STUDYING THE DRAWING PROCESSES OF GROUNDWATER LEVELS AND MINERALIZATION ON THE BASIS OF SOLVING RETURN PROBLEMS IN THE MODEL

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Qisqacha bayon. Maqolada parabolik turdagi xususiy hosilali differentsial tenglamalar tizimi asosida yer osti suvi oqimi filtratsiyasi tarkibidagi minerallashuvi, muhitning o'zaro birgalikdagi sizilib oqishi bo'yicha sho'rlanishi o'zgaruvchan yer osti suvlari oqimining massa uzatish, diffuziya jarayonlarini, geofiltratsiya jarayonlari bilan bog'langan matematik modellash usuli, algorimlari va dasturi vositalari yaratilib, modelda Oxangaron yer osti suvi koni misolida teskari masalalar yechish asosida yer osti suvlari sathi va minerallashuvining sizilish ko'rsatkichlarini aniqlash bo'yicha tajriba eksperimentlari o'tkazish tadqiqiotlari olib borilgan.

Аннотация. В статье рассмотрены на основе системы дифференциальных уравнений частных производных параболического типа, путем математического моделирования изучены фильтрации и минерализации подземных вод, связанных с массопереносом, диффузионных процессов, составлены алгоритмы и программных средств. По разработанной методике проведены вычислительные эксперименты, на основе решения обратных задач определены фильтрационные параметры и изучены процессов фильтрации и минерализации подземных вод на примере Ахангаронского месторождений подземных вод.

Annotation. In the paper has discussed on the basis of a system of special derivative differential equations of parabolic type, by mathematical modeling study of the mineralization of groundwater flow filtration associated with the mass transfer, diffusion processes, geofiltration processes the modeling method, algorithms and software tools were developed, experimental experiments were conducted to study the leakage processes of groundwater level and mineralization on the basis of solving the inverse problems in the example of Akhangaron groundwater aquifers.

INTRODUCTION

The classical theory of mass flow processes, diffusion, energy, and energy processes is based on the idea of hydrodynamically stable energy and the continuity of the regional environment.

According to the occurrence of regional hydraulics, the local dynamic equilibrium in each sub-element of the study area is averaged (in general, the hydraulic parameters in the systems depend on the gradient factors). This idea allows us to perform basic equations of dynamics in order to study the processes of use of incompressible forces. However, this only applies to internal dimensional processes of the system (average particle leakage time, transition time to the steady state of the system) such as' free leakage path, inter-particle distance) differential equations of parabolic type are formed based on the theoretical local stability of the indicators from a specific point of view [1, 2, 3, 4]. They are calculated using linear relationships between mass transfer currents and potential gradients (Dupuis, Fourier, Fick, Darcy, Guck's laws, etc.) [5, 10, 11] .

Differential equations obtained in this way (mass transfer, shear, thermal conductivity, diffusion, etc.) are difficult to take into account the time and spatial uncertainty of the studied processes. From the analysis of these, it is clear that any disturbance as a result of external influences also causes a rapid response of the system. For example, according to Dupuis's law, the filtration rate of a liquid depends on the pressure gradient $\vec{v} = k\vec{I}$, (where $\vec{v}$ is the fluid velocity,

k is leakage coefficient, $\vec{I}$ is water level gradient) also, the derivation of the parabolic equation of thermal conductivity is based on the Fourier hypothesis, according to which the instantaneous (without delay) temperature gradient inside the body causes energy transfer (heat flux), i.e. $\vec{q} = -\eta\, grad\, \mathrm{T}$ (where $\vec{q}$ is the vector of heat flux density, η is the coefficient of thermal conductivity, T is the value of thermal temperature) [10]. In fact, the transfer of energy from one point of the system to another occurs within a limited time determined by the physical properties and internal structure of the environment. This contradiction leads to identified paradoxes: - negative temperatures in the reverse heat wave, infinite surface stresses during thermal shock, the formation of isotherms inside the body, and so on. Similar problems arise when using class models of mass and torque transfer. In particular, a complete similarity to the problems of mass transfer, vibration, and thermal conductivity is observed in the derivation of equations using Darcy, Hooke, Fick's laws, and in the timeliness of tasks related to the use of Hooke's and Newton's laws in solving differential equations. change is observed [5, 10, 11]. Analysis of the movement activity of groundwater used in the study and solutions of equations taking into account the minerals and concentrations in them, attention to the delay of the system for external disturbances, timely flow in the strata and changes in boundary conditions.

