Assessment of Uncertainties in Calibration of Langavant Calorimeter

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When cement is mixed with water, its constituent compounds undergo exothermic chemical reactions which are responsible of concrete hardening. During these hydration reactions, the temperature of concrete evolves due to the internal heat generated. These phenomena are of great concern for the safety of large concrete structures such as buildings, tunnels, bridges and nuclear reactor containments. In such constructions, a high heat evolution in the early stages of cement hydration, producing a big temperature difference between the surface and the core of the structure, can cause thermal stresses that result in crack formation. It is therefore important to control the heat released during the hydration process of cements, in order to ensure the lifetime of concrete structures. The hydration heat of cement is determined in most European countries by using two standardised methods: solution method (EN 196-8: 2010), and semi-adiabatic calorimetry also known as Langavant method (EN196-9: 2010). The second method consists of introducing a sample of freshly made mortar into a semi-adiabatic calorimeter in order to determine the quantity of heat emitted. The hydration heat is equal to the sum of the heat accumulated in the calorimeter and the heat lost into the ambient atmosphere throughout the test period. Before performing measurements of hydration heat, the Langavant calorimeter must be calibrated by electrical substitution, in order to determine its coefficient of total heat loss and its heat capacity m. As National Metrology Institute (NMI), LNE has carried out for many years the calibration of this type of calorimeter with a homemade facility, which is included in its calorimetry laboratory. This paper gives a detailed presentation of the estimation of measurement uncertainties of the two parameters a et m calculated by LNE according to the ISO/BIPM "Guide to the expression of uncertainty in measurement".