Evaluation of the 2016 ENV57/MetroERM measurement comparison on simulated airborne particulates: 137Cs, 134Cs and 131I in air filters
Abstract:
In 2016, the European Commission (EC) Directorate-General Joint Research Centre (JRC) Geel site (former Institute for Reference Materials and Measurements (IRMM)) organized an interlaboratory comparison (ILC) exercise on the measurement of 137Cs, 134Cs and 131I in air filters. Similar exercises, although EC ILC, were organized in 2014 (Altzitzoglou and Máté, 2016) and in 2003 (Wätjen et al., 2007); in both exercises the measurand was 137Cs only. The 2016 ILC, which is the subject of
this report, was conducted in the frame of the EMRP project with code ENV57 and entitled MetroERM "Metrology for radiological early warning networks in Europe" project with the aim to optimise the metrological foundation of measurements for monitoring airborne radioactivity and promote pan-European harmonisation in data reliability. The JRC participates in the ENV57 MetroERM project having the responsibility to carry out a number of tasks. Work Package 3 (WP3) addresses the traceability of dose rate and airborne radioactivity measurements and explicitly supports the process of harmonisation of radiological data from early warning networks in Europe by systematic investigations, comparison exercises and the publication of recommendations. Task 3.2 of WP3 entitled "Traceability management for airborne radioactivity" aims in developing traceable reference materials and standard sources in the form of large-area spiked aerosol filters and conducting a laboratory comparison exercise to quantify the performance of the airborne radioactivity measuring field stations. This report describes the full life cycle of the above mentioned comparison among 67 European laboratories monitoring radioactivity in the environment. JRC provided the comparison samples, which were prepared individually for each laboratory using a gravimetrically diluted solution of 137Cs, 134Cs and 131I. Reference values traceable to the International System of Units (SI) and the International Reference System (SIR) for gamma-ray emitting radionuclides were determined at the JRC. The samples were made by gravimetrically dispensing the appropriate activity amounts, close to those the laboratories routinely measure, on blank air filters provided by the participants. A robust evaluation of the individual performance using three different approaches, percentage difference (D%), En numbers and PomPlots, is presented. Finally, for the laboratories which have participated in the 2003 and 201 exercises, their performance evolution in measuring 137Cs in air filters over the years, is examined. All 67 participating laboratories reported valid results. The majority of the laboratories reported reliable measurement results for 137Cs and 134Cs; 56 (84%) out of the 67 participants reported values with a percentage difference from the reference value within the ±20% range. Furthermore, 42 (63%) of the laboratories fulfilled the criterion of the compatibility test based on En numbers for 137Cs and 36 (54%) for 134Cs. As the calculation of the En numbers takes into account the uncertainties on both the measured activity and the reference value, the lower scores for the En numbers reveals that the uncertainty estimation is not adequate in many laboratories and there is a need to improve their application of uncertainty propagation. An observation for the 134Cs results is a negative bias on the reported results compared to the reference values, which might be partly attributed to a non-adequate summing correction applied by some laboratories. The evaluation of the performance of the laboratories on 131I was complicated by two effects. First, in a number of spiked air filters a fraction of the 131I activity was transferred to the protective plastic bag. Second, the integrity of the 131I activity content of many spiked air filters was compromised to a variable degree. Nevertheless, 20 (30%) laboratories reported results for 131I with a percentage difference from the reference value within the ±20% range and 9 (13%) with compatible En numbers. This performance is not satisfactory, but the difficulties encountered have to be taken into account. A major output of this project is the identification of the need of additional studies on how to perform reliable measurements of radioiodine on air filters. Overall, the majority of laboratories master their gamma-ray spectrometry analytical procedures, including the counting efficiency calibration of the detection systems and the corrections for coincidence summing. More attention has to be paid to the elaboration of the uncertainty to obtain correct and realistic uncertainties on the reported results.

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Authors:
ALTZITZOGLOU Timotheos
MALO Petya

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