# PREPARATION FOR THE DEVELOPMENT OF ROCKS, WHICH ARE CONSIDERED COMPLEX IN TERMS OF PHYSICAL AND MECHANICAL CHARACTERISTICS IN A QUARRY, BY BLASTING WITH THE HELP OF AN ELECTRIC PULSE

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**Annotation:** *The article discusses the physical aspects of selective electro-pulse destruction of rocks and the areas of its effective industrial use. It is shown that the electric pulse method satisfies all the necessary conditions for selective crushing and crushing of rocks.*

**Keywords:** *rock, crushing, crushing, pulse discharge, minerals, electro-pulse disintegration, energy.*

## INTRODUCTION

When crushing rocks, the problem of their selective destruction is important. This is due to the fact that traditional mechanical methods of destruction do not have selectivity and when they are used, there is a partial violation of the shapes of crystals and grains of extracted minerals, as well as contamination of processed products with hardware metal. Selective destruction of rocks containing precious raw materials (diamonds, gold, etc.) makes it possible to separate useful components from the host rock while preserving the natural forms of minerals. In many cases, chemical purity of processed products (quartz, ceramics, etc.) is required. Traditional crushing and crushing equipment doesn't has selectivity of destruction and is mainly designed to reduce the size of the feedstock, which leads to the destruction of minerals and an increase in their losses.

## METHODOLOGY

This article was prepared on the basis of information from industrial practice and theoretical literature.

One of the known methods of crushing rocks is the electric pulse method, when destruction occurs during the formation of an electric discharge channel inside a solid body placed in a liquid [1].

To form a discharge channel inside the material, it is necessary to create a pulse shape in which the electrical strength of the environment would be higher than the strength of the material being destroyed [2]. Therefore, for the destruction of solid materials by pulsed discharges, it is necessary to know their electrical strength. Figure 1 shows the volt-second characteristics of the breakdown of some rocks and industrial water on oblique voltage pulses of positive polarity. It follows from the figure that it is necessary to use pulses with a voltage rise rate from 100 kV/mks to 1500 kV/mks. When choosing the pulse voltage level, it is necessary to focus on voltage gradients of 5-25 kV/mm [3].

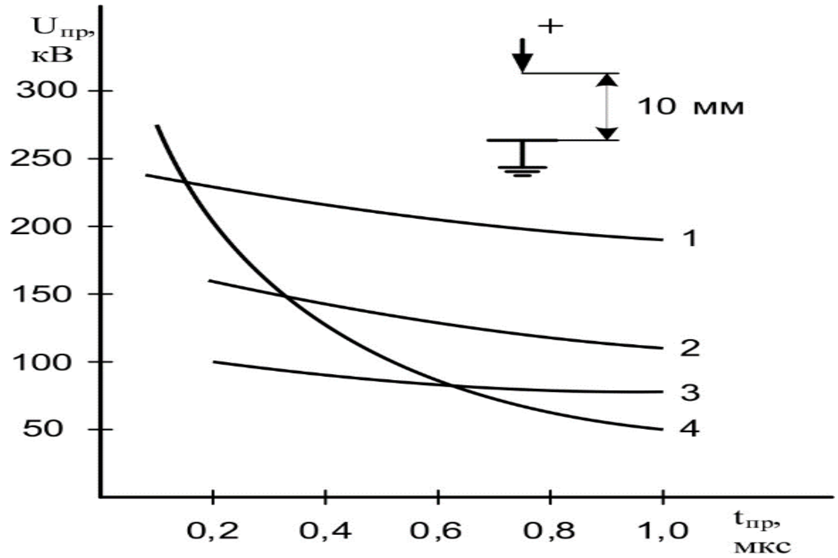


Fig. 1. – Volt-second breakdown characteristics:
1– quartz, 2– granite; 3 – sandstone; 4 – industrial water

The study of the mechanism that ensures the selectivity of the destruction of mining raw materials by the electric pulse method has shown that the following stages can be distinguished. At the stage of discharge formation in the rock, the discharge channel passes through the areas of location of local electrical inhomogeneities, that is, inclusions (grains, crystals) and the boundaries of their fusion with the waste rock [4]. Thus, the discharge channel passes along the boundary of the “mineral – host rock” section, creating prerequisites for their separation. When the discharge channel is formed, the pulse generator energy is released in it for a short period of time ~10-6 s, while the temperature in the discharge channel rises almost instantly to 2 ×104 0 K, and the pressure reaches 109 Pa [5]. As a result, the discharge channel, expanding, generates a shock wave and compression waves, which, moving in an inhomogeneous medium, form mechanical stresses inside the rock. This creates conditions for effective crushing and separation of extracted mines.

