GENERALIZATION AND EXTRAPOLATION OF EXPERIMENTAL DATA ON THE THERMAL CONDUCTIVITY OF RAREFIED GASES

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UDC 535.23

Calculations of the thermal conductivity of rarefied gases using the formulas of rigorous kinetic theory are only sufficiently reliable for monatomic gases. To calculate the thermal conductivity of materials which have only been slightly studied over a wide temperature range, methods based on the use of the law of corresponding states are often employed.

It should be noted that the generalization of the data on the thermal conductivity is a much more difficult problem than the generalization of other thermal properties (the coefficient of viscosity, the virial coefficients, etc.). This is due to the fact that the disagreement between the values of the reduced thermal conductivity of different gases for the same values of the reduced temperature is due not only to the deviation of the form of the intermolecular force field from a spherically symmetrical one, but also to the considerable effect of the internal degrees of freedom of the molecules.

In this paper the approach used to generalize and extrapolate the data on the thermal conductivity of different materials is based on the representation of any gas in the form of a hypothetical monatomic gas with spherically symmetrical intermolecular interaction. This is done using the characteristic values of the volume and temperature which are used as reduction parameters. These parameters are determined from data on the thermal conductivity of the material, and a well-known monatomic material used as a standard.

The reduction of the material to a pseudospherical model enables one, using a small amount of initial data, to calculate the thermal conductivity of any rarefied gas over a range of reduced temperatures determined by the range over which the thermal conductivity of the standard material is known. The error of the method is +3%, and does not exceed 8% in the worst case.

Values of the thermal conductivity of F_2, Cl_2, Br_2, HCl, and HBr are obtained over the temperature range 100-3000°K ignoring thermal dissociation.

Technological Institute of the Food and Refrigeration Industry, Odessa. Translated from Inzhenerno-Fizicheskii Zhurnal, Vol. 20, No. 5, p. 931, May, 1971. Originl article submitted March 31, 1970.