CHOOSING THE BEST CRUSHING EQUIPMENT FOR LIMESTONE PROCESSING: TECHNICAL AND ECONOMIC JUSTIFICATION OF THE METSO NP1415 MODEL

Kurbonov Oybek Muhammadqulovich
Istamov Zafarjon Vohid o'g'li
Lecturers at the Department of Natural and Technical Sciences
Navoi University of Innovation
Musurmonov Shohzodbek Utamurod o'g'li
Xakberdiyeva Aygerim Nurshatovna
Students majoring in Mining (by type of activity)
Navoi University of Innovation

Annotation. The article discusses the properties, applications and technologies of limestone mining, as well as the stages of its crushing - from primary to fine grinding. The calculation of the required productivity of equipment with an annual volume of 800 thousand tons / year was carried out. The choice of the Metso NP1415 impact crusher is justified, its main technical characteristics, energy efficiency indicators and processing costs are given. It is established that NP1415 provides the required productivity, high crushing coefficient and versatility of application in the processing of large limestone fractions.

Keywords: limestone; crushing; Metso NP1415; productivity; processing; energy efficiency; prime cost; primary crushing.

INTRODUCTION.

Limestone is a versatile material that is widely used in various fields-from industry and agriculture to construction and interior design. The specific areas of its

use depend on the chemical composition, origin, and physical properties of the stone. The main areas of application include:

- Construction. Some types of limestone have sufficient strength for the construction of low-rise structures, but more often this stone is used in the form of facing materials. It is used to make decorative panels for walls, facing plates, as well as architectural details — columns, pilasters, bas-reliefs. Fine-grained limestone is used as crushed stone in the production of concrete, coarse-grained limestone is used to create the foundations of highways and hydraulic structures. Large fragments of stone (rubble stone) up to 500 mm in size are often used for foundation work.
- Production of finishing compounds. Limestone serves as a raw material for the manufacture of whitewash, paints and putties.
- Cement production. Carbonate components, mainly represented by limestone, can make up up to 80% of the raw mix for cement. Clay, slag and other corrective materials are also added to it.
- Chemical industry. Limestone is used in the production of plastics, rubber and pharmaceuticals.
- Metallurgy. Limestone flux is an important component in metal smelting — it lowers the melting point of the ore and makes it easier to separate the metal from the waste rock. It is particularly effective in processing ores with a high content of silica and alumina.

DISCUSSION OF THE ISSUE

In addition, limestone plays a significant role in sugar refining and glass production. When heated, it is actively used in metallurgy to produce iron, steel, as well as alumina and magnesia.

The main conditions of limestone formation are marine salt basins, although in some cases sedimentation is also possible under conditions of evaporation of

lagoon or lake-type waters. The color scheme of limestones varies from light gray and beige to yellowish shades. The presence of organic substances, as well as inclusions of iron, manganese and other elements can give the rock more saturated colors — dark gray, brown, reddish or greenish.

Figure 1. Fractionated limestone before processing

Limestones are extracted using various technologies, depending on the conditions of the deposit, the characteristics and depth of the mineral.

The main methods include:

Open pit mining	This method is used if the rock is located on the surface or at a shallow depth. Development is carried out using milling combines, excavators, bulldozers, and other construction vehicles.
Underground mining	is used when deposits are located at a significant depth from the earth's surface.

	First, mines or tunnels are created underground, then the rock is extracted to the surface using crushers, conveyors and conveyors. The method is more expensive and is used less frequently than in open pits.
Drilling and blasting technology	The top layer of soil is removed using a bulldozer. Pits are drilled in the rock, where explosives and detonators are laid. After destruction, the rock is loaded by heavy excavators into mining dump trucks and taken to the place of crushing and further use.
Hydraulic method	This method uses high-pressure water jets to extract limestone. This method is used less frequently, but it can be effective in certain conditions.

In order to minimize the negative impact on the environment, process automation, energy-saving technologies, and reclamation systems are used in mineral extraction.

