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Note

The heat capacity of dimethyl phthalate, 250–370 K

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Dimethyl phthalate has recently been proposed[1] as a suitable calibrant for thermal conductivity measurements on liquids. In recent years, there has been a considerable shift away from the steady-state methods for measuring thermal conductivities to transient techniques. These transient techniques yield the thermal diffusivity, a, which is related to the thermal conductivity, k, by the equation $a = k/C_p\rho$, where C_p and ρ are the specific heat capacity and density of the liquid, respectively. Thus, it is necessary that reliable heat capacity data should be available if dimethyl phthalate is to be used as a calibrant in transient techniques. Because no heat capacity data are listed in the literature, measurements were made at temperatures between 250 and 370 K.

EXPERIMENTAL

The dimethyl phthalate was supplied by British Drug Houses Ltd and had a stated purity of > 99%. Some samples were taken direct from the bottle and others were dried over molecular sieves (number 5); there were no differences in the values of the heat capacities of the original and dried samples.

The heat capacity was determined using a Perkin Elmer-differential scanning calorimeter (dsc) model 2. The experiment was run with the calorimeter (i) empty; (ii) filled with Al_2O_3 (Calorimetry Conference Sapphire); and (iii) filled with dimethyl phthalate. The treatment of output data to yield heat capacities has been described previously[2]; corrections were also made for thermal lag in the calorimeter[3]. Previous investigations have shown that the heat capacities of test materials obtained with these techniques agree with the accepted values to within 1%. Temperatures were based on IPTS-68.

RESULTS AND DISCUSSION

The molar mass of dimethyl phthalate, $C_{10}H_{10}O_4$ was taken as 194.18 kg. The heat capacities obtained between 250 and 370 K are shown in Fig. 1. For this tem-

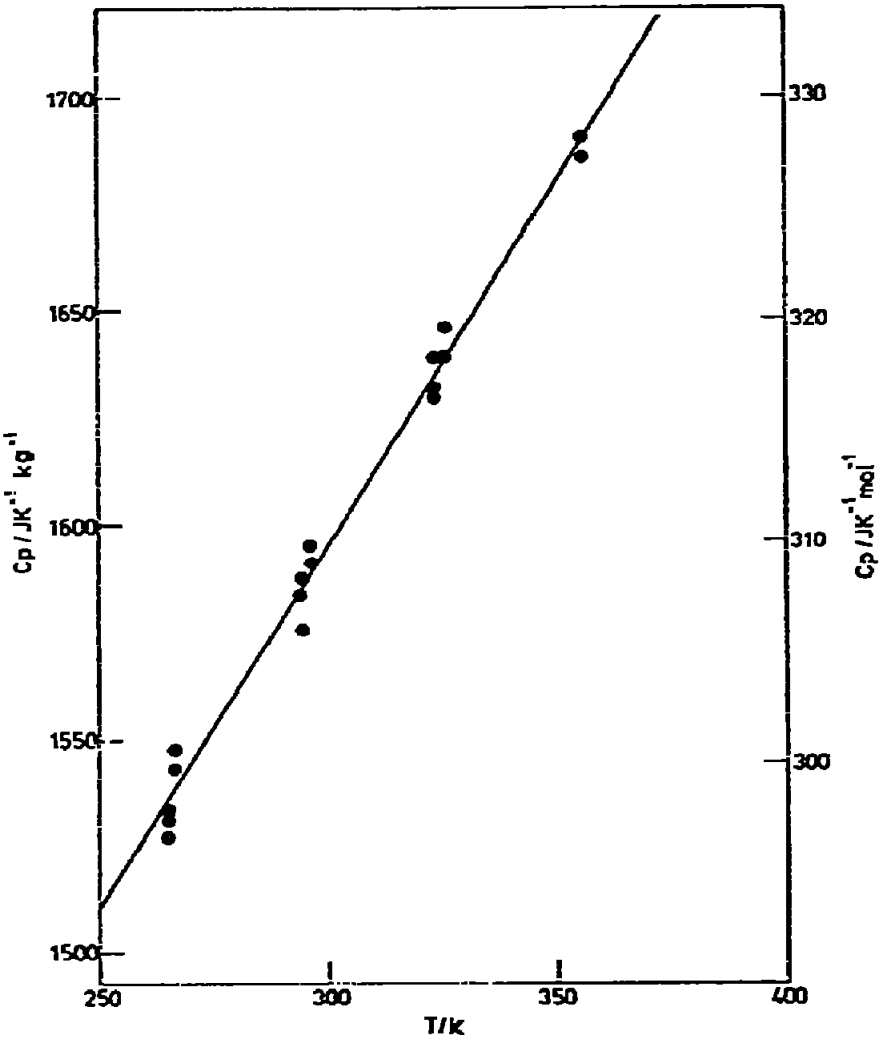

Fig. 1. The temperature dependence of the heat capacity of dimethyl phthalate. ●, experimental points; ——, computed curve.

perature range, the heat capacity was found to be linear within the limits of experimental uncertainty; these are given for 1 kg and 1 mole, respectively, in eqns (1) and (2).

$$C_p(\text{J K}^{-1}\ \text{kg}^{-1}) = 1089 + 1.689\ (T/\text{K}) \quad (1)$$

$$C_p(\text{J K}^{-1}\ \text{mol}^{-1}) = 211.5 + 0.328\ (T/\text{K}) \quad (2)$$

The scatter of the experimental points from this curve had a standard deviation of 0.35%.

In the course of measuring the thermal diffusivity of dimethyl phthalate by a transient technique, it was found necessary to calculate the time required for the onset of convection. These calculations[1] require values for the density, viscosity, η, and coefficient of thermal expansion, α; these data were not available in the literature. Thus, the following values were obtained experimentally for a temperature of 298.15

K, $\rho = 1187\ \mathrm{kg\ m^{-3}}$, $\eta = 12.9 \times 10^{-3}\ \mathrm{N\ s\ m^{-2}}$ and α had a value of approximately $68 \times 10^{-5}\ \mathrm{K^{-1}}$.

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