



## OPTIMIZE THE OPERATING MODE OF THE QUARRY DRAINAGE INSTALLATION.

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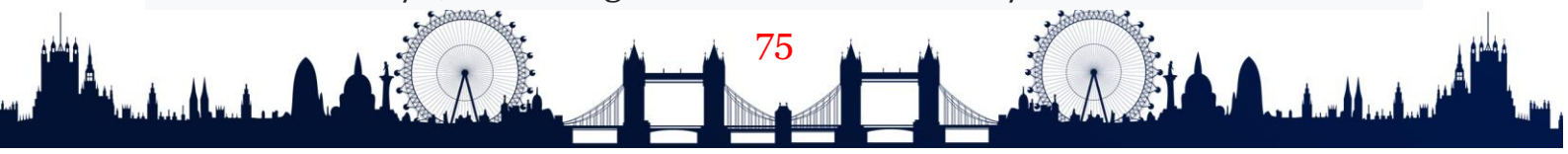
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Drainage plants of mining enterprises, as a rule, were laid several years ago. Currently, pumps are installed for drainage, selected during the design with the values of maximum or normal inflows specified at the time of the construction of the mine or section, as well as the values of the lift height. During operation, the water inflow indicators inevitably changed, but the pumps remained the same. In connection with the foregoing, there is a need for a verification calculation of the dewatering installation for the parameters that are currently in effect.

When pumping contaminated mine waters, the hydraulic resistance of the pipeline increases significantly, which leads to a change in the operating mode of the drainage installation. What causes a decrease in productivity, efficiency pump and pressure increase.

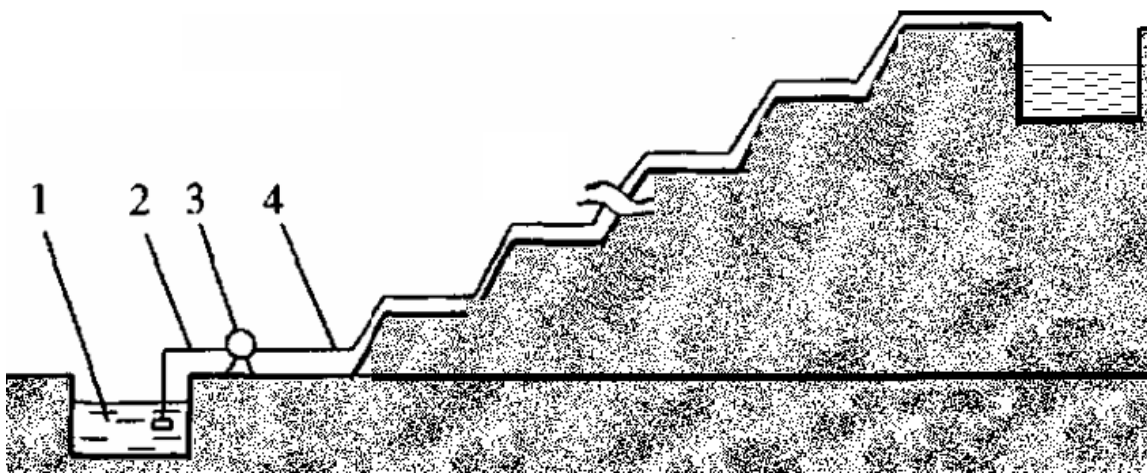
This article presents a geometric model with which you can determine the optimal mode of operation of the drainage system of mines and quarries

Industrial wastewater from mining enterprises has a significant impact on the state of the natural environment. The main components of industrial wastewater from operating mining enterprises are mine (quarry) water, as well as atmospheric water runoff contaminated due to water erosion of waste rock dumps and substandard minerals. The opening and exploitation of coal deposits is associated with the indispensable pumping of water that enters the mine workings. In some water-abundant deposits, in order to create favorable conditions for mining operations, the fields of minerals are pre-drained; the water pumped out at coal mining enterprises is taken in passing; subject to pollution. Quarry waters are formed during open-pit coal mining, and surface runoff, surface water bodies and streams, as well as groundwater participate in their formation. During spring and autumn floods, with sufficiently large catchment areas, surface runoff prevails, and during dry periods, groundwater. At the Angren Open-pit mine, open pit coal mining is carried out only during the development of brown coal. Quarry water inflow ranges from 150 to 1300 m<sup>3</sup>/h, the average inflow is 300-1300 m<sup>3</sup>/h. The main indicators of



