Reachable accuracy and precision for tritium measurements by calorimetry at TLK

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Inside a tritium facility, calorimetry is an important analytical method as it is the only reference method for accountancy. Because it is based on the measurement of the heat generated by the radioactive decay, the result is independent from the chemical and physical form. Another advantage is that the calibration does not require a certified tritium source. The heat source for the calibration is provided by an electrical resistor. Therefore, the accuracy of the measurement is directly related to the accuracy of the electrical components and measuring devices used for calibration. The precision of a measurement is related to the reproducibility of that type of measurement. It is affected by the changes of the calorimeter signal as a result of the environmental changes.

Presently, at TLK, four calorimeters are in operation, one of isothermal type and three of inertial guidance control type. These calorimeters have been calibrated covering a total power range from 10 μW to 10 W, corresponding to a mass of $3.09 \cdot 10^{-6}$ to 30.86 g tritium or a tritium activity of 10^9 to 10^{16} Bq. The volume of the calorimeters varies between 0.5 and 20.6 litres.

A series of measurements with various tritium samples has been performed to determine the reproducibility of the measurements for each calorimeter. Also, the results from all the TLK calorimeters were compared.

This paper will present the experimental results of the series of measurements. In particular, the influence of the environmental changes on the possible reachable precision will be discussed. This issue is of high importance for measurements of samples with low activity (equivalent to less than 1mW), since in this case one measurement can last up to four days.