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Simultaneous determination of organically bound tritium and radiocarbon by Liquid Scintillation method

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Krško Nuclear Power Plant (KNPP) is located in south-eastern part of Slovenia, on the left bank of the Sava River. Emissions of the operational Pressurized Water Reactor (PWR) are mainly ^{14}C and ^3H . The dam for the Brežice Hydroelectric Power Plant (BHPP) constructed few kilometres downstream has caused changes in the local climate parameters and hydrology around KNPP. The simultaneous method for determination of OBT and ^{14}C seems efficient tool for the study of the BHPP impact on the distribution, dynamics, and retention time of the ^3H and ^{14}C in biota in the vicinity of KNPP.

Simultaneous methods for determination of ^3H and ^{14}C in organic samples have been already developed. Pyrolyzer or oxidizer are commonly used for this purpose because they allow well controlled and fully automated procedure, but detection limits are rather high due to limitations of allowed sample quantity. Paar 1121 oxygen vessel allows combustion of larger sample quantities and is therefore more suitable for the analysis of environmental samples from the vicinity of PWR reactor. On the other hand, the procedure cannot be automated and sample size is limited by its caloric value which might cause big pressure leap during the combustion.

The presented method consists of combustion of the sample in a Paar vessel in an oxygen atmosphere where it is converted to CO_2 and H_2O . Formed CO_2 is released through a cleaning system containing two chemicals $0,1\text{M CrO}_3$ and $0,1\text{M AgNO}_3$ and trapped in the mixture of CarbonTrap and CarbonCount. Formed water is neutralized using Na_2O_2 and KMnO_4 followed by liophylisation and mixed with scintillation cocktail. Critical point in this method is determining the right amount of sample for combusting that will provide enough CO_2 for complete saturation of trapping medium and enough water for determination of OBT. Usually, depending on the sample, from 15 to 20 g is enough to satisfy this criterion.

The accuracy, trueness, and precision of the simultaneous method will be presented through inter-laboratory comparisons and results of international inter-comparison tests organized by International OBT group. We took part in 4th, 5th and 6th international inter-laboratory OBT exercise organized on grass, fish and quince where we achieved excellent results. For ^{14}C , we compared our results with the official values from the regular KNPP monitoring report. By these comparisons we proved the suitability of the implemented inexpensive, yet accurate and precise simultaneous method for analysis of both radionuclides in the environmental samples.

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