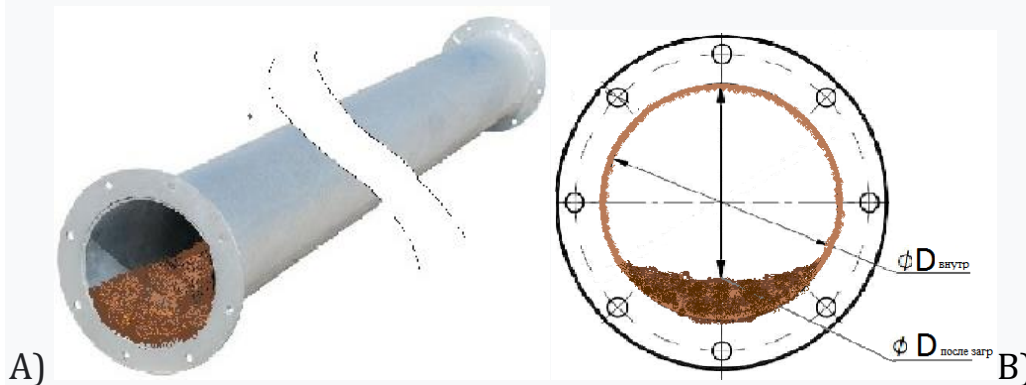
the composition of quarry waters The Angren cut: Suspended substances, mg / l - 50-460. Mineralization, mg / l - 480-870. pH - 6.5-7. The composition of quarry waters in terms of pollution indicators practically do not differ from mine waters; the exception is hydrogen ions pH. All quarry waters are neutral, slightly alkaline and contain particles of sand. In the process of discharging these waters to the ground level, over time, the buildup of rust and salts on the inner surface of the injection pipeline leads to a decrease in the internal diameter of the pipeline. (Fig. 2)

Fig-1.



Technological scheme of the dewatering plant of the Angren coal mine. 1 - water collector; 2 - suction pipeline; 3 - pump; 4 - discharge pipeline.

The technological scheme of the spillway device currently used at the Angren coal mine is as follows. (Fig. 1). The discharge pipes of this type of technological scheme are located mainly horizontally and at an angle. For this reason, sand particles contained in quarry water pumped to ground level settle to the bottom of the pipe and form a sediment. Figure-2(b) shows a pipe that was used for 3 years to release quarry water from the Angren PK-22 open pit with sand particles to ground level.





.Fig-2. Change in the inner surface and inner diameter of a water pipe over time, a) general view of the pipe, b) view of the inner surface of the pipe.

The operating conditions of quarry drainage installations are characterized by high pressure in the discharge pipeline, high productivity of pumping units, the need to pump out contaminated and acidic quarry water, high humidity, dustiness and explosiveness of the mine atmosphere, limited mine workings and a significant deviation of the operating modes of installations, the operation process compared to design solutions. The latter is explained by an increase in local resistances in pipelines, which lead to a change in the operating mode of drainage installations from the calculated one. Even correctly selected pumping units do not always work economically, and in these conditions the choice of equipment must be made taking into account the characteristics of the pipelines. The study of the operating mode of a drainage installation is of great practical importance, since it allows one to obtain the value of their individual parameters (pressure, productivity, power, efficiency, etc.) and increase the technical and economic indicators of the installation.

To determine the mode of operation of the pump on the pipeline, it is necessary to know its characteristic, the equation of which has the following form:

$$H = H_r + \frac{g^2}{2g} (1 + \sum \xi) = H_r + R_T \cdot Q^2 ,$$

Where:  $R_T = \frac{(1 + \sum \xi)}{2g \cdot S^2}$  -pipeline constant.

