The SX isothermal calorimeter

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Introduction

Isothermal calorimetry is the measurement of heat and heat production rate (thermal power) under essentially isothermal conditions. This is a very general measurement technique that can be used in almost all fields of science and technology.

The calorimeter described in this report is an isothermal calorimeter, i.e. the measurements are carried out at essentially constant temperature. The principle it works by is that of heat conduction; heat produced in the calorimeter is conducted away from the sample. This is the most general isothermal calorimetric measurement technique available. Note that the SX calorimeter is *not* a temperature scanning calorimeter.

In many application areas one has found it necessary to employ very sensitive microcalorimeters as the thermal powers to be measured are very low. There are, however, many processes that can also very well be studies by less sensitive instruments. This instrument described in this report is such an instrument.

There is a need for simple isothermal heat conduction calorimeters with which one may perform educational experiments, both for teaching calorimetry and for teaching other subjects. The present report describes such an instrument that has been tested with good result in different types of laborations performed by students that had not previously worked with calorimetry.

The instrument

Each calorimeter has a bottom heat sink onto which two thermocouple plates are fastened. On the thermocouple plates are ampoule holders with an inner diameter of 27.5 mm. The bottom heat sink is connected to a top heat sink with two square tubes and the assembly is held together with two long screws. In the top heat sink are two holes through which one can insert ampoules into the ampoule holders.

In each calorimeter one of the ampoule holder is for the sample ampoule and the other ampoule holder is for a reference ampoule, i.e. the SX calorimeter is a twin calorimeter. Note that each calorimeter has its own reference.

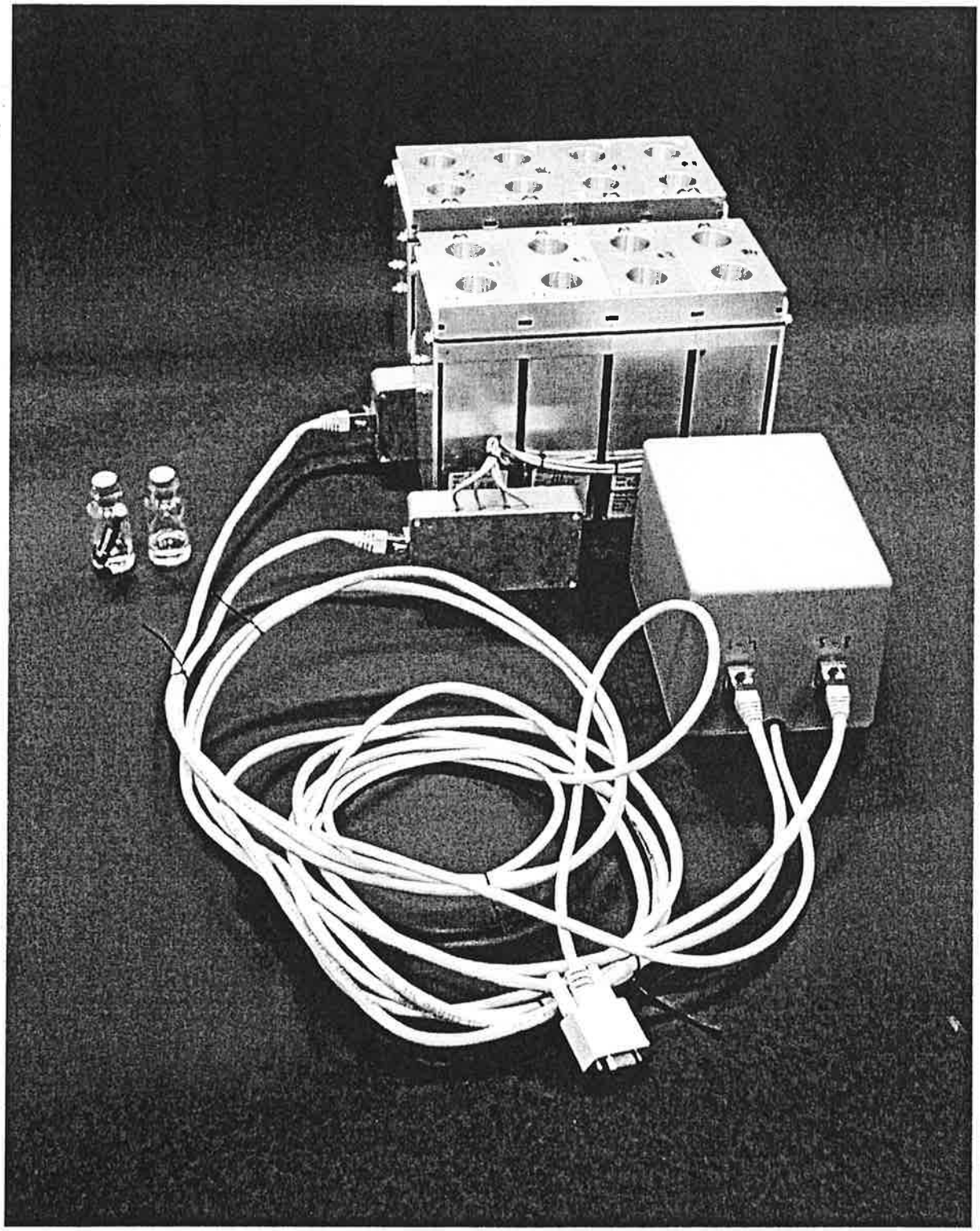

Figure 1. Eight SX calorimeters shown together with a logger (the gray box). The cable from the logger connects to the serial port of a computer. Two 20 ml glass ampoules from an experiment with a battery are also shown.

A number of SX-calorimeters may be mounted together to form one calorimetric unit. Figure 1 shows such an assembly with eight calorimeters.

Each SX-calorimeter is connected to a channel to a data-logger with 1 μV resolution corresponding to approx. 7 μW resolution (least significant bit). The data logger is connected to the serial port of a computer.

An SX-calorimetric unit may be protected from temperature disturbances in different ways:

- By placing it in an insulated box.
- By placing it in a thermostat.

In general can the insulation be made thinner the better the temperature stability of the surroundings are.

Typical experiments

Below is a list of some experiments that I have tested on the SX calorimeter with good result (reports of some of these applications are under preparation):

1. Cement hydration.
2. Discharge of AAA battery.
3. Acid-base titration.
4. Insect metabolism.
5. Lactose recrystalization.
6. Measurement of vaporization enthalpy of vapors.
7. Measurement of heat capacity of solids.
8. Percarbonate-paper compatibility
9. Epoxy curing.
10. Milk fermentation.
11. Microbiological degradation of liquid food stuffs.

Commercialization

The calorimeter is being commercialized by Thermometric AB (Järfälla, Sweden, www.thermometric.com).