Evaluation of analyzing uranium enrichment in swipe samples using alpha spectrometry

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A traceable amount of nuclear material is produced in the every nuclear facility. The environmental sampling (ES) is one of the most powerful measures for strengthening safeguards implemented by the International Atomic Energy Agency (IAEA). Swipe sample collected from the environment is useful for detecting undeclared nuclear activities in the declared facilities or at the undeclared location.[1] A particle analysis with FT-TIMS, LG-SIMS is usually adapted to verify the undeclared nuclear activities.

Particle analysis with mass spectrometry (MS), which capable to verify the information declared, is required much more time and cost.[2] Alpha spectrometry could remedy these shortcomings of MS, even though it has limitation which is capable to analyze only the average uranium enrichment of particles in the swipe sample. Therefore, it could be adapted for the purpose of screening and timely-discrimination of the swipe sample which is necessary particle analysis, if the database of average uranium enrichment result from the Bulk Handling Facility (BHF) has accumulated already. KINAC considers to establish uranium enrichment analysis DB with the alpha spectrometry of the swipe samples from declared facilities.

This article showed the uranium enrichment with alpha spectrometry and ultrasonic processing of swipe samples collected from the BHF in 2016. These results were compared with the LG-SIMS analysis commissioned by ITU.

In general, uranium isotope analysis is performed of radionuclide separation using UTEVA resin in preprocessing steps. However, the BHF does not produce other actinides because the only pure uranium is treated in it. It means the additional purification steps such as UTEVA resin and etc. are not required. Therefore, the samples could be analyzed faster than other samples collected from other sites or facility.

The uranium enrichment results of the swipe samples with alpha spectrometry are higher in comparison with the results (mean) using SIMS. Low tail of ^{234}U peak tends to overlap with ^{235}U peak when analyzing the uranium enrichment. The increment of ^{234}U low tail count causes ^{235}U peak and enrichment overestimation. It might be caused by finite thickness of electro-deposition (Ref. 3). Hence, further study using standard uranium isotope source is required to verify the enrichment and its scale.

The enrichment result from the alpha spectrometry would be provided to establish the database. KINAC expects it could provide the information capable to predict the variance of enrichment of the specific facility and discriminate the sample required for the particle analysis to verify the nuclear activity. Therefore, the verification efficiency of declared nuclear activities can be increased.

REFERENCES

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