

SPECIFIC HEAT OF TEFLON-40 AND BF-2 GLUE IN
THE 10-300°K TEMPERATURE RANGE

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Results are shown pertaining to measurements of the specific heat (c_p) made on Teflon-40 and BF-2 polymerized glue in the 10-300°K temperature range. At $T \geq 100^\circ\text{K}$ c_p becomes almost a linear function of T .

In various branches of low-temperature engineering one uses polymer materials and, therefore, it is certainly important to examine their thermophysical properties in such applications. In this article the authors present results obtained in measuring the specific heat of Teflon-40 and BF-2 polymerized glue over the 10-300°K temperature range. The measurements were made in a vacuum-type adiabatic calorimeter similar to the one described in [1]. Some improvements made by the authors have been described in [2]. Actually, the calorimeter was a thin-walled cylindrical copper vessel (diameter 30 mm and height 30 mm) with a removable lid. On the outside surface of this cylinder was mounted a heater which could be shielded with a copper foil. The temperature was measured with a standard platinum resistance thermometer inserted into a copper tube which had been placed along the calorimeter axis and soldered to its bottom. Thermal contact was ensured by a tight packing around the thermometer bulb with a thin layer of lubrication grade D-1 grease.

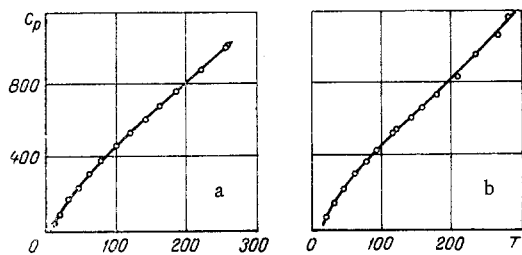


Fig. 1. Specific heat c_p ($\text{J}/\text{kg}\cdot^\circ\text{C}$) as a function of the temperature T ($^\circ\text{K}$): a) Teflon-40; b) BF-2 glue.

The Teflon specimen in the form of fine chips was placed inside the calorimeter, whereupon the latter was covered and sealed. Gaseous helium was used as the heat exchanger medium. Both air was evacuated and helium was injected through a leaden capillary which had been soldered to the lid. Later on this capillary was bent over and unsoldered.

For measuring the specific heat of BF-2 glue, the latter was pasted on a copper foil wound into a spiral and placed snugly inside the calorimeter (with grade D-1 sealing grease). In this case there was no need for the heat exchanger gas and the calorimeter remained open. The

TABLE 1. Specific Heat of Teflon-40

| $T, ^\circ\text{K}$ | $c_p, \text{J}/\text{kg}\cdot^\circ\text{C}$ | $T, ^\circ\text{K}$ | $c_p, \text{J}/\text{kg}\cdot^\circ\text{C}$ |
|---------------------|--|---------------------|--|
| 13,6 | 47 | 119,5 | 524 |
| 20,8 | 94 | 140,8 | 597 |
| 32,3 | 166 | 162,5 | 668 |
| 46,5 | 228 | 186,2 | 752 |
| 61,6 | 303 | 223,2 | 872 |
| 77,9 | 375 | 256,9 | 990 |
| 99,2 | 452 | 254,0 | 998 |

TABLE 2. Specific Heat of BF-2 Glue

| $T, ^\circ\text{K}$ | $c_p, \text{J}/\text{kg}\cdot^\circ\text{C}$ | $T, ^\circ\text{K}$ | $c_p, \text{J}/\text{kg}\cdot^\circ\text{C}$ |
|---------------------|--|---------------------|--|
| 20,3 | 88 | 141,6 | 603 |
| 32,9 | 152 | 158,1 | 661 |
| 46,0 | 225 | 179,2 | 732 |
| 62,4 | 302 | 209,3 | 837 |
| 77,7 | 369 | 236,0 | 958 |
| 92,3 | 430 | 267,3 | 1063 |
| 115,6 | 525 | 284,5 | 1163 |
| 120,9 | 544 | | |

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glue was pasted on the copper foil in several dabs of thin layer, after which it was polymerized by heating for 1.5 h at 120°C. The total mass of glue was 3.24 g and the mass of copper was 14.45 g. The heat capacity of copper (and also of the calorimeter) was accounted for by auxiliary measurements.

The accuracy in measuring the specific heat of Teflon was 3% below 30°K and 1% within the 30-300°K range. The error in measuring the specific heat of BF-2 glue was 5-6% below 30°K and approximately 3% at higher temperatures.

The values of the specific heat (c_p) at various temperatures are given in Tables 1 and 2. The general trend of the temperature characteristic is shown in Fig. 1. Over a wide range above 100°K the specific heat of Teflon-40 is a linear function of the temperature. The specific heat of BF-2 glue is also almost a linear function of the temperature within this range. Such a characteristic of the specific heat is typical of polymer materials (see, for example, [3]), and is explained as a consequence of the "chain" structure of these systems [4, 5]. At a sufficiently low temperature (not considered in this test), however, the relation between specific heat and temperature should become normal, i. e., $c_p \sim T^3$ [5], which in the case of BF-2 glue has been confirmed by the measurements below 4.2°K in [6].

NOTATION

T is the temperature, °K;
 c_p is the specific heat at constant pressure, J/kg·°C.

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