Models confirmed by experimental data, experimental calculations and simulation models show the difference between natural physical processes and events. Based on the analysis of many theoretical and experimental studies, a conclusion was drawn about the possibility of using mass transfer expressions to describe regional equilibrium processes.

MAIN PART

In this study, studies on mass transfer based on the equilibrium equation, i.e. diffusion processes, salt concentrations in groundwater flow filtration, mutual leakage of the medium, etc., showed that it is the local areas that play a key role in the mechanism of action. 'shows the mystery.

The growing interest in studying the processes that take place in the conditions of regional hydrogeological fields is due to the wide range of their practical application: groundwater and multi-component mineral waters and reservoirs, optimization of monitoring regimes, etc.

In modeling regional geofiltration and geomigration processes, it becomes necessary to take into account the internal structure of the objects under study, which leads to the complication of mass transfer models. Numerous theoretical and experimental studies have developed mathematical models of water leakage processes, using different physical approaches to describe the process of mass transfer within water flows when differential equations are derived.

Large-scale tasks such as geofiltration of groundwater and modeling of salt migration are naturally divided into two stages: in particular, modeling of groundwater flow - geofiltration processes and modeling of qualitative structural flows and mass transfer of groundwater, i.e. groundwater transfer of substances mixed with the flow.

The mathematical model of geofiltration processes is described by a system of differential equations with special derivatives of parabolic type, expressed in terms of initial and boundary conditions in the field of non-stationary plane in solving a problem on the basis of numerical solution [1, 2, 3, 10, 11]:

$$\mu\frac{\partial h}{\partial t}=\frac{\partial}{\partial x}\left(kh\frac{\partial h}{\partial x}\right)+\frac{\partial}{\partial y}\left(kh\frac{\partial h}{\partial y}\right)+f-\delta Q_c, \tag{1}$$

$$h(x, y, t_0)=\varphi_1(x, y, t_0);\ (x, y)\in G. \tag{2}$$

$$h(x, y, t)=\varphi_2(x, y, t);\ (x, y)\in \Gamma;\ t>t_0; \tag{3}$$

$$kh\frac{\partial h}{\partial n}=\varphi_3(x,y,t); \qquad x, y\in \Gamma;\ t>t_0. \tag{4}$$

$$-kh\frac{\partial h}{\partial n}=\gamma(h_в-h),\ \ x\in \Gamma;\ t>t_0. \tag{5}$$

The numerical method is used to solve Equation (1) with boundary conditions (2) - (5), the transition from differential to finite separation can be done after the filtering area is a grid area consisting of a network of elementary blocks / nodes. Each block of this water balance equation, i.e. the stepwise origin of the filtration area Δx and Δy, is replaced by the same grid.

To study the process of groundwater movement and migration of pollutants, taking into account the qualitative mineral or salinity of aquifers, the process of molecular diffusion and dispersion, as well as their relationship to surface water, the following system of equations based on [3, 10, 11].

$$\begin{cases} \mu\frac{\partial H}{\partial t}=\frac{\partial}{\partial x}\left(km\frac{\partial H}{\partial x}\right)+\frac{\partial}{\partial y}\left(km\frac{\partial H}{\partial y}\right)+W_n-W_o \\ \mu\frac{\partial (mC)}{\partial t}=\frac{\partial}{\partial x}\left(Dm\frac{\partial C}{\partial x}-mv_xC\right)+\frac{\partial}{\partial y}\left(Dm\frac{\partial C}{\partial y}-mv_yC\right)+W_nC_n-W_oC_o \end{cases} \quad (6)$$

$$\begin{cases} \mathrm{H}\,(\mathrm{x},\mathrm{y},\mathrm{t}_0)=\varphi(x,y); \quad \mathrm{t}\geq t_0 \\ \mathrm{C}\,(\mathrm{x},\mathrm{y},\mathrm{t}_0)=\psi\,(x,y); \quad \mathrm{t}\geq t_0 \end{cases} \quad (7)$$

$$\begin{cases} \mathrm{H}\,(\mathrm{x},\mathrm{y},\mathrm{t})=F_1(x,y,t); \;\; \mathrm{x},\mathrm{y}\,\epsilon\,\Gamma_1; \;\; \mathrm{t}>t_0 \\ \mathrm{C}\,(\mathrm{x},\mathrm{y},\mathrm{t})=F_2(x,y,t); \;\; \mathrm{x},\mathrm{y}\,\epsilon\,\Gamma_2; \;\; \mathrm{t}>t_0 \end{cases} \quad (8)$$

