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THE INFLUENCE OF WELLS LOCATION ON DEPOSIT'S EXCAVATION RATE AT ORE EXTRACTION BY THE METHOD OF UNDERGROUND DISSOLUTION

The problems of increasing mineral's excavation rate, calculation of optimum wells location are arose at minerals extraction by the method of underground dissolution. In this work the influence of wells location on mineral's extraction rate is investigated. According to the existing rules the deposit's extraction is stopped when the average mineral concentration in a productive solution on drain is equal to some critical value. However, the rate of mineral's extraction depends on type of wells location and distance between them at the same average mineral's concentration. The more detailed analysis of the deposit's working out allows optimize its exploitation.

Dissolution of salt by water is considered as a model of ore extraction.The equations for hydrodynamic pressure, dissolution of mineral and transfer of dissolved component are basic equations for the description of solution's filtration in the porous media.

The equation for hydrodynamic pressure is solved by iterative method. The filtration velocity is obtained from Darcy's law. The equations of mineral dissolution and dissolved components transfer are solved by combination of analytical and numerical methods.

Practically two types of wells locations (linear and hexagonal) are used at deposit's extraction by the method of underground dissolution. Simple and common cases are considered for each type of wells location. The site of deposit with width 20 m and length 40 m, consisting from three wells is considered as simple case for linear wells location. An initial salt mass fraction in a layer $\overline{C}_0 = 0.23$, initial mass concentration of salt in solution $C_0 = 0$ kg/m^3, the concentration of saturation $C_e = 320$ kg/m^3, velocity of mineral dissolution $\gamma = 240$ 1/day.

The distribution of pressure (Fig. 1), field of velocity, distributions of salt concentration in a solution and a layer are received for this case.

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Results show, that far from wells the filtration of a solution practically is absent, and so-called stagnant zones that reduce mineral's excavation rate appear.

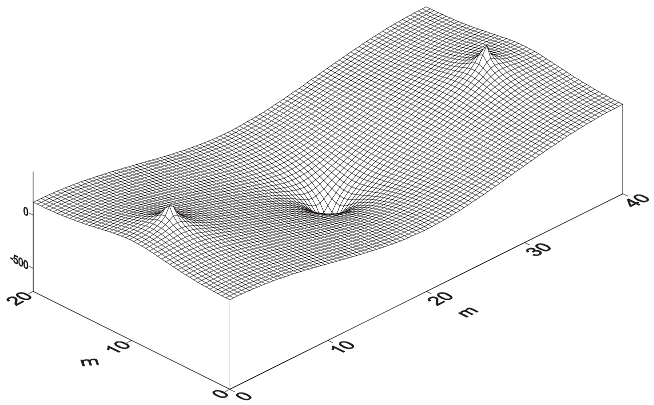

Fig. 1. The pressure distribution for a simple case of the linear type of wells location

The time dependence of mineral's extraction completeness and relative mineral's concentration in a productive solution on drain are investigated on the basis of the received distributions of mineral concentration in solution (Fig. 2).

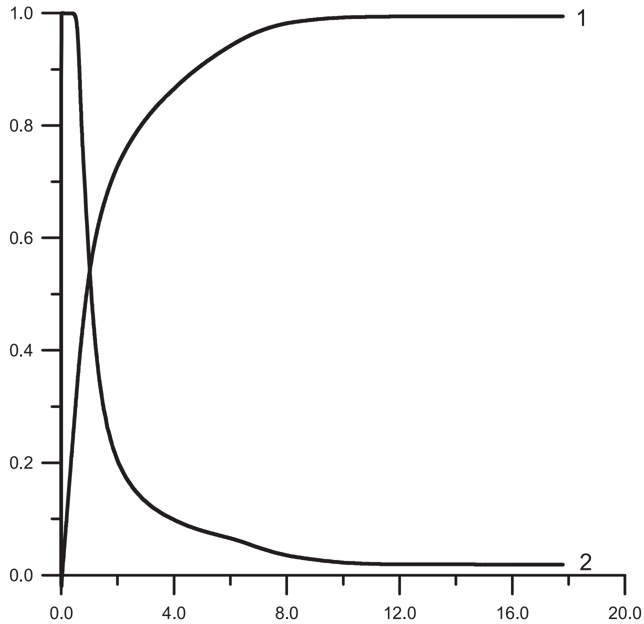

Fig. 2. Time dependence of mineral's excavation rate and mineral's concentration on drain. Lines: 1 – mineral's extraction rate, 2 – relative mineral's concentration on drain C_d/C_e

The results of calculations of optimal wells location are given in Table 1. It is seen, that mineral's extraction completeness depends on distance between wells and borders. The reduction of distances between site's borders and wells results in increasing in a deposit's excavation rate and practically have not influence on excavation time at the same minimum output concentration on the. The increasing of minimal output concentration on drain decreases excavation time and almost has not effect to deposit's excavation rate.

