Speed of Sound and the Thermodynamic Properties for Pentadecane and Hexadecane in Liquid State

T.S. Khasanshin and A.P. Shchamialiou
Institute of Technology
Mogilyov, Belarus

Speed of sound measurements have been performed in liquid pentadecane and hexadecane in an interval of temperatures 303-433 K and pressures up to 50 MPa. Measurements were carried out by a pulse-echo overlap method. The experimental data for pentadecane at high pressure are obtained for the first time. The error of the experimental data does not exceed 0.1 %. The experimental data of the sound velocity in alkanes were compared to the most precise published data for pentadecane at atmospheric pressure and hexadecane at high pressure. The deviation does not exceed 0.1 %, which agrees with the limits of experimental accuracy. By using published data for the low molecular mass alkanes, correlations of the sound velocity and the number of carbon atoms in a molecule of alkane vs. temperature and pressure are surveyed. It is determined, that in a homologous series of normal alkanes, the experimental data may be expressed as a function of the number of carbon atoms. The mathematical description is obtained for the dependence of the ultrasonic property on the number of carbon atoms.

A procedure to calculate density and heat capacity C_p from sound velocity data as a function of temperature and pressure is offered. The procedure is grounded on a known thermodynamic relation linking ultrasonic and thermodynamic values. For the specified range of temperatures and pressures, the procedure can be used to calculate values of density, heat capacity C_p and C_v, compressibility, coefficient of thermal expansion, enthalpy and entropy. The calculated values of n-hexadecane density with an uncertainty of 0.1 % agree with most precise direct measurements of density.