TECHNOLOGICAL WELL RESEARCH METHODS AND WAYS TO REDUCE THE NEGATIVE IMPACT OF COMPLICATIONS ON THE EFFICIENCY OF IN-SITU LEACHING TECHNOLOGY

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Abstract
The article presents the results of research of technological wells and gives recommendations to reduce the negative impact of complications on the efficiency of in-situ leaching technology. Development and implementation of effective technology of in-situ leaching of ores in conditions of complications is considered as a system of tasks.

Keywords: mining, ore deposit, underground leaching, injection well, pumping well, pumping well, pressure differential, sanding, downhole pump, flow-pressure characteristic, operating mode control.

Introduction

The control of mining processes and equipment by in-situ leaching (ISL) is a difficult problem due to the inaccessibility of direct operational measurement of key technologically unstable in operation and non-stationarity of key technology parameters [2].

In the process of mineralisation of minerals there is a transition of solid matter into liquid phase by selective influence and controlled movement of chemical agents through the deposit and pumping of the productive solution saturated with the component to the surface. For this purpose, a special chemical agent is injected into the mineral deposit by means of injection wells, which is designed to convert minerals into a fluid form. The special chemical agent flows through the ore deposit to the pumping wells, taking with it the minerals of the mineral, and through it rises to the surface and then with the help of pipelines is transported to the primary treatment plants [1].

PROBLEM DISCUSSION

For the identification question, consider the interaction between the injection and pumping wells, where the pumped solution contains gas-solids. In the injection well, the main variable is the level of leaching solution supplied. In the pumping well, characterised by technological instability is the pressure difference created by the submersible pump [4].

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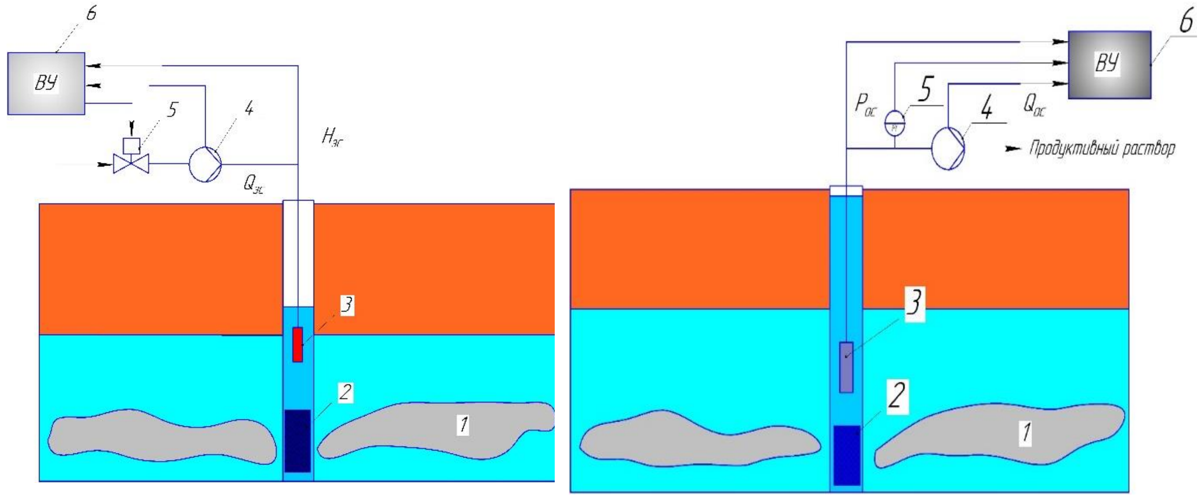
Injection well (Fig. 1. a) is designed for injection into productive formations (1) of leaching solutions through a filter (2), capable of dissolving minerals containing minerals, which are used to create reservoir pressure and regulate the rate of mineral extraction [6]. The main technological variable of the whole process, in order to resolve the issue of quality control of in-situ leaching, is the dynamic level and its continuous control in the wells carried out by means of hydrostatic level gauge (3). An electro-valve (5) for regulation of solution supply and a flowmeter (4) for continuous measurement of leaching solution supply are installed in the wellhead. For controlling the electrovalve and processing the measured parameters a computer or controllers (6) are installed (Fig.1.b).