Table 1

Calculation of an optimality wells location

Distance from the well to left border [m]	Distance from the well to right border [m]	Relative mineral concentration on drain	Deposit's excavation rate [%]	Required time [day]
4	4	10	98	110
6	6	10	97	125
8	8	10	96	176
4	4	20	93	83
6	6	20	91	92
8	8	20	87	98
4	4	30	91	70
6	6	30	89	77
8	8	30	77	79

In Figure 3 the pressure distribution for the linear type of wells location consisting 5 drains and 13 reaches is shown.

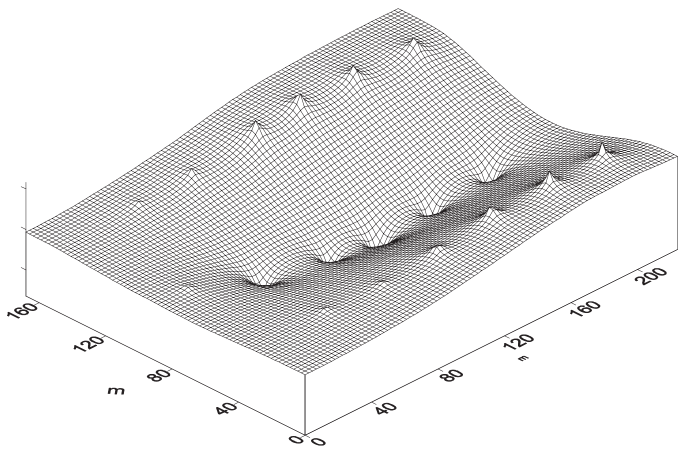

Fig. 3. The pressure distribution for a case of the linear type of wells location (5 drains, 13 reaches)

Field of velocity, distributions of salt concentration in a solution and a layer are received for this case too. Dependence of mineral's excavation rate and mineral's concentration on drain are shown in Figure 4, where line 1 is mineral's extraction rate, 2 – relative mineral's concentration on drains. In this case also there are the stagnant zones lowering a degree of development of a deposit.

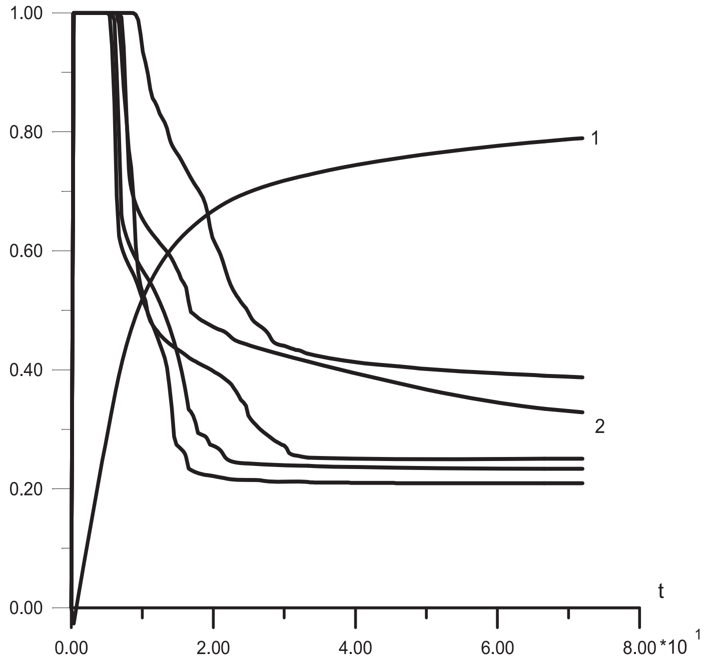

Fig. 4. Time dependence of mineral excavation rate and mineral's concentration on drain. Lines: 1 – mineral's extraction rate, 2 – relative mineral's concentration on drain

Calculations are carried out for one hexagonal cell set consisting six reaches, placed in tops of a correct hexagon and one drain – in the center too. Distribution of pressure is shown in Figure 5. Velocity field, distributions of salt concentration in a solution and a layer are received for this case.

