Operational measurements of ^{18}F and ^{81}Rb activities during transport to the production site

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Introduction

Activity measurement of the produced radionuclide prior its transport to further processing in the clean rooms indicates proper irradiation settings and target functioning. It is particularly true for short-lived radionuclides. Precise on-line activity measurement of the radionuclides transported from the target to the hot cells in a liquid phase was highly desirable in order to estimate compliance with the required value. In this paper, we present simple operational systems for activity measurement of the irradiated enriched (^{18}O) water for ^{18}F labelled PET radiopharmaceuticals and ^{81}Rb aqueous solution for manufacturing radionuclide generator $^{81}Rb/^{81m}Kr$.

Material and Methods

Irradiated aqueous solution (2.5 ml of enriched water with ^{18}F up to 200 GBq) is transported via capillary to a synthesis module. Due to spreading out the liquid product on measuring vial walls, measured activity may vary up to 12 %. In order to avoid this variability, we have introduced simple system based on the measurement of several loops of the transporting capillary. The product is then evenly distributed around GM tube positioned in the loops' centre. Typical GM tube response is displayed on FIG. 1.
The data are recorded and processed on-line. Maximum mean value of 20 consecutive values is calculated. The GM tube response was calibrated by precise activity measurement of the same product in a calibrated ionizing chamber (Atomlab). Calibration covers full range of the produced ^{18}F activities.
Radionuclide ^{81}Rb for the $^{81}Rb/^{81m}Kr$ generator is produced via proton irradiation of pressurized enriched ^{82}Kr gas. The product deposited on the target walls is washed out by water and transported to a container in a hot cell for filtration before transfer to a clean lab. The solution activity in the container (7–25 GBq) is measured with a GM tube in constant geometry. Typical response of the GM tube to the measured activity of ^{81}Rb is displayed on FIG. 2.

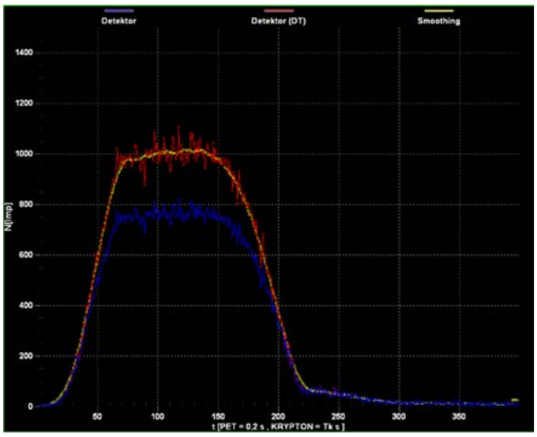

FIGURE 1. Typical GM tube response of the ^{18}F activity in the irradiated enriched water. Blue line – raw data, red line – dead-time corrected data, yellow – smoothed data used for activity calculation.

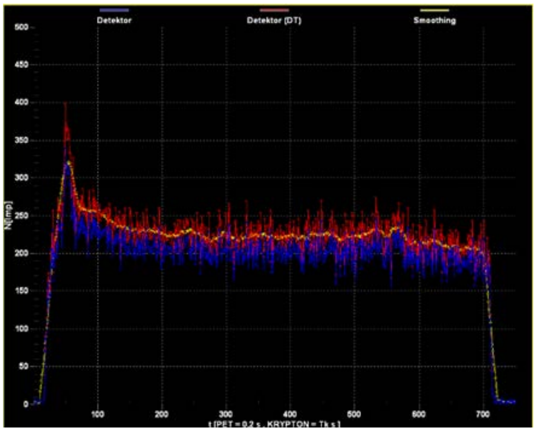

FIGURE 2. Typical GM tube response to the activity of ^{81}Rb. Blue line – raw data, red line – dead-time corrected data, yellow – smoothed data used for activity calculation.

For activity determination, the mean value of 200 consecutive readouts starting from the 120th readout following maximum is used. The calibration for the whole range of the produced activities was performed via precise measurement of the cumulative ^{81}Rb activity concentration by standard γ-spectrometry using HPGe detector.

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Results and Conclusion

A simple operational system for on-line activity measurement of ^{18}F and ^{81}Rb in aqueous solutions using GM tube was designed, calibrated and implemented. Long term statistics show that the measured activities do not differ from the values obtained on calibrated ionizing chamber (^{18}F) or γ-spectrometer (^{81}Rb) for more than ± 2.5 %. The method seems to be cheap and rapid for reliable estimate of the produced activities on-line.

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