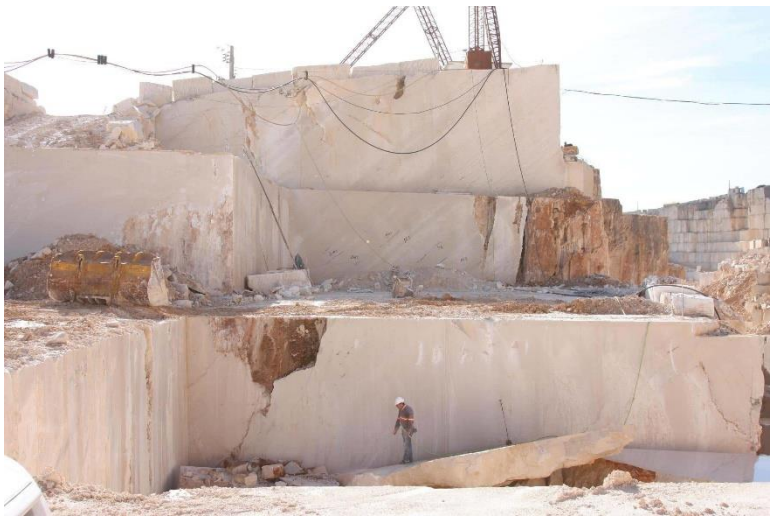

Fig. 2. Development of a limestone deposit

MATERIALS AND METHODS

The process of preparing limestone raw materials includes successive stages of rock destruction: primary and secondary crushing. At these stages, large-sized source material (fragments up to ~1.5 m) is brought to a fineness class of the order of -25 mm. In a number of production schemes, this degree of dispersion is not sufficient, since a powdery product is also in demand.

Limestone powder is widely used in the manufacture of ceramic and glass products, as well as in the composition of construction and finishing materials. To obtain it, after the primary and secondary crushing stages, a fine and, if necessary, ultrafine grinding stage is introduced.

All stages of crushing and processing require specialized equipment that can give the product a marketable appearance and divide it into the desired fractions.

RESULTS AND DISCUSSION

The annual production volume at the start-up stage is 800,000 tons/year. The design capacity of the enterprise provides for an increase in the production of fractionated limestone to 1,200,000 tons/year. The estimated service life of technological equipment is assumed to be 10 years. The standard annual working time fund is 220 working days with a shift duration of 8 hours, which in total amounts to 1,760 hours per year.

Calculation of the required crusher capacity

$$P = \frac{Q}{t}$$

- Q=800,000 tons / year
- t=1760 h

$$P = \frac{800{,}000}{1760} \approx 454{,}5т/ч$$

Required crusher capacity - ~455 t / h

Based on the required performance of the crusher, you can choose the NP1415 type **of crusher**.

The technical characteristics of the Metso NP1415 impact crusher include a number of key parameters that determine its performance and application. The crusher belongs to the equipment type of horizontal impact crushers (HSI). The rotor of the unit has a diameter of 1540 mm and a width of 1320 mm, which ensures high kinetic energy of impact and effective destruction of rock pieces.

The size of the feed port is 1540x1320 mm, allowing you to receive raw materials of a large fraction. The maximum feed size reaches 1000 mm, making the NP1415 suitable for both primary and secondary crushing applications. The power of the drive is 315 kW (400 hp), ensuring stable operation in a wide range of loads.

The capacity of the equipment varies from 250 to 670 t / h, depending on the properties of the processed material and technological settings. The weight of the crusher is 22,300 kg, which indicates its robust construction and ability to withstand intense operating conditions. The NP1415 model is used for both primary and secondary crushing, which makes it a universal solution for processing various types of mineral raw materials.

Calculating performance

Based on an annual production capacity of 800 thousand tons and a working time of 220 days of 8 hours:

$$P = \frac{800{,}000}{220 \times 8h} = 454.5 \text{ t / h}$$

Energy efficiency

With a drive power of 315 kW and a working time of 1,760 hours per year:

$$E_{year} = 315kW * 1760h = 554400\ kWh\ /\ year$$

If the electricity price is $0.10 per kWh:

$$C_{el} = 554400\ kW\ * 0.10\$\ /kW = 55440\$$$

Cost of crushing

Assume that the cost of maintenance and spare parts is $25,000 per year. Then the total operating costs are:

$$\mathrm{C_{exp}} = \mathrm{C_{el}} + \mathrm{With_{maintenance}} = \$\ 55440\ /\ \mathrm{year} + \$25000/\mathrm{year} = \$80440$$