The characteristic of the pipeline expresses the dependence of the geodetic head -Hg and hydraulic losses - RT·Q<sup>2</sup> depending on the performance and section of the pipeline and does not depend on the characteristics of the pump itself. [1]

When pumping contaminated mine waters, the hydraulic resistance of the pipeline increases significantly, which leads to a change in the operating mode of the drainage installation. What causes a decrease in productivity, efficiency pump and pressure increase. Let us consider the influence of changes in hydraulic losses on the operating mode of a dewatering plant. For this purpose, the previously accepted coordinate axes of head - H, productivity - Q will be introduced by the coordinate axis of the plant operation time - T. This method of





approach to solving the problem allows you to create a geometric model of the operating modes of installations and more clearly and reliably analyze their work for a certain period of time. Geometric modeling of the operating modes of dewatering installations makes it possible to set several figures on the model, the volumes of which are determined by the product of pressure, productivity and time. If the unit of pressure is taken as a unit - kgf / m<sup>2</sup>, then the volumes of these figures have the dimension kgf·m and this is the work expended by the installation for lifting water.

The net power of the installation is determined by the formula

$$N = \frac{Q \cdot H}{102 \cdot 3600} , \quad - \text{ kvt},$$

We multiply both sides by the operating time of the installation T, we get

$$E = \frac{Q \cdot H \cdot T}{102 \cdot 3600} , \quad \text{kvt} \cdot \text{hour}$$

The useful consumption of electricity on a geometric model will be equivalent to the volumes of figures determined by the product of the parameters Q, H, T.

The pressure characteristic of the pump does not depend on the operating time and it can be cut out on the model with a spherical surface ABSD.

The operating modes of the pump for the period of operation "T" is set by the line of intersection (9-10) of the above spherical surfaces.

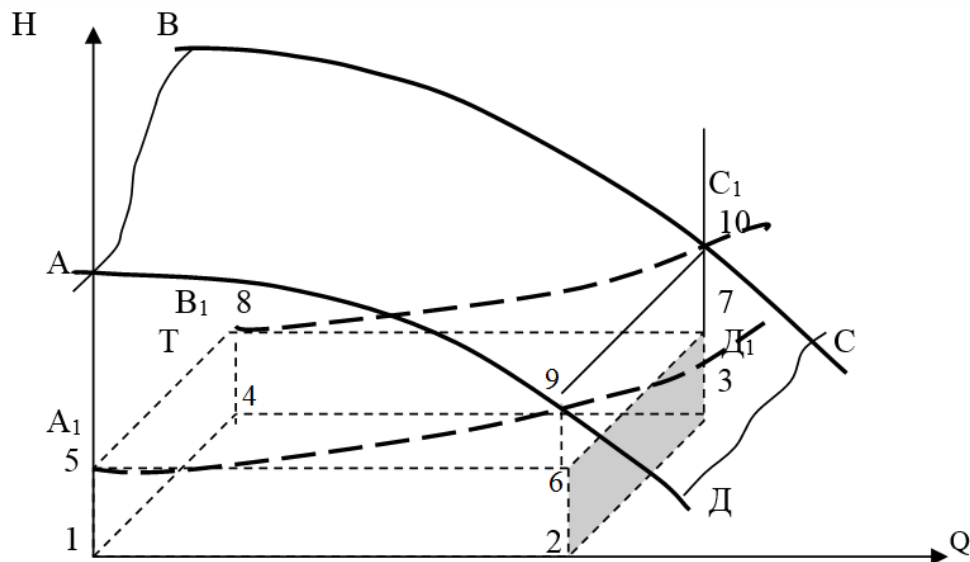
The volume of figures 1, 2, 9, 5, 4, 3, 10, 8 is the useful consumption of electricity for the period of operation and is determined by the formula

$$E = H_r \cdot Q_p \cdot T + \int_0^{Q_p} H_i dQ$$

where Q<sub>r</sub> is the calculated (design capacity), m<sup>3</sup>/hour.

When pumping contaminated quarry water, the hydraulic resistance of the pipeline and the characteristics of the pipeline increase significantly, which requires further research.





Thus, the geometric model of operating modes makes it possible to more clearly and reliably evaluate the operation of dewatering plants in mines and quarries. In particular, if the improvement of the optimal operating mode of the Angren mine drainage installations is carried out on the basis of this geometric model, then it is possible to ensure reliable and efficient cleaning of equipment for a long time.

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