NOTATION

\( \zeta \), hydrodynamic drag coefficient; \( p, v, T, \rho \), pressure, specific volume, temperature, and density; \( R \), universal gas constant; \( \mu \), molecular mass; \( c_{pef} \), effective isobaric mass specific heat; \( k_T \), adiabatic temperature index of dissociating gas; \( p_0, T_0, \rho_0 \), stagnation parameters; \( \alpha \), degree of dissociation; \( k \), adiabatic index of nondissociating ideal gas; \( w \), velocity of dissociating nitrogen tetroxide; \( G \), flow rate per second; \( F \), cross section; \( a_{cr} \), critical velocity of dissociating nitrogen tetroxide; \( \lambda \), velocity coefficient.

LITERATURE CITED


DYNAMIC VISCOSITY OF GASES OVER A WIDE RANGE OF TEMPERATURES. I.

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The results are presented of a generalization of the experimental data on the viscosities of He, Ne, Ar, Kr, Xe, and \( \text{N}_2 \) at atmospheric pressure over the range of temperatures from the boiling point at atmospheric pressure to 2000 K using polynomial approximating relationships.

The recommended value of the viscosities of the inert gases and nitrogen which exist at present [1-4] differ fundamentally in the methods of generalizing the experimental data, in the type and quantity of the block of data used in the generalization, in the form of representing the results, and in the magnitude of the errors inherent in them.

The results of the direct generalization of the experimental data on the viscosities of the gases [1] are characterized by errors not exceeding 1.5%, but they are based on an incomplete collection of data obtained only up to 1972.

The standard handbook data [2] are based on a reliable theoretical model, but the generalization of the experimental results was carried out only for argon, and for the other gases the data were obtained by using the principle of corresponding states. As shown in [5], this method can lead to inaccuracies for neon at temperatures above room temperature and for helium in the low temperature region. In fact, the deviation of the data of [2] from the experimental viscosity values is largest for Ne at \( T > 300 \text{ K} \) compared to the other gases (Ar, Kr, Xe); as regards helium, the measured results for this gas were generalized graphically over the entire temperature range. The data of [2] on the viscosities and thermal conductivities had similar errors, though the errors of the initial experimental material were different.

The recalculation of thermal conductivity data into values of the viscosity carried out in [3] has the same deficiency: the error of the values which are obtained is caused by the


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Fig. 1. Deviations between the recommended data and the theoretical values of the gas viscosities from the results of the generalization of the data of the following references: 1) [2, 4]; 2) [1]; 3) [11]; 4) [3]; 4-6) calculations using the (12-6), (12-7), and (m-6 - 8) potential functions respectively; 7) statistical corridor for the error of the generalized values with a confidence coefficient of 99%. \[ \delta = \frac{\eta - \eta_{gen}}{\eta_{gen}}, \% \]

\[ T \text{ is in } \text{K}. \]

error of the thermal conductivity data, even though most of the viscosity measurements which are carried out at present have an accuracy an order of magnitude higher on average. The viscosity values in [3] at \( T = 2500-6000 \text{ K} \) are the only high-temperature data so far, and in view of high errors are in need of confirmation and subsequent refining.

It follows from the discussion above that the existing recommended and handbook data [1-3] on the viscosities of the inert gases have definite inherent deficiencies, mainly in connection with the evaluation of the errors. The objective of the present paper is the determination of smoothed data on the viscosities of the inert gases and nitrogen on the basis of reliable experimental values (indicated in [6]) obtained recently, taking into account the authority of the experimental data, and to carry out a subsequent evaluation of the error of the results of the generalizations.

Polynomial regression was used for determining the temperature dependence of the coefficient of dynamic viscosity. The regression equation was set up in the form a polynomial of a single variable

\[ y_i = a_0 + a_1 x_i + a_2 x_i^2 + \ldots + a_p x_i^p \]

(1)