Annual processing:

$$\mathrm{Q_{year}} = 800{,}000\ \mathrm{tons}$$

Then the cost of crushing:

$$Per_{ton} = \frac{With_{exp}}{Q_{year}} = \frac{\$\ 80440\ /\ year}{800000t} = \$0.1005\ /\ ton$$

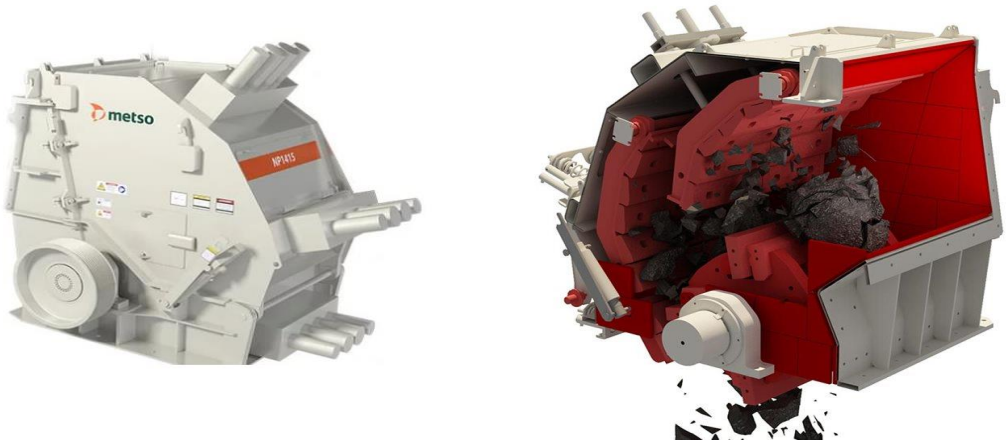

Fig. 3.Impact crusher (Horizontal Shaft Impact – HSI) NP1415

Features and advantages of the Metso NP1415 model are determined by its design and operational characteristics. The crusher provides a high crushing ratio, which makes it efficient for primary grinding and allows you to achieve a significant reduction in the size of the starting material. Thanks to its versatile application, the unit is able to process a wide range of rocks — from soft to medium-hard, while maintaining stable operation and high quality of the finished product.

The crushing chamber has an optimized geometry, which helps to reduce the wear of the working elements and increase the uniformity of the granulometric composition of the final fraction. The design provides the possibility of flexible adjustment of crushing parameters, allowing you to adapt the operating mode to specific requirements of the technological process. An important operational advantage is easy maintenance, including easy access to wear parts and shorter replacement times.

Applications of the Metso NP1415 crusher cover a wide range of industries. The equipment is most effectively used at the stages of primary crushing in the production of building materials, where processing of limestone, granite and other non-metallic rocks is required. In the mining industry, the unit is used for crushing ore raw materials and various minerals. In addition, the model is in demand in the recycling sector, where it is used for processing construction waste and other materials returned to secondary circulation.

CONCLUSION.

Metso NP1415With a capacity range of 250-670 t/h, the Metso NP1415 is ideally suited for the required capacity of 454.5 t/h. Despite its higher power output, the NP1415 delivers high performance and energy efficiency. Despite the higher operating costs, the cost per ton of production remains competitive. Metso NP1415 offers higher productivity and flexibility in processing larger fractions, which can be

useful when increasing production volumes or changing the characteristics of the starting material.

REFERENCES:

1. Ivanov V. I., Petrov A. A. "Fundamentals of mineral raw material processing", Moscow: MISIS, 2016.
2. Akhmedov R. R. "Technologies of crushing and sorting". Tashkent: TUIT Publ., 2020.
3. GOST 8269.0-97. Crushed stone and gravel. Methods of physical and mechanical testing.
4. Metso Outotec. Technical documentation of the Metso NP1313 impact crusher.
5. Liming Heavy Industry. Catalog of impact crushers of the PF series.
6. "Safety rules for the operation of mining equipment". Gosgortehnadzor Publ., 2020.