а) б)

Fig. 1. Functional scheme of measurement and control of parameters in injection (a) and pumping wells (b)

To determine the change in the flow-pressure characteristics of the well pump during sanding, we use the formula, which is an analytical relationship of the change in pump pressure [5]:

$$\Delta P = \rho_{жтс} g H_{н} , \qquad (1)$$

where $\rho_{жтс}$ is the density of the liquid-solid mixture in the well, kg/m^3 ($\rho_{жтс}$ =1450 kg/m);^{3}
g is the acceleration of free fall (g=9.81 m/s);^{2}
$H_н$ - head of the depth pump, m (according to the passport).
As a result of calculations using the obtained model, the parameters and dependence of the flow-pressure characteristic of the well pump on changes in the density of the productive solution were determined (Fig. 2).

MATERIALS AND METHODS

In the developed methods for determining the parameters of the model of technological wells, under different modes of operation of the submersible pump, it is provided to determine the quantitative data on the indicators of sensors and instruments at the wellhead, as well as to clarify the actual parameters of flow-pressure data of the submersible pump [7,8].

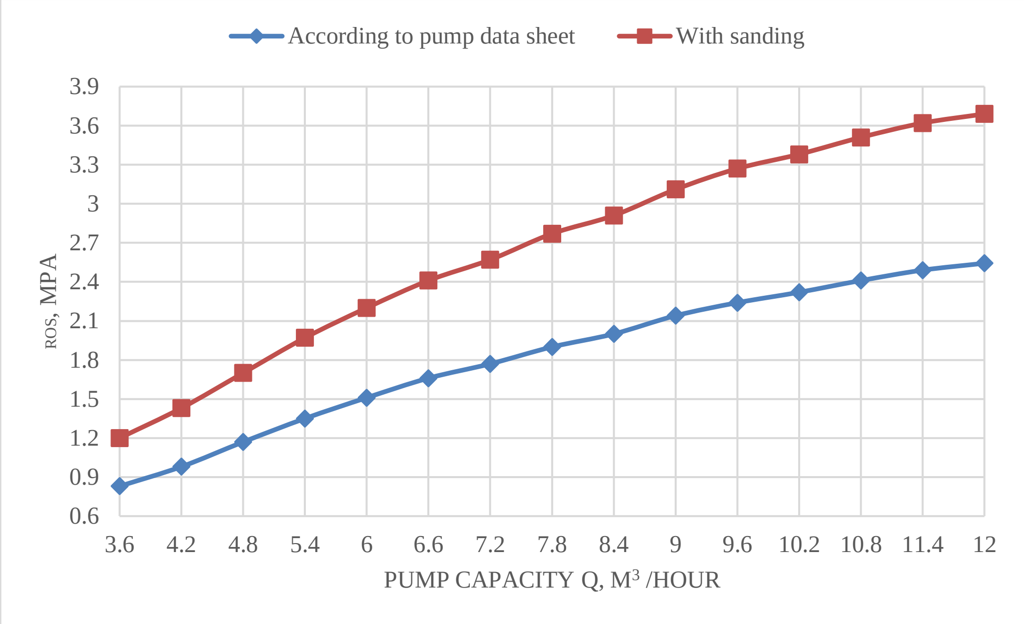


Fig. 2. Flow-pressure characteristic of a USK 408/42 downhole pump

RESULTS AND DISCUSSION

We took the principle technological scheme of PV and the established analytical dependencies considered above in this paper as a basis for the mathematical model of the PV process for calculation with Excel software. In studies and calculations of the main parameters along the technological chain: "well - ore deposit - pumping well" with a 7.5 kW pump, the change in pressure ΔP depending on the pump capacity was plotted (Fig. 3).