Dependence of mineral's excavation rate and mineral's concentration on drain are shown in Figure 6, where line 1 – mineral's extraction rate, 2 – relative mineral's concentration on drains.

In Figure 7 the plan of wells location, consisting 7 hexagonal cell set is submitted.

The pressure distribution for this case is shown in Figure 8.

Dependences of mineral's excavation rate and relative concentration of mineral on drain are submitted in Figure 9, where line 1 is deposit's excavation rate, 2 – relative concentration of salt on the drains, 3 – relative concentration salt on central drain.

The hydrodynamic model of solution filtration and mineral dissolution in ore layer is created in this work.

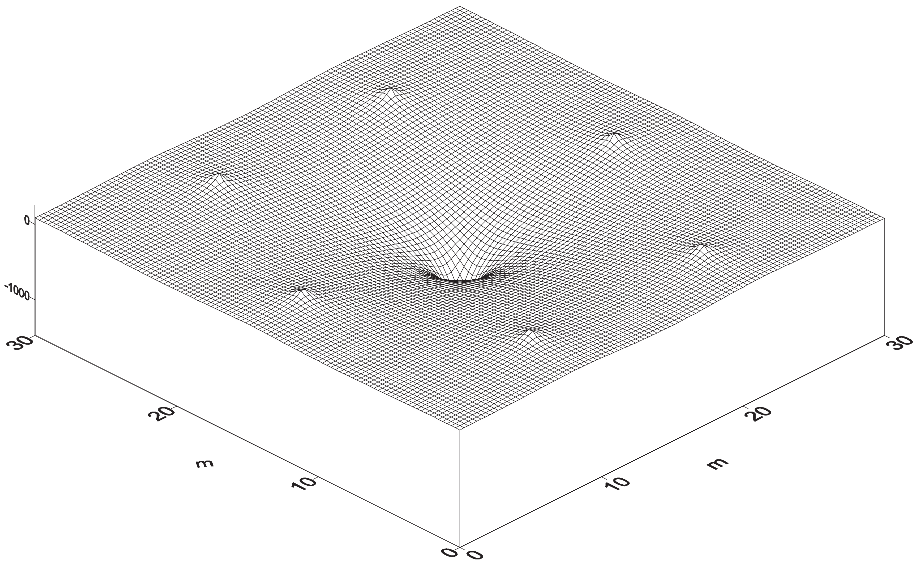

Fig. 5. The pressure distribution for one hexagonal cell

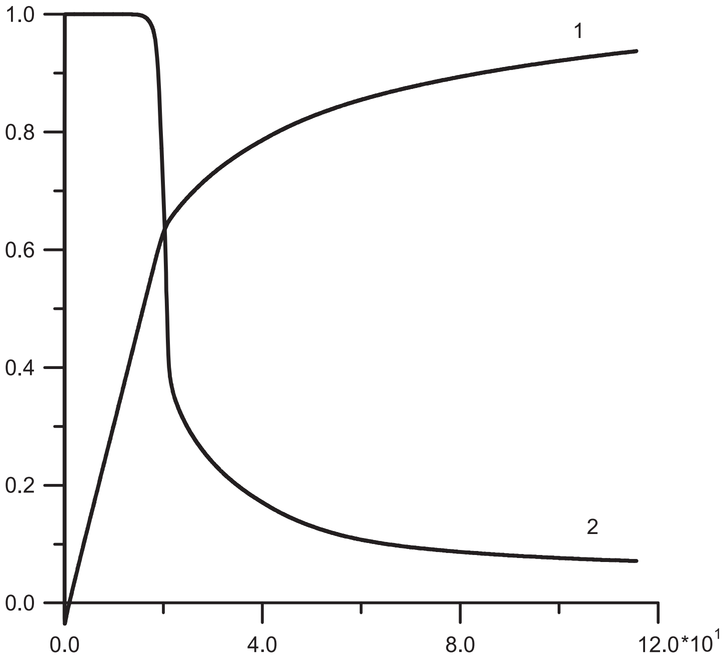

Fig. 6. Time dependence of mineral's excavation rate and mineral's concentration on drain. Lines: 1 – mineral's extraction rate, 2 – relative mineral's concentration on drain C_d/C_e

