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Түркі әлемі математиктерінің
VII Дүниежүзілік Конгресі
(TWMS Congress-2023)

БАЯНДАМАЛАРЫНЫҢ ТЕЗИСТЕРІ

ABSTRACTS

of the VII World Congress of Turkic
World Mathematicians
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TWO-DIMENSIONAL PROBLEM OF ANOMALOUS TRANSPORT IN A TWO-ZONE FRACTAL POROUS MEDIUM

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Two-zone media are very common in a macroscopically inhomogeneous media. In such a media, the process of solute transport proceed with the manifestation of internal mass transfer between different zones. This significantly changes the overall pattern of filtration and mass transfer [1] . The transfer equations here, unlike the previous ones, have fractional derivatives. Therefore, the object can be considered as a macroscopically inhomogeneous fractal medium.

In this case, the equation in the two-dimensional case is written as

$$\theta_m \frac{\partial c_m}{\partial t} + \gamma\theta_{im}\frac{\partial^\alpha c_{im}}{\partial t^\alpha} = \theta_m\left(D_{mx}\frac{\partial^\beta c_m}{\partial x^\beta} + D_{my}\frac{\partial^\beta c_m}{\partial y^\beta}\right) - v_{mx}\theta_m\frac{\partial c_m}{\partial x} - v_{my}\theta_m\frac{\partial c_m}{\partial y}, \qquad (1)$$

where θ_m, θ_{im} - porosity; c_m , c_{im},-volumetric concentrations of the substance $\left(\frac{m^3}{m^3}\right)$; D_{mx}, D_{my} are the hydrodynamic dispersion coefficients in the moving zone $\left(\frac{m^{\beta+1}}{c}\right)$; v_{mx}, v_{my}-average solution velocity (m/c), the index m corresponds to the mobile zone, and im-to the immobile zone.

The presence of a stagnant (immobile) zone is taken into account on the basis of the kinetic equation

$$\gamma\theta_{im}\frac{\partial^\alpha c_{im}}{\partial t^\alpha} = \omega\left(c_m - c_{im}\right), \qquad (2)$$

where is the γ mass transfer coefficient $[\gamma] = T^{\alpha-1}, [\omega] = T^{-1}, 0 < \alpha \leq 1, 0 < \beta \leq 2$.

The fields of pressures and filtration rates are also determined. For this, an anomalous filtration equation is used and it is derived on the basis of the anomalous Darcy law

$$\frac{\partial p}{\partial t} = X_x\frac{\partial^{1+\delta_1} p}{\partial x^{1+\delta_1}} + X_y\frac{\partial^{1+\delta_2} p}{\partial y^{1+\delta_2}}, \qquad (3)$$

where χ_x and χ_y are the piezoconductivities in the directions x and y.

For equations (1) - (3), the problem of filtration and solute transport is fixed and solved numerically. The anomalous transfer is characterized by the order of the derivative in the diffusion term of the transfer equation and the mass transfer kinetics equation . Decreasing the order of the derivative β in the diffusion terms of the transport equation in both zones leads to "fast diffusion".

Keywords: Anomalous solute transport, diffusion, fractional derivative, porous media.
AMS Subject Classification: 76-10

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