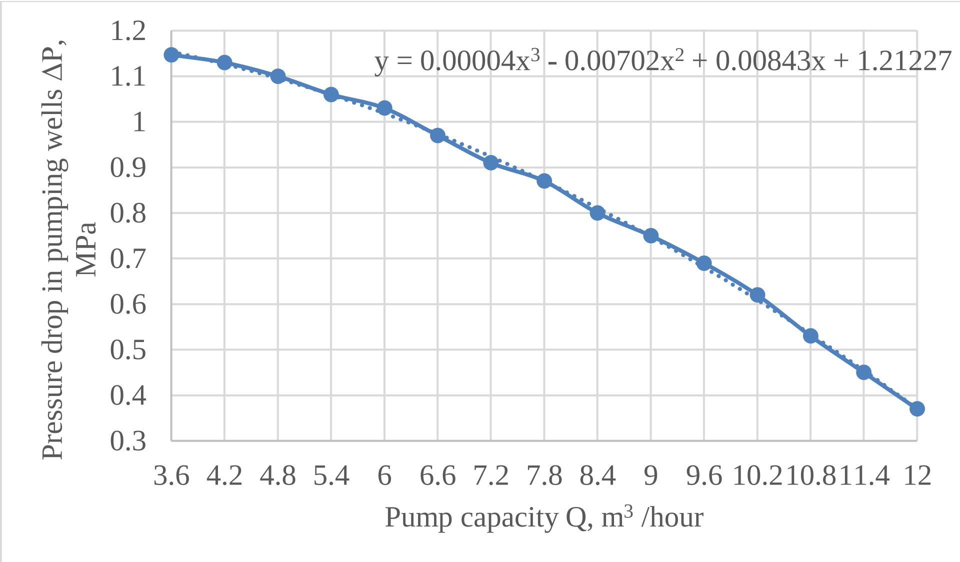


Figure 3. Change of pressure in pumping wells (ΔP) determined in EXCEL programme

From the result obtained, the change in pressure of the pumping well itself and pumping equipment was identified, and polynomial coefficients were determined for further determinations of the exact change in pump pressure during sandburst, respectively: a_0 =1.21227; a_1 =0.00843; a_2 =0.00702; a_3 =0.00004.

It is established that the flow-pressure characteristic takes the following form

$$\Delta P_{oc} = 1{,}21227 + 0{,}0084\,Q_{oc} - 0{,}00702\,Q_{oc}^2 + 0{,}00004\,Q_{oc}^3\,, \qquad (2)$$

From the results of the conducted researches and **EXCEL** calculations it was determined that with increasing of the injection well head the well flow rate increases, but the pumping efficiency of the solution decreases, and with decreasing of the head the well flow rate decreases, which increases the uranium concentration in the productive solution, but decreases the filtration rate of the solution in the deposit and, accordingly, the uranium leaching process speed.

Further the task of the conducted research was to develop a level system and to choose the optimal method of controlling the technological process of in-situ uranium leaching.

As shown by the calculations according to the above functional flow chart with EXCEL software, the dependence of the pressure change on the ore deposit on the flow rate and content of solutions has been established, which takes the following form (Fig. 4).

Based on the results of research and analysis of the dependence of pressure change on the ore deposit at the content of solid particles and on the level of solution in injection wells, it is possible to choose such a flow rate $Q_{зс}$, which provides maximum differential at the ore deposit and reduces the share of solid particles in its content.

