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EXPERIMENTAL STUDIES OF THE HEAT CAPACITY OF LIQUID OCTENE-1 IN THE TEMPERATURE RANGE 282–368 K

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Results are presented on the heat capacity c_p of octene-1 in the temperature range 282–368 K. The present experimental data are compared with results in the literature.

Hydrocarbons of the olefin series are widely used in various chemical technological processes. In particular, they are used extensively in industrial petrochemical and organic synthesis [1-3]. Because of this, the study of their thermal properties in a wide range of state parameters (including the isobaric heat capacity c_p) is not only of practical importance for caloric calculations of the various processes and apparatuses, but also of some scientific interest for the development of the theory of the liquid state.

Some reports are known ([4] and [5]) in which the molar and volumetric isobaric heat capacities of liquid octene-1 were measured. In [4], using the adiabatic calorimeter method, the heat capacity is determined for a liquid in thermodynamic equilibrium with its saturated vapor at temperatures from 175.43 to 308.54 K. The authors estimated the error of the method to be within ±0.2%. In [5], the method of monotonic heating in a relative variant was used to obtain volumetric isobaric heat capacities at 303.15–383.15 K and 0.1–25 MPa. The author's estimation of the error does not exceed ±2.2%. Using the literature values for density, the author of [5] evaluated the specific isobaric heat capacity of octene-1 in the studied ranges of temperatures and pressures. Analysis of these data shows that the value of c_p of [5] at 303.15 K and 0.1 MPa is underestimated by 3.3% in relation to the data of [4]. It should be noted that the data of [5] on c_p for decene-1 at 0.1 MPa are also underestimated by 6.3% relative to the results of [4] in the overlapping temperature range 303.15–343.15 K.

These discrepances necessitated experimental determination of c_p for liquid octene-1 at 282–368 K. We measured the heat capacity of the liquid in thermodynamic equilibrium with its saturated vapor. The purity of the test specimen was at least 99.9% relative to the mass of the main component. Measurements of c_p were carried out on an experimental setup manufactured and certified by the Khabarovsk Branch of the All-Union Research Institute for Physicotechnical and Radiotechnical Measurements, by stepped heating in an adiabatic calorimeter (the temperature step was about 4–7 K). The experimental setup, experimental procedures, and processing of results are described in detail in [6-8]. Results for c_p are given in Table 1. From the experimental data it was found that the mean-square error of measuring c_p did not exceed ±0.3% with a confidence coefficient of 0.95. The discrepancy between our values of c_p and the data of [4] at 282.15–308.53 K does not exceed ±0.2%; this difference is within the experimental error.

Our results and the values of c_p at 196.58-308.53 K from [4] were processed by the least-squares method. As a result we obtained an approximating equation of the form

$$c_p = \sum_{i=0}^{4} a_i T^i ,$$

where c_p is expressed in kJ/(kg·K), T in K; $a_0 = 4.0692$; $a_1 = -3.0654 \cdot 10^{-2}$; $a_2 = 1.4805 \cdot 10^{-4}$; $a_3 = -2.8815 \cdot 10^{-7}$; $a_4 = 2.1487 \cdot 10^{-10}$.

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TABLE 1. Heat Capacity c_p of Liquid Octene-1, kJ/(kg·K)

T, K	c_p	T, K	c_p
282.15	2.100	326.30	2.253
289.04	2.118	332.23	2.277
294.50	2.143	337.50	2.297
299.93	2.157	342.73	2.319
305.32	2.177	347.93	2.338
305.51	2.178	353.24	2.358
310.76	2.197	358.29	2.379
315.97	2.218	363.30	2.399

This equation is applicable to the temperature range 196.58–368.27 K and describes the experimental data (excluding two points) with deviations not exceeding ±0.08%. Larger deviations (up to 0.2%) were observed at 282.15 and 294.40 K. Comparison of the values of c_p of [5] and those calculated from this equation shows that in the temperature range 303.15–363.15 K they are underestimated by 3.3–2.5%.

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