$$\begin{cases} -km\frac{\partial H}{\partial n}=F_3(x,y,t); \quad \mathrm{x},\mathrm{y}\epsilon\,\Gamma_3; \quad \mathrm{t}>t_0; \\ -D_nm\frac{\partial C}{\partial n}+mv_nC=mv_nC; \quad \mathrm{x},\mathrm{y}\epsilon\,\Gamma_4; \quad \mathrm{t}>t_0; \end{cases} \quad (9)$$

$$\begin{cases} -\mathrm{km}\frac{\partial H}{\partial n}=km\frac{H_{B-}H}{\phi}; \quad \mathrm{x},\mathrm{y}\epsilon\,\Gamma_5; \; t>t_0; \\ -D_nm\frac{\partial C}{\partial n}+mv_nC=mv_nC; \quad \mathrm{x},\mathrm{y}\epsilon\,\Gamma_6; \quad \mathrm{t}>t_0; \end{cases} \quad (10)$$

This system of equations representing the processes of geofiltration (1) - (5) and migration (6) - (10) and the hydraulically interconnected surface flow was solved on the basis of an algorithm of numerical methods called finite differences, a series of practical problems and software tool was created [2, 5].

The authors have developed software tools based on the principle of modular programming, which is an object-oriented software tool designed to solve a class of programming module systems, programming languages, specific practical problems in the example of the Akhangaron groundwater deposit [2] .

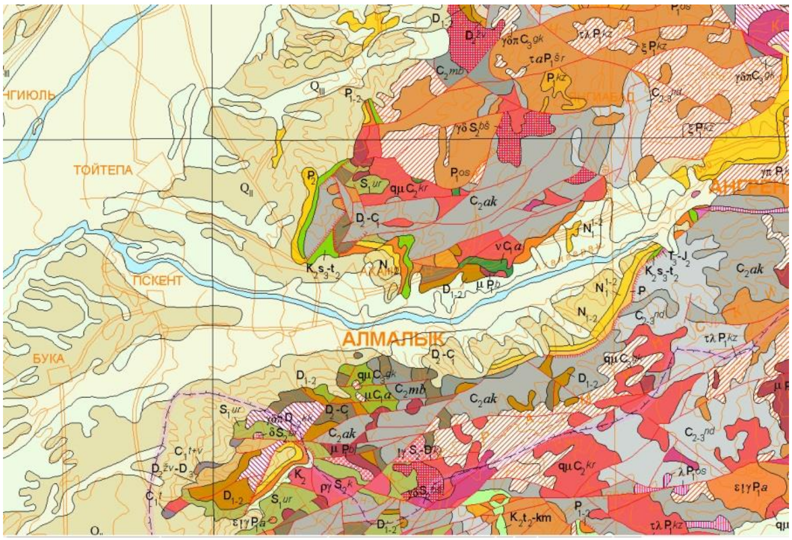
The program modules perform input-output of initial data, call part programs such as filtering and permeability coefficients between nodes, output salinity or mixing results according to the defined coordinates of the nodes, as well as output water level results at all nodes. Let us consider the example of a hydrodynamic model of fresh groundwater area(Okhangaron groundwater field) to confirm the specificity of the software package, its capabilities and features, as well as the developed method, created by the method of one- and two-dimensional finite separations based on the above digital schemes and algorithms.

Initially, the modeling area was classified for modeling, which is the separation of the same types of areas according to hydrodynamic properties and design schemes. They are distinguished by the generality of the flow structure, the conditions of the reservoirs and the hydraulic condition of the aquifer, the generality of the structure of the water intake structure and the boundary conditions that affect them.

In this case, the main classification is to identify the main factors; -determine the structure of water deposits and the calculated values of leakage indicators; -

