INVESTIGATION OF THE POSSIBILITY OF USING THE ELECTROHYDRAULIC EFFECT IN THE PROCESS OF LEACHING METALS

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First of all, the electrohydraulic effect was proposed as a way to transform electrical energy into mechanical one. In this regard, the efficiency factor of this transformation is a determining factor in solving the issues of practical use of electrohydraulic methods and devices. The efficiency factor (n) of the electrohydraulic effect depends on both the parameters of the electrical circuit and on the properties of the objects undergoing electrohydraulic process in which it occurs, and the nature of the processing [1].

The qualitative presentation of the factors influencing the value of the efficiency of the electrohydraulic effect is given below [2, 3]:

$$\eta = f(a, l, kp, \frac{1}{\tau}, b),$$

where a=f (C, U, $\frac{1}{L}$, $\frac{1}{R}$) is the amplitude of the pulse current; l is the distance between the electrodes (spark length); k_p is the coefficient characterizing the resonant properties of the material; τ is the pulse duration; b is the steepness of the pulse front; C is the electrical capacitance; U is the nominal voltage; L – inductance of the discharge circuit; R – resistance of the discharge circuit.

It is proved that the efficiency increases with increasing values of a and b, as well as the spark length l, and decreases with increasing τ. A decrease in the values of b and R of the discharge circuit, as well as an increase in voltage U and, within known limits, capacity C, contribute to an increase in the mechanical efficiency factor of the electrohydraulic effect. An increase in the efficiency factor is also facilitated by an increase in the density of the working fluid [4].

However, it should also be borne in mind the complex nature of the dependence of electrical parameters on each other. Thus, with an increase in the capacity of the circuit, the pulse energy and the current amplitude increase linearly, the spark lengthens, but at the same time, the pulse duration increases. An increase in the amplitude of the current and an increase in the length of the spark contribute to an increase in efficiency factor, but their positive effect is suppressed by a rapid increase in the pulse duration.

Rocks are characterized by extremely diverse electrical and magnetic properties, which depend on a large number of factors – mineral composition, porosity, humidity, temperature, pressure, etc. These properties are widely used to search for minerals using magnetic and electrical exploration tools. They act with electromagnetic fields of high and ultrahigh frequencies on the mining environment in order to obtain thermal and thermomechanical effects, intensification of chemical reactions and diffusion and filtration processes. The heating of the rock mass is determined by the level of density of the energy introduced into the array, which depends on the intensity of the electric field. The electromagnetic field in the array is created with the help of electrodes lowered into wells located along the office of the array to be heated. Having a high penetrating power, electromagnetic fields contribute to the acceleration of chemical processes occurring inside a significant volume of the medium more efficiently than chemical catalysts, the action of which is possible only with surface contact with the mining environment. The destruction of the array can be achieved due to thermoelastic stresses arising in locally heated areas. In addition, due to the occurrence of high temperatures around conductive inclusions, chemical reactions intensify. All this leads to a significant increase in the filtration capacity of the rock.

The heating of the deposit for melting, sublimation of minerals, activation of chemical reactions or the achievement and thermomechanical stresses that cause the destruction of the rock can be carried out either due to the Joule heat of conduction currents, or due to the heat of dielectric losses during high-frequency exposure to the deposit. When performing an electrical breakdown of a rock, especially wet, its non-explosive dispersion at the site of occurrence is possible (the Yutkin effect) [1]. During underground coal gasification, electric drilling of wells was successfully used, that is, the formation of a gasification channel with partial coking of coal heated by conduction currents.

A promising direction is the electrochemical effect on the mineral deposit and reservoir fluids (fig. 1). A constant electric field acts on minerals, changing their physical properties and producing electrolysis in the solid state, resulting in the separation of the mineral into elements. A constant electric field also causes electrokinetic phenomena that cause fluid movement in capillary-porous media in the desired direction, which can be used to increase the flow of productive fluids to wells.

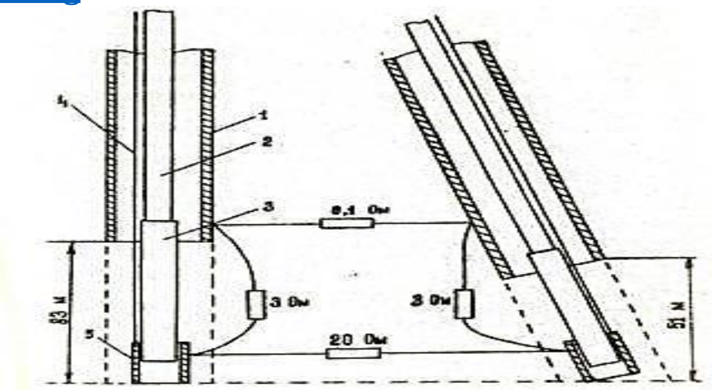

Fig. 1. Diagram of the electrical effect on the bottom-hole zone of the formation

To warm up the bottom-hole zone of the well, it is possible to use various electric heaters and an ultra-high frequency generator, which can be lowered directly to the bottom of the well.

Bibliography

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