A cylindrical specimen with a circumferential crack emerging at the surface of a stress concentrator \((R_c/R = 0.9)\) was submitted to four-point bending (Fig. 1), and fracture load \(F^*\) was recorded. After fracture necking, radius \(a\) was measured and the value of \(K_{IC}\) for \(F = F^*\) was calculated by Eq. (6).

The fracture toughness of steels 40Kh, 45KhN2MFA, and U8 was determined by this method. Material condition and specimen dimensions are given in Table 1. Radius of curvature at the base of the notch \(\rho\) in all cases equalled 0.1 mm; \(2L_1 = 45\) mm.

Values of \(K_{IC}\) calculated in this way agree well with data obtained by a different method (see Table 1), and experimental points are well placed on the curve (Fig. 2) plotted by Eq. (6).

**LITERATURE CITED**


**GENERALIZED CONDITIONS FOR MASS TRANSFER AND DIFFUSION PROCESSES IN THREE-COMPONENT ALLOYS**

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It is known that results of chemicothermal treatment of structural materials, particularly deposition of diffusion coatings, depend on the nature of the structure in the diffusion zone, and the nature of interaction and distribution of different elements through its section. The controlling external parameters of the zone are composition and activity of the external medium, saturation temperature and duration, and also contact conditions between treated metal and the external medium. Assuming that deposition of a diffusion coating is limited by the diffusion stage, we consider the phenomenon of two-component diffusion, and in particular the distribution of dissolved components in a round cylinder under boundary conditions formulated below.

**Contact Conditions of a Three-Component Reactive System.** According to [1], the mass balance equation for a three-component reactive system may be presented for independent values in the form

\[ \rho \frac{dc_i}{dt} = - \text{div} \, I_i + \gamma_{i,s} J_s \quad (i, s = 1, 2). \]  

In this equation there are terms of the sum (we adopted \( a_i b_i = \sum_{j=1}^{2} a_i b_j \)) corresponding to the mass change during chemical transformation (the number of independent reactions is 2) of the \( i \)-th component in a unit volume in unit time. Values of \( a_i b_i \) are determined by stoichiometric coefficients; \( \rho \) is density; \( \tau \) is time. Diffusion current \( I_i \) and chemical reaction rate \( J_{ii} \) are given by the equations [1]

\[
I_i = -L_i \text{grad} \nu_j, \quad J_{ii} = -F_{ij} \nu_i \nu_j \quad (i, j, l = 1, 2),
\]

where \( \mu_j \) is chemical potential of the dissolved \( i \)-th component concentration \( c_j \); \( L_{ij} \) and \( F_{ij} \) are kinetic coefficients. In Eqs. (1) and (2) no account is taken of the effect of variation in temperature and deformation on chemical potential of the dissolved components. Assuming that \( \mu_j = d_{ij} c_j \) [2], Eq. (1), having regard for Eq. (2), is presented as

\[
L_{ij} \Delta \nu_j = \omega_{lj} \frac{\partial \nu_j}{\partial \tau} + F_{ij} \nu_j,
\]

where \( \omega_{lj} \) is the specific physical volume determined from the relationship

\[
\frac{1}{\rho} d_{ii} \omega_{ii} = \delta_{ii};
\]

\( \tilde{F}_{ij} \) is calculated by the equation

\[
\tilde{F}_{ij} = \nu_{ii} F_{ii} \nu_{ii}.
\]

Relationship (3) is also written in concentrations

\[
D_{ij} \Delta c_j = \frac{d c_j}{d \tau} + K_{ij} c_j,
\]

where \( D_{ij} = 1/\rho L_{ij} \) are the respective diffusion coefficients of the \( i \)-th component, \( K_{ij} = 1/\rho \tilde{F}_{ij} \tilde{d}_{ij} \).

Mass-transfer conditions at the surface of a body will be established from the thesis in [3] assuming that an intermediate layer is formed in the shape of shell \( 2 \delta \) thick in which diffusion proceeds, described by Eq. (3) with kinetic coefficients \( L_{ij} ^{\delta} \) and \( \tilde{F}_{ij} ^{\delta} \). If the shell is presented on a combined coordinate system \((\alpha, \beta, \gamma)\) then relationship (3) takes the following form:

\[
L_{ij} ^{\delta} \frac{\partial \nu_j ^{\delta}}{\partial \gamma ^{2}} + \rho_{ij} ^{\delta} \nu_j ^{\delta} = 0,
\]