Micro Reaction Calorimeter - µRC™
Technical Application Note 6
Heat Capacity Measurement

Introduction

Heat capacity is an integrated function of the THT Micro Reaction Calorimeter (µRC). Measurements require minimal setup and little or no analysis to obtain quick and reliable heat capacity data. Cp is determined by directly measuring the amount of heat required to shift the sample temperature. Water samples of several sizes were used to verify the µRC performance and demonstrate the instrument performance over a typical operational range.

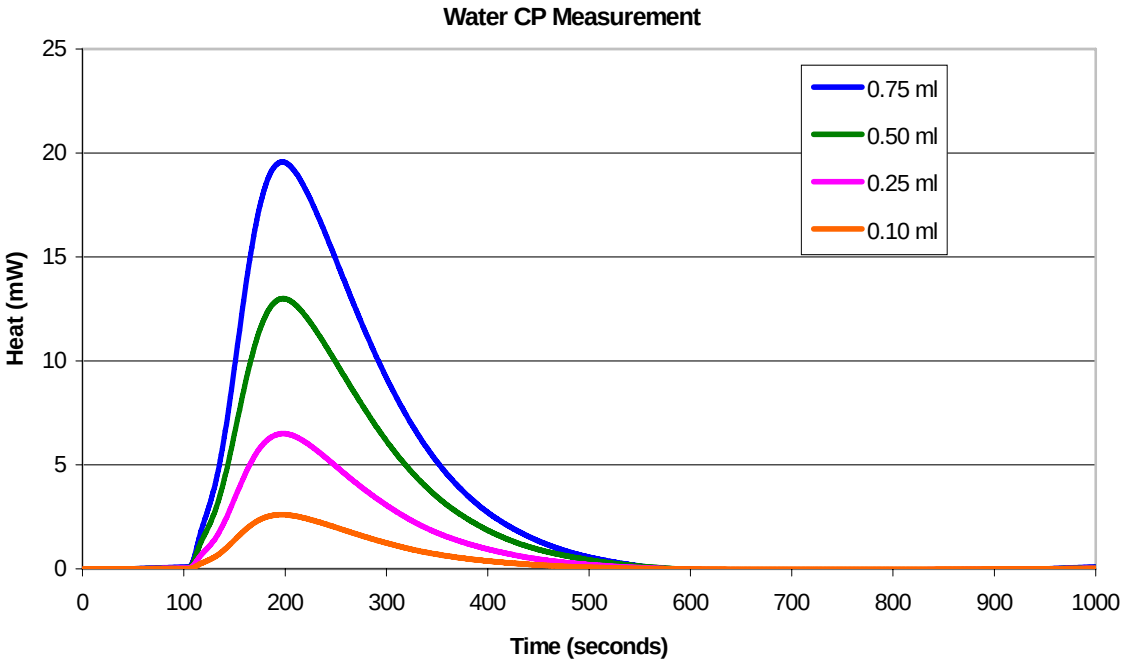
Experiment setup for Cp analysis is very simple. Precise knowledge of sample composition or expected values is not needed. Default settings are adequate for most experiments. Most measurements can be made by simply dropping in the sample and running.

Experimental

Typical experiments utilize a temperature shift of 1.0° C. Smaller shifts can be used for temperature sensitive materials. The temperature shift can be optimized to provide greater sensitivity, or greater dynamic range.

Several different masses of water were placed in a standard µRC vial and allowed to equilibrate at 25° C. A small temperature step (usually in the order of 0.5-1°C) is then applied to the system and the heat is measured. The experiment is then repeated in reverse to verify the measurement. The results from each shift direction are averaged to give the final result.

The experiment is conducted using 2 matched vials (pre weighed to reduce differences in mass affecting the results) and a measurement with an empty vial is conducted first to ensure that any small difference is accounted for.



The results of 4 experiments with 0.1 ml, 0.25 ml, 0.5 ml, and 0.75 ml of water.
Each experiment required approx 17 min.

thermal hazard technology

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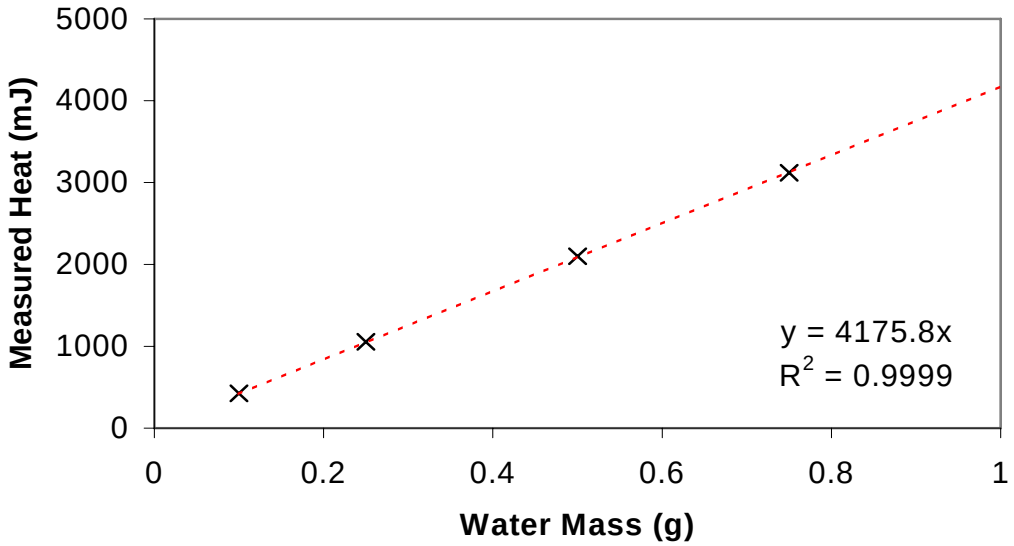
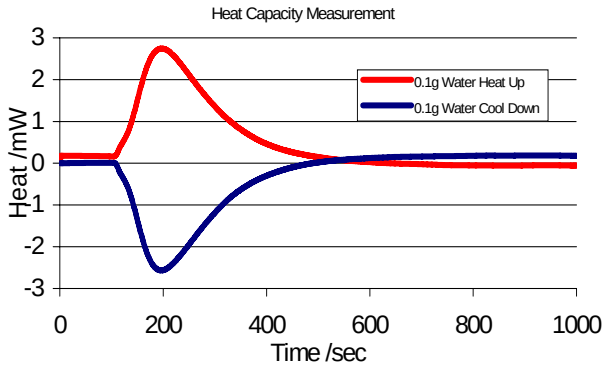


Results

The data shown overleaf highlight the ease of operation, accuracy and speed of measurement of heat capacity data. The wide range of masses used in these experiments highlights both the accuracy and wide applicability of this system.
The data measured gave an overall heat capacity of $4.198 J.g^{-1}.°C^{-1}$ compared to the literature value of $4.182 J.g^{-1}.°C^{-1}$ giving an error of 0.4%. The repeatability of this measurement is 0.2% within each experiment and 1% between tests.



Discussion and Conclusions

Analysis of these measurements shows the excellent performance of the µRC Calorimeter. The average heat capacity measured is well within 1% of the published value over the whole of the mass range used.

The speed of measurement and the ability of the instrument to measure non homogeneous materials with realistic sample sizes makes the µRC unique in its operation. The experimental protocol only requires the user to input the sample mass, experiment duration and the temperature shift required, no knowledge of material composition is required. This very simple approach makes this ideal for routine measurements of heat capacity for a wide range of operations.

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