

Alpha spectrometry enriched uranium urinalysis results from IPEN

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Abstract

IPEN (Instituto de Pesquisas Energéticas e Nucleares) manufactures the nuclear fuel to its research reactor, the IEA-R1. The CCN (Centro do Ciclo do Combustível) facility produces the fuel cermet from UF₆ (uranium hexafluoride) enriched to 19.75% in ²³⁵U. The production involves the transformation of the gaseous form in oxides and silicates by ceramic and metallurgical processing. The workers act in more than one step that involves exposition to types F, S and M compounds of uranium. Until 2003, only fluorimetric analysis was carried out by the LRT (Laboratório de Radiotoxicologia – IPEN) in order to evaluate the intake of uranium, in spite of the sub estimation of the ²³⁴U contribution to the internal doses. Isotopic uranium determination in urine by alpha spectrometry is the current method to monitoring the contribution of ²³⁴U, ²³⁵U and ²³⁸U. Alpha spectrometry data of 164 samples from 84 individuals separate in three categories of workers: routinely work group; special operation group and control group - were analyzed how the isotopic composition excreted by urinary tract corresponds with the level of enrichment and isotopic composition of the plant products. Results show that is hard to estimate these intakes of ²³⁴U and ²³⁵U since these isotopes alpha activities are below the limit of detection or minimum detectable activity (MAD) of this method in the most part of the samples. Only in 22 samples it was possibly to measure the three radionuclides. Not expected high contribution of ²³⁴U activity was found in samples of the control group. No one result over the ²³⁴U and ²³⁵U MAD was found in the samples from the special operation group. Only in 5 samples from the routinely group the levels of ²³⁵U was higher than the levels of others groups. In a complementary study, 3 solid samples of UF₆, U₂O₈ and U₃Si₂ from CCN plant were analyzed to determinate the isotopic uranium composition in these salts, since this composition varies with the amount of any of the isotopes in the original ores. Considering the results from workers urine and salts measurements, the LRT studies the options to introduce a more sensitive method to estimate the intake of ²³⁴U and ²³⁵U.

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