The pellets could be placed in predefined positions within the drum in a reproducible way. The geometry and composition of the three drums was well characterized and consisted of Ethafoam, a mixture of Ethafoam, stainless steel and PVC, a mortar with an inner core of extruded polystyrene. The measurement setup was arranged such that the drum was placed between the two slab counters. The positions of the slab counters relative to the drum were accurately measured before each measurement, and a dedicated system was used to minimize the uncertainty on the detector positioning.

The measurement data were analysed by applying the point model of Hage and the mass of nuclear material in the drum was determined from the totals, reals rate and radionuclide composition. Due to the fact that not all the point model conditions were met, we found that the point model overestimates the mass up to 80%. In addition, a Monte Carlo model of the measurement geometry was developed using the MCNP code. The model was used to determine a calibration factor between the reals rate and the mass of the sample. Measurements with a calibrated 252Cf source were used to verify the model. With a Monte Carlo based approach the mass of the mixed oxide pellets is slightly underestimated up to 10%. The results reveal the importance of an accurate background correction and of accounting for surrounding materials such as walls in the Monte Carlo model.

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