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High precision calorimetry to determine the enthalpy of combustion of Methane

Abstract

The enthalpy of combustion of methane is the most important property used in the determination of the calorific value of natural gas. Only two sets of values with high accuracy and precision and measured under appropriate conditions have been published since it was first determined in 1848. These studies were by Rossini, at the National Bureau of Standards in the USA in 1931, and Pittam and Pilcher, at the University of Manchester in 1972.

This talk details the design and operation of a high precision constant-pressure gas burning calorimeter, based on the design of those used in the previous studies, to measure the superior enthalpy of combustion of ultra-high purity methane at 25 °C.

The use of modern equipment and automatic data collection leads to a value, traceable to national standards, of $890.61 \text{ kJ mol}^{-1}$ with a combined standard uncertainty of 0.21 kJ mol^{-1} . This is in full accord with the value of $890.63 \text{ kJ mol}^{-1}$ calculated from the average of Rossini's and Pittam and Pilcher's work (with a random uncertainty based on 1 standard deviation of 0.53 kJ mol^{-1}).