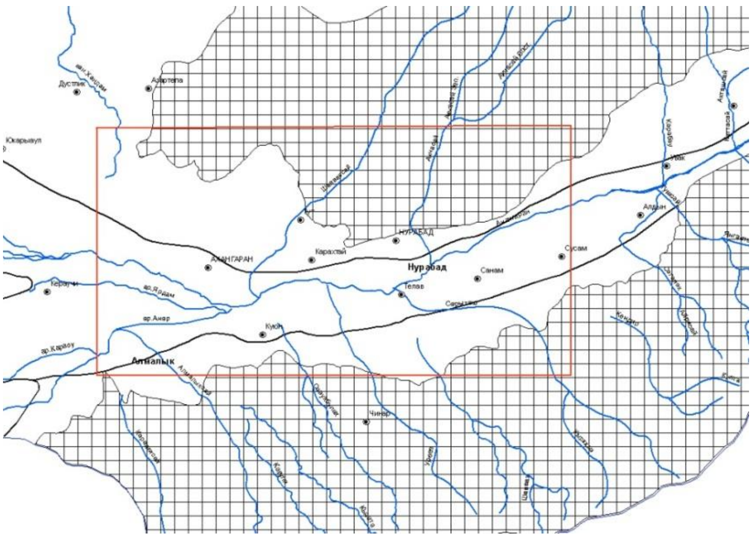
simplification of filtration and replacement with detailed plan or flat-vertical; - Laws of simplification and modification of boundary forms, flow rates and costs. The physical, hydrogeological and theoretical bases of the studied processes are taken into account in the scheme. First, the type of water filtration, flow rate and size of the studied area are evaluated, then the structure of the studied complex, ie quality composition, water-retaining mineral content or salt, internal and external boundaries and boundary conditions are set.

The amount of water in reservoirs depends on their level, mineralization and amount of precipitation. According to the hydrological zoning of the basin of the Akhangaron River basin, located at a depth of 8.0-10.5 m above the ground, it is fully included in the Tashkent pre-artesian pool and is located on the border of the foothills [8].



Picture. 1. Geological data support of the model

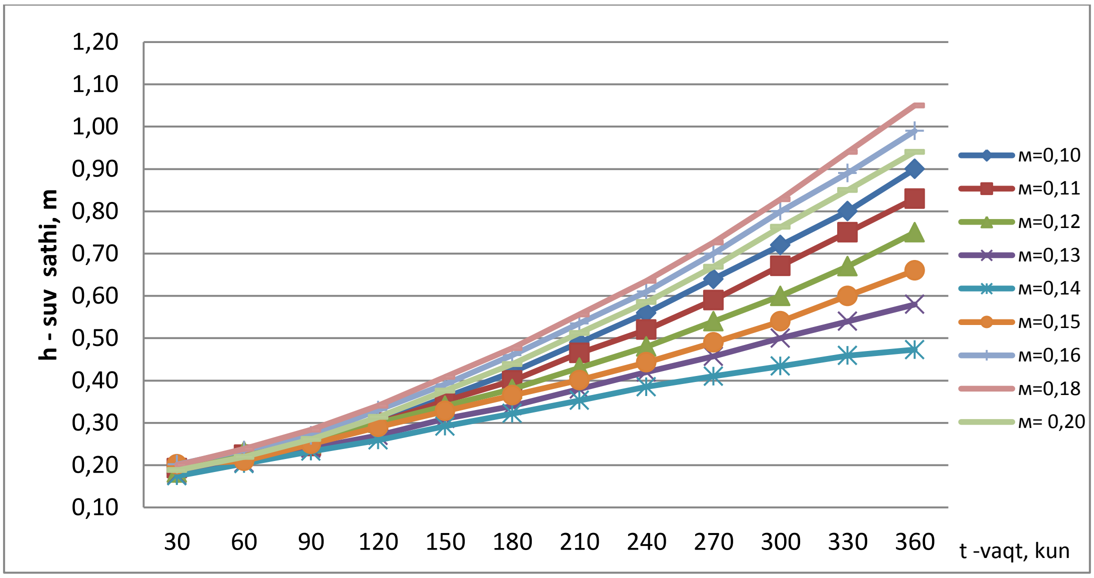
Results of geological, hydrogeological and regime data The results obtained during the hydro-regime studies of the Tashkent pre-hydrogeological station, a model was developed taking into account the conditions of water intake (Picture 2.). Initially in the model



