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TRACE COEFFICIENTS OF COMPONENTS OF SOME NATURAL GASEOUS MIXTURES DIFFUSING INTO THE AIR

Abstract. Multicomponent mass transfer process is described by an effective diffusion coefficient (EDC). Effective diffusion coefficients D_i^{eff} are introduced similar to the binary diffusion coefficient. D_i^{eff} is the diffusion coefficient characterizing the diffusion rate of component *i* in the mixture of other gases. It is shown that the effective diffusion coefficient is a complex value. It changes when transferring from a certain point of system to another one. This is due to the fact that the flow $\boldsymbol{j}_i$ of each component depends on the concentration distribution of all components. The sign of the EDC will depend on the component distribution within the system. The dependence of the EDC on the concentration of components is considered weak. Therefore, a known solution of the corresponding diffusion problem for binary systems is used. We consider the special case diffusion of small impurities, i.e. the trace diffusion wherein $D_i^{eff} = D_{i1}$. The obtained expressions for the EDC will not depend on the initial concentration distribution of components. This method is used to study the effective diffusion coefficients of trace components in a number of natural gas mixtures diffusing into the air. These gases are following CH_4, C_2H_6, C_3H_8, n-C_4H_{10}, n-C_5H_{12}, CO_2, N_2.

The experiments were carried out at T = 298.0 K and P = 0.101 MPa. The calculated effective diffusion coefficients were compared with those obtained on basis of the solution of a system of Stefan-Maxwell equations and the experimental data. In the numerical experiment, the EDC of components are determined on basis of the Stefan-Maxwell equations and the approximate methods. Application of the EDC method gives the best quantitative agreement with the experimental data for the examined systems. The comparison results indicate that the calculation procedure of the EDC proposed by authors greatly simplifies the analysis of multicomponent mass transfer.

Key words: diffusion process; multicomponent mass transfer; gas mixture.

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СЛЕДОВЫЕ КОЭФФИЦИЕНТЫ КОМПОНЕНТОВ НЕКОТОРЫХ ПРИРОДНЫХ ГАЗОВЫХ СМЕСЕЙ, ДИФФУНДИРУЮЩИХ В ВОЗДУХ

Аннотация. Процесс многокомпонентного массопереноса описывается эффективным коэффициентом диффузии (ЭКД). Эффективные коэффициенты диффузии $D_i^{эф}$ вводятся аналогично коэффициенту бинарной диффузии. $D_i^{эф}$ – коэффициент диффузии, характеризующий скорость диффузии компонента *i* в смесь остальных газов. Показано, что эффективный коэффициент диффузии представляет сложную