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The Experience of the Introduction of Mobile Crushing and Screening Complexes on a Deposit of Building Materials

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Abstract: Operation guidelines of mobile crushing-screening plant trademark consisting of two crushing and screening steps of crushed rock have been considered in this study. Method of calculation and selection of mining equipment for reliable and efficient operation of higher demand output have been presented.

Key words: Mobile crushing and screening plant, jaw crusher, cone crusher, grate, rubble

INTRODUCTION

The most widespread and highly developing branch of mining in Northern-West region of Russian Federation is mining of constructive mining rocks. This is based on development of roads and dwellings constructions mainly in Saint Petersburg and in Leningrad region (Efremov 2013). Now a days, the following features are particular for the sector of mining rocks:

- Occurrence of many small plants, besides one deposit can be developed by various plants at several areas
- Environment protection measures strengthening of mineral wealth

Hence, it is necessary to expand product line, improve mobility and ecological safety with high rate of productivity.

The perfect solution for crushed rock quarries are crawler and wheeled mobile crushing-screening equipment. The most widely spread units in Leningrad region and republic of Karelia are the equipments of Terex, Sandvik, Powerscreen trademarks.

Process flow diagram of enterprise operation includes jaw and cone crushers, screening and conveying machines as well as auxiliary mining equipments carrying out loading and gathering work with excavating machine and wheel loader (Fomin *et al*., 2013).

Changing the mode of crushing-screening equipment from vehicular position to operation ones and vice versa can be done in half an h. After adjustment equipments operate in unmanned mode with minimal work of an operator, it helps one person to manage several units (Ubeikon, 2013).

The object of study: Equipment of Terex Finlay trademark has been chosen as the object of study. Crushing units and screening machines are accounted 25 units. As the base of this choice output efficiency and physics-mechanical properties of developing rocks have been taken into consideration.

The anisometric Rapakivi granite deposits of homogeneous mineral structure are provided for the development. Average density of mining rocks is 2.6 kg cm^{-2}, rock failure limit on the compression is 1316 kg per cm^2 in dry condition and in aquic condition it is 1076 kg per cm^2. The granite structure is disseminated irregular, average and coarse-grained. The most important minerals in rocks are microcline (50%), plagioclase (15-20%) and quartz (25%).

Essential productivity of mineral raw materials processing equipment is 300 thousand tons cubic meter per a year output. Mode of plant behavior is all-year, without off days, in one shift for 12 h.

MATERIALS AND METHODS

The technology: At the first stage crushing happens with jaw crusher due to the compression of stuff between two jaw plates one of which is moving another one not. Moving plate operates ellipsoid track and crash the stuff against stationary jaw plate. End edge of moving jaw is possible to regulate the jaw width which helps to measure the stuff size at exit. Jaw forms V-shaped chamber, in which the stuff under gravity moves from the top to outlet crushing and the stuff proceeds into cone crusher.

Crushing of stone takes place in the chamber of two frustums: outside frustum is stationary and inside frustum is movable. The size of outlet jaw and size of outlet

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product is changed in terms of high on which the cone moves. Then the stuff comes to sizing screen where assortment of crushed rock is.

In the technologic complex of manufacturing the separate machine and devices must be to severe connected with efficient and operation condition to meet requirement of industrial processing and high performance.

Based on assigned industrial capacity and operation condition of enterprise the efficiency of mobile crushing and screening plant can be calculated. The following condition such as:

- Productivity of plant is measured with datum of less productivity plant
- Basic productivity of plant must be increased in relation to desired value of pre-crushed stuff should be taken into account

The productivity of crushing and screening equipment:

$$Q = \frac{A_p \cdot \gamma \cdot K_1}{365 \cdot T} \text{ ton h}^{-1}$$

Where:

A_p = Basic productivity of plant cubic meter per a year
γ = Average density of rocks (γ_{tm} = 2.6 ton m^{-3})
K_1 = Coefficient of rock pre-crushing mass, defined the amount of rocks sent to jaw crusher (K_4 = 1.1)
T = Duration shift (T_{cm} = 12 h)

$$Q = \frac{300000 \times 2.6 \times 1.1}{365 \times 12} = 196 \text{ ton h}^{-1}$$

For the primary crushing got as a result of rock explosion crusher Terex Finlay, J-1175, productivity of 250 ton per an h is employed. Fast load of stuff, high productivity and reliability operation are provided with powerful vibration feeder and hydrostatic gear units.

Feed inlet of jaw crusher permits to crush the stuff of size up to 700 mm; width of jaw is 50 up to 200 mm that appoints the faction size in the outlet of crusher is 0-200 mm. taken into account the alternative parameters the size of stuff that is 160 mm.

For repeated crushing Terex Finlay C-1540 cone crusher with productivity of 220 ton per h has been taken to identify an efficiency of mobile crushing-screening plant. While crushing stone of 0-160 mm the size of output is 0-40mm.

It is better to size crushed rock using the 3 deck screener of 694 Super Trak. Enlarged volume of feed hopper permits to increase efficiency of equipment. There is screening of crushed rocks size of 0-5, 5-20 mm and 20-40 mm.

Crushing and screening can be carried out by two ways: cyclic processing scheme or straight-line scheme. Cyclic processing scheme involves unloading material from the jaw crusher into cone then overcharging it into a hopper cone crusher. When straight line technology is used if products are not required at an intermediate stage, the individual units are mounted in series, overcharge through the system feeding conveyors. This provides better performance compared to the complex cyclic scheme.

RESULTS AND DISCUSSION

Straight-line scheme of processing based on Terex Finlay assemblies has been presented on Fig.1. Next step of calculation under justification of mobile crushing-screening plant combination is selection of loading equipment. Selection of loading equipment is