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An influence of the final volume of samples during the electrolysis of water, on counts for tritium activity determination

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Tritium levels in natural waters today have a similar value to the concentration before thermonuclear bomb testing conducted between 1954 and 1963. Because of the low concentration of this radioisotope, the analysis requires enrichment techniques to produce low detection limit, accurate results and to reduce uncertainties. This analysis includes preliminary distillation, electrolytic enrichment of the samples, the second distillation, and measurement on ultra low-level liquid scintillation spectrometer.

The enrichment system consists of 16 electrolytic cells, each with a capacity of 250 ml, placed in the freezer and connected to a direct current source. One cell contains *spike water* with known tritium concentration and is used for enrichment factor determination. The initial volume for all samples is 250 ml. Na_2O_2 is used as an electrolyte to make the solution alkaline. Each cell has a gas outlet to ensure the escape of gases H_2 and O_2. In order to obtain a high enrichment factor, the system works on 5 A, to reduce the initial volume of the samples by 10-15 times. After electrolysis, second distillation must be performed to eliminate electrolyte. 8 ml of water sample after the second distillation is mixed with a scintillation cocktail in polyethylene vials and measured on a liquid scintillation spectrometer Quantulus 1220.

At the end of the electrolytic enrichment process, the final volumes of the samples can be different, which causes different enrichment between the cells. To eliminate this influence, the final volume of all enrichment samples can be normalized at one value. In order to determine the corrected count rates obtained for each sample, the separation factor must be first calculated, taking into account initial volume, normalized final volume, count rate for *spike water* (after enrichment), count rate for *spike water* (before enrichment), and background count rate. In the example of one electrolysis, with 15 samples of drinking water, precipitation, and surface water, and one sample of *spike water*, with 670 Ah and an enrichment factor of 8.10, the final volume is normalized on a value of 18 ml. The calculated separation factor was 4.88. The corrected count rates for samples vary from 0 to 9.6 %, which causes a change in the final activity concentration of tritium from 0 to 22.2 %.

Keywords: Electrolytic enrichment, tritium, the separation factor

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