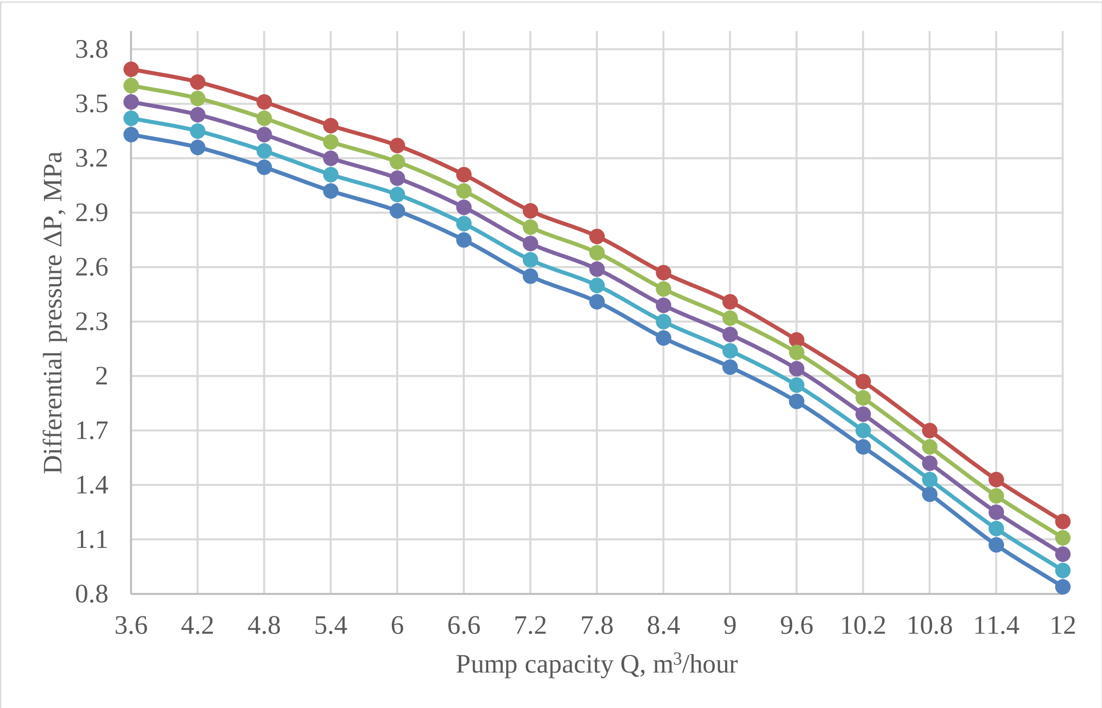


Figure 4. Dependence of pressure drop at the pumping well on pump capacity

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CONCLUSION

Based on the differences of these data in the injection and pumping wells, it is possible to estimate the pressure difference on the ore body, which is the main factor in the flow of productive solutions towards the pumping wells. Establishment of a nonlinear problem-maximum differential, the solution of which will allow to optimally conduct the process of uranium mining technology by in-situ leaching.

Thus, according to the level control system of the operation mode "well - ore deposit - pumping well" are implemented on the pressure gradients in the ore deposit and maximisation of uranium concentration at the pumping well, and on the basis of the analysis of the quality of the productive solution and pumping equipment operation, the decisions on the distribution of loads on leaching solutions and obtaining productive solutions, the use of unusual operation modes of pumping pumping units, as well as the increase of the efficiency of the in-situ leaching process are started.

REFERENCES

1. Schmidt D., Follin S.E., Peterson K.A., Level E.V. Geochemical kinetics model for in-situ leach mining. - SPE Journal. -1981. - № 198. - P. 132-141.
2. Schechter S.P., Bommer M. Optimization of uranium leach mining. - Society of Petroleum Engineers Journal. - 1982. - № 22. - P. 133-141.
3. Suat Bagci, Murat Kece and Jocsiris Nava, Challenges of Using Electrical Submersible Pump (ESP) in High Free Gas Applications, CPS/SPE International Oil & Gas Conference and Exhibition in China held in Beijing, China, 8–10 June 2010. SPE 131760. 1-13 p.p.
4. Сулейменов Б.А., Омирбекова Ж.Ж., Онбаев А.Б., Оракбаев Е.Ж. Разработка системы управления процессом подземного выщелачивания урана, «Роль и место молодых ученых в реализации новой экономической политики Казахстана» // Международных Сатпаевских Чтений. - Алматы, 2015. - № 4,- С. 120-125.
5. Муханов Б. К., Омирбекова Ж. Ж., Оракбаев Е. Ж. Исследование и разработка системы оптимального управления процессом подземного выщелачивания // Вестник Национальной Академии Наук Республики Казахстан. - 2016. - №5. - С. 178-185.
6. Mukhanov B. K., Wojcik W., Omirbekova Zh. Zh., Orakbayev Y.Zh. Study of in-situ leaching of metals by numerical simulation // Известия национальной академии наук республики Казахстан. -Алматы, 2017. - №1. - С. 205-216.
7. Atakulov L.N., Kurbonov O. M. Исследование по повышению работоспособности насосного оборудования // Journal of Advances in Engineering Technology. Vol.1(1). 2020/ - 21-24 p.p.
8. Kurbonov O.M. Method of selection and operation of pumps with regulation of change of frequency of rotation of shaft of the submersible electric pumping equipment // Scientific enquiry in the contemporary world: theoretical basics and innovative approach. – San Francisco, California, 2017. – №9. – pp. 226-230.