The results obtained. A high-voltage installation was used to implement the electric pulse crushing method. As a source of high-voltage pulses, a five-stage pulse voltage generator was used, which allows forming a pulse with a voltage of up to 250 kV with a pulse energy of up to 600 J at a pulse repetition frequency of 5 Hz.

An important part of the installation is the working chamber (Figure 2), which is designed to accommodate rock in it and destroy it in an aqueous medium by pulsed electrical discharges. The chamber includes the following elements: discharge chamber, high-voltage electrode, classifier electrode, collector. The volume of the chamber is 15 liters. The initial size of the raw material loaded into the chamber is up to 30 mm, and the final size of the resulting product is up to - 1 mm.

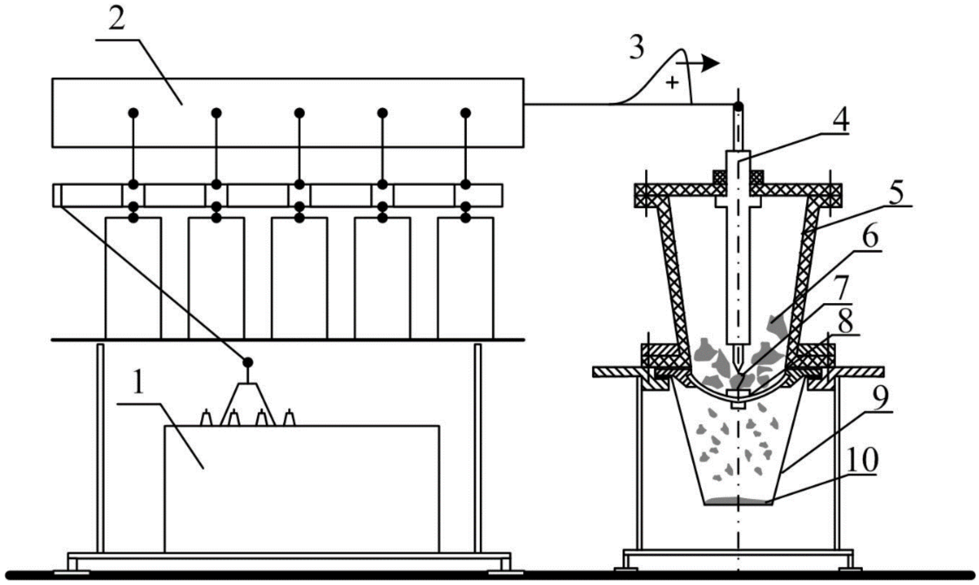


Fig. 2. – Diagram of a high-voltage installation:

1 – charger; 2 – pulse voltage generator; 3 – voltage pulse; 4 – high voltage electrode; 5 – discharge chamber; 6 – rock; 7 – discharge channel; 8 – classifier electrode; 9 - collector; 10 – finished product.

The experience of operating the installation has confirmed the high degree of opening of minerals. Table 1 shows the results of the opening of wolframite grains during the grinding of wolframite ores consisting of individual fragments with a size of 30 mm on an electric pulse unit. The grain size of wolframite in the rock ranged from 0.1 to 12 mm. Comparative tests were also carried out on a laboratory jaw crusher.

| Size class, mm | Crushing method | Pure grains, % | Accretions, % |
|---|---|---|---|
| - 14 + 5 | Electropulse | 18,2 | 81,8 |
| | Mechanical | 3,6 | 96,4 |
| - 5 | Electropulse | 47,4 | 52,6 |
| | Mechanical | 25,3 | 74,7 |

It can be seen from the table that the use of the electric pulse method makes it possible to extract mineral inclusions from the rock more efficiently than with mechanical. It should be noted that during electro-pulse crushing, mineral grains do not have technological damage, whereas with the mechanical method up to 15% of the grains are damaged. It should be noted that with electro–pulse destruction, the opening of crystals and grains of minerals occurs when the size of the raw materials is 2-3 times larger than the size of the inclusions, which cannot be achieved with mechanical crushing methods.

The analysis of physical phenomena in the electro-pulse destruction of rocks indicates the possibility of obtaining a finished product with a more uniform size characteristic compared to mechanical methods, which is due to the absence of the abrasion effect characteristic of traditional devices. The degree of contamination of the finished product with hardware metal also decreases.

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