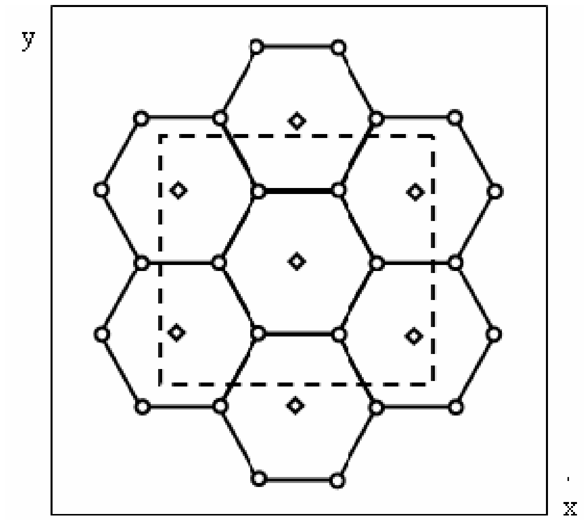

Fig. 7. The plan of wells location: ○ – reaches, ◇ – drains

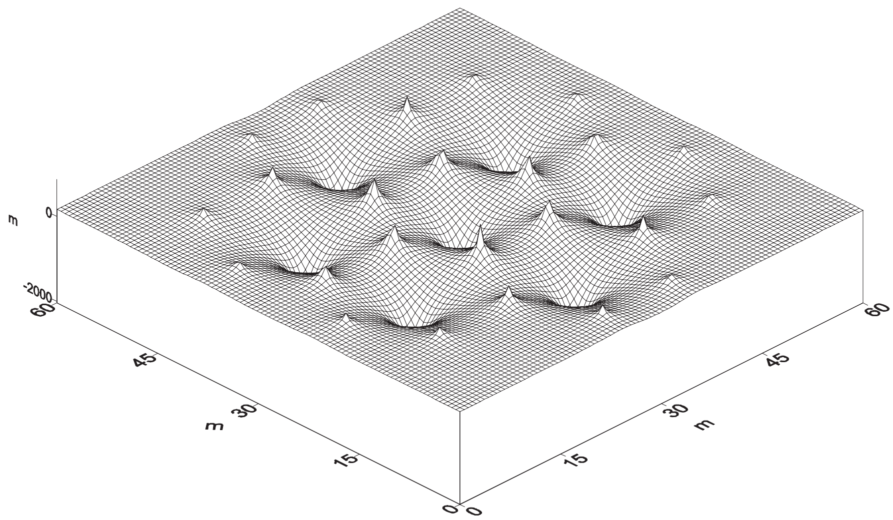

Fig. 8. Distribution of pressure for hexagonal wells location

Two types of wells location, which used in practice, are considered: linear and hexagonal wells locations. As a simple case for a linear wells location, the site of deposit with three wells is considered, for hexagonal wells location – one hexagonal cell. The site of concrete deposit with linear wells location is common case for a linear arrangement of wells is the site of a concrete deposit, for hexagonal arrangements – seven cells.

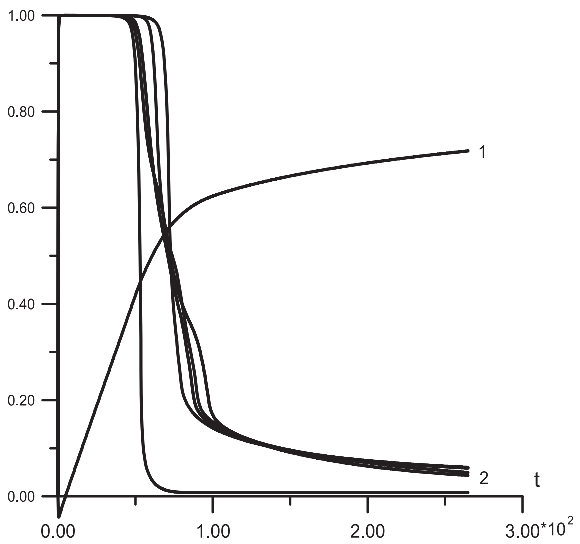

Fig. 9. Time dependence of mineral excavation rate and mineral's concentration on drain. Lines: 1 – mineral extraction rate, 2 – relative mineral's concentration on drain C_d/C_e

The received results show that exact value of minerals dissolution velocity does not influence results of such important problems, as an optimum wells location for achievement of the maximal deposit's excavation rate. On the other hand, results of calculations of optimality wells location show that the rreduction of distance between wells increase deposit's excavation rate and have not influence on excavation time at the same minimum output concentration on the drain. Increasing of minimum output concentration on the drain decreases excavation time and almost has not effect to deposit's excavation rate.

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