Picture. 2. General view of the model

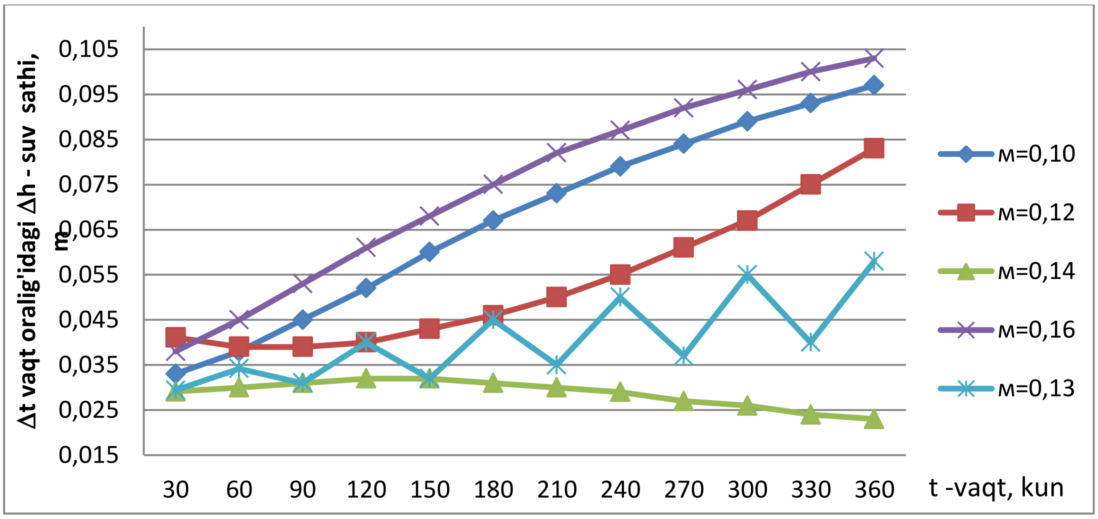
the filtration coefficients of natural conditions were calculated, i.e., the parameters of the aquifer were determined and the quantitative relationship between surface and groundwater was determined [2, 7, 9, 12].

In order to determine some of the principles of flow filtration properties, ie to determine the leakage coefficient and water transfer coefficient and the balance of total input and output factors in the model, the inverse problem was solved, which solved a number of tasks such as , the results were compared with the values of hydrogeological shears and observation results (Picture. 3).



Picture. 3. Graph for determining the coefficient of water supply

After selecting the coefficient of water capacity in the model, according to fieldwork research data, the coefficient of fluid loss varies from 0.10 to 0.20, the model showed a result of 0.14, then based on the factorial range evaluation method leakage coefficient, water balance calculation was performed.



Picture. 4. Graph of changes in water level values during the iteration interval of time

If the maximum difference between full-scale and model results at individual observation points is 1% to 3%, the inverse problem solution is considered complete. Here, the accuracy of the iteration calculation is ε = 0.01.

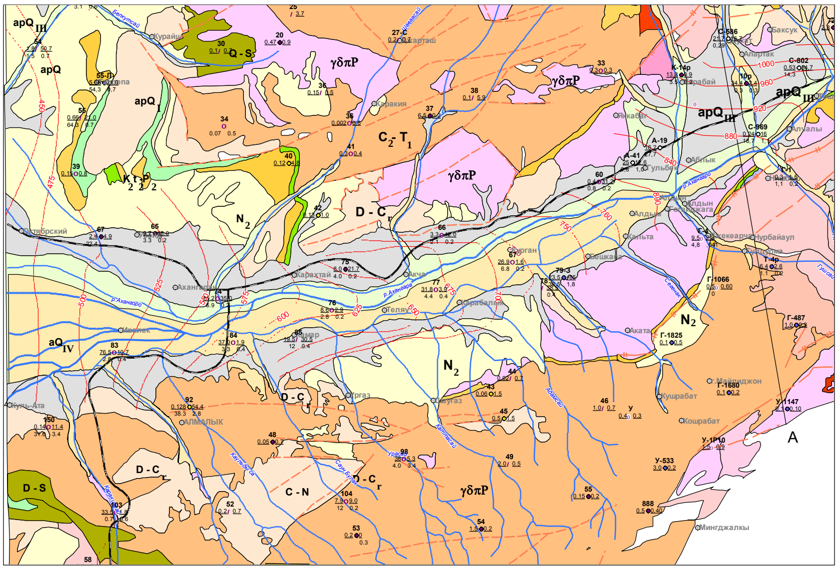


Figure 5. View of the model results in the hydrogeological scheme

IN CONCLUSION

Based on the results of solving the inverse problem in the modeling of geofiltration processes, the following problems were solved:

- a map of the distribution of filtration coefficients is obtained at each node point of the discrete region;

-comparison and comparison of the hydroisogypsum map of the territorial distribution map of the groundwater level model with the hydrogeological map;

-comparison of water level values with model points and proved the reliability of the full-scale filtration scheme, the values of leakage and water supply coefficients were adopted accordingly;

- A complete comparative table of natural measurements and model values of groundwater level on the object of study.

The tasks of modeling and imagining the processes of geofiltration and geomigration of groundwater were carried out on the basis of computer modeling to view, compare and contrast information about the results obtained at the facilities. The mineralization or salt mass of the subsurface hydrosphere, the general background distribution of each element of the object, the generalized shape characteristic, the construction of images of the main geofiltration and mineralization elements, the model was constructed according to the geographical coordinate reference.

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