EFFECT OF ADDITIVES ON THE THERMAL CONDUCTIVITY OF CYCLOHEXANE

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UDC 536.223

The thermal conductivity of pure cyclohexane with an addition of benzene has been measured over the 77-300°K temperature range.

The thermal conductivity of two cyclohexane specimens, as a function of the temperature, has been determined earlier in [1]. The purer specimen revealed an anomalous increase in thermal conductivity within the 150-186°K temperature range, where, according to published data, molecules reorient themselves in anticipation of a phase transformation [2]. This peculiarity of the thermal conductivity characteristic was attributed to the excitation of molecular spin in combination with the resulting extra heat transfer.

The authors have subsequently studied the effect of 0.67 and 1.17 mole % benzene addition on the thermal conductivity of chromatographically pure cyclohexane. Results of these measurements are shown in Fig. 1. According to [3], the cyclohexane–benzene system has an eutectic point at 230.5°K and 22 mole % benzene, but no data are available for benzene concentrations below 10 mole %. Benzene molecules, which are much smaller than cyclohexane molecules, must evidently easily fill the voids in the cyclohexane lattice.

According to the diagram, an addition of benzene to pure cyclohexane causes appreciable changes in the temperature-dependence of thermal conductivity. While in plastic cyclohexane (186-279.5°K) the benzene molecules act as additional dissipation centers, inasmuch as the decrease in thermal conductivity depends on the concentration of benzene molecules, the situation becomes more complicated in the low-temperature modifications and does not reduce to a pure defect-type dissipation. The addition of benzene

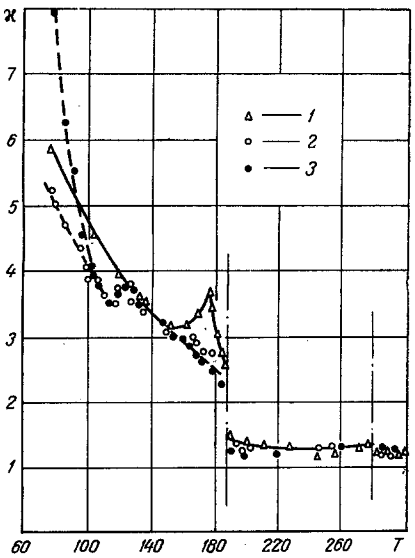

Fig. 1. Thermal conductivity $\varkappa$(W/cm · deg C · 10^{-3}) of various cyclohexane specimens, as a function of the temperature T (°K): 1) pure cyclohexane; 2) pure cyclohexane with 0.67 mole % benzene; 3) pure cyclohexane with 1.17 mole % benzene.

Scientific-Research Institute of Agrophysics, Leningrad. Translated from Inzhenerno-Fizicheskii Zhurnal, Vol. 23, No. 1, pp. 139-140, July, 1972. Original article submitted November 21, 1971.

results, first of all, in the vanishing of the "slew anomaly" so characteristic of pure cyclohexane at 150-186°K. As the temperature drops further, a sharp dip in thermal conductivity is noted where, according to [4], the rotation of benzene molecules is inhibited. At a low concentration of benzene molecules (0.67 mole %) the thermal conductivity of such impure cyclohexane remains below the value characteristic of the cyclohexane lattice while the temperature drops, but at a higher concentration of benzene molecules (1.17 mole %) the thermal conductivity increases fast up to $8 \cdot 10^{-3}$ W/cm · deg C at 77°K (the thermal conductivity of pure cyclohexane at the same temperature is $5.8 \cdot 10^{-3}$ W/cm · deg C). This anomalous temperature characteristic of thermal conductivity has, apparently, to do with a change in the vibration spectrum of the cyclohexane lattice due to the presence of this additive.

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