The constants \( \lambda_1 \) and \( \lambda_2 \) are expressed in terms of factors of quadratic form \( \Phi \) and \( F \)
\[
\lambda_1 = \frac{b_1}{a_{11}}, \quad \lambda_2 = \frac{a b_1 - c_1^2}{a_{11} a}.
\]
Here \( \lambda_2/\lambda_1 > 1 \).

**NOTATION**

- \( Q(e) \), external heat flux; \( Q' \), uncompensated heat; \( U \), interval energy; \( S \), entropy; \( T \), temperature; \( dA^{(i)} \), elementary work of the internal surface forces; \( \eta_\alpha \), internal degrees of freedom; \( B_\alpha \), thermodynamic parameters conjugate to \( \eta_\alpha \); \( \Phi \), dissipative function; \( \sigma_{ij} \), stress tensor in the liquid; \( v_i \), liquid-particle velocity; \( V_\alpha \), volume of the porous medium; \( V \), liquid volumes; \( S_\alpha \), surface of volume \( V_\alpha \); \( S_e \), "liquid part" of \( S_\alpha \); \( S_i \), liquid contact surface with the porous matrix inside \( V_\alpha \); \( P \), mean (over \( S_e \)) liquid pressure; \( q_i \), filtration velocity; \( s \), Laplace-transform parameters; \( t \), time.

**LITERATURE CITED**


**COMPONENT-TRANSFER EQUATION IN COLUMN WITH LONGITUDINAL SEPARATION**

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By the method of "integration over the transverse coordinate," a transfer equation in a separating column in obtained, taking the longitudinal enrichment mechanism into account.

The most widespread type of equipment for isotope separation in gas or liquid phases is a column in which the transverse enrichment effect is converted into a longitudinal effect as a result of circulational flow of the mixture [1]. The derivation of the transfer equation describing the axial distribution of the mean (over the column cross section) concentration of liberated isotope is based on the equilibrium conditions for the component fluxes and the total flux of mixture. To calculate the separation characteristics of equipment of the usual type (thermodiffusional [2, 3] or mass-diffusional [4] columns), it is sufficient to use the transfer equation taking only the radial separation process into account. This kind of relation is obtained, e.g., in [1] by the approximate method of integration over the transverse coordinate [5]. At the same time, in some equipment (in particular, in a separating system with a traveling magnetic wave [6-8]), in addition to the transverse enrichment effect, intensified by forced countercurrent motion of the mixture, there is also a primary longitudinal separation process. There then arises a situation in which circulation has a double effect on the distribution since, on the one hand, it facilitates the multiplication of the transverse effect over the length of the column and, on the other, it causes agitation and, correspondingly, a reduction in the primary longitudinal effect. Below, on the basis of the method of calculations outlined in [1], a transfer equation in a column when both transverse and longitudinal enrichment mechanisms are present is obtained.

With a view of simplifying the analysis, attention will be confined to separation processes in binary isotopic mixtures. Assuming that the radial component of the hydrodynamic mixture velocity may be neglected, the continuity equation for the heavy component in a cylindrical coordinate system is written in the form

\[
\frac{\partial j_z}{\partial z} + \frac{1}{r} \frac{\partial}{\partial r} (r j_r) = 0,
\]

where

\[
i_z = \rho v_z c - \rho D \frac{\partial c}{\partial z} + \varepsilon_D \rho D (1 - c);
\]

\[
i_r = -\rho D \frac{\partial c}{\partial r} + \varepsilon_D \rho D (1 - c);
\]

\[\varepsilon_r \text{ and } \varepsilon_z \text{ are "local" enrichment factors in the transverse and longitudinal directions. Substituting Eqs. (2) and (3) into Eq. (1), and using the continuity equation for the mixture as a whole, it is found that}
\]

\[
\rho v_z \frac{\partial c}{\partial z} + \frac{\partial}{\partial z} \left[ \varepsilon_D \rho D c (1 - c) - \frac{\partial}{\partial z} \frac{1}{r} \frac{\partial}{\partial r} \left[ \rho D \left[ \frac{\partial c}{\partial r} - \varepsilon_D c (1 - c) \right] \right] \right] = 0.
\]

Taking account of the slight change in concentration \(c\) over the radius of the system in Eq. (4) gives

\[
\frac{\partial c}{\partial r} = \varepsilon_D c (1 - c) + \left[ \frac{1}{\rho D r} \int_0^r \rho v_z dr \right] \frac{\partial c}{\partial z} + \frac{d}{dz} \left[ \frac{\varepsilon_D c (1 - c)}{\rho D r} \int_0^r \rho D dr \right] - \left[ \frac{1}{\rho D r} \int_0^r \rho D dr \right] \frac{dc}{dz^2}.
\]

The material-balance equations for the concentrated isotope and the mixture as a whole for the chamber cross section take the form

\[
2\pi \int_0^R \left[ \rho v_z c - \rho D \frac{\partial c}{\partial r} + \varepsilon_D \rho D c (1 - c) \right] dr = \tau c,
\]

\[
2\pi \int_0^R \rho v_z dr = \tau.
\]

Integrating Eq. (6), and using Eqs. (5) and (7), it is found that

\[
(K_1 + K_3) \frac{dc}{dz} = (K_3 + \varepsilon_z K_2) \tilde{c} (1 - \tilde{c}) - \frac{d}{dz} [K_1 \varepsilon_D \tilde{c} (1 - \tilde{c})] - K_4 \frac{dc}{dz^2} + \tau c - \tau c,
\]

where

\[
K_1 = 2\pi \int_0^R \frac{\Psi}{\rho D r} dr, \quad K_2 = 2\pi \int_0^R \rho D dr, \quad K_3 = 2\pi \int_0^R \varepsilon_D \Psi dr;
\]

\[
K_4 = 2\pi \int_0^R \frac{\Psi}{\rho D r} \left[ \int_0^r \rho D dr \right] dr, \quad \Psi = -\int_0^r \rho v_z dr.
\]

When \(\varepsilon_z = 0\), which is the case in the absence of the longitudinal separation process, Eq. (8) coincides with the usual mass-transfer equation [1]. Some solutions of Eq. (8) will be obtained. For conditions without withdrawal \((\tau = 0)\), when the conditions

\[
\frac{D}{R^2} \gg \frac{v_z}{L}, \quad \varepsilon_z L \ll 1
\]

are satisfied, Eq. (8) takes its simplest form

\[
(K_1 + K_3) \frac{dc}{dz} = (K_3 + \varepsilon_z K_2) \tilde{c} (1 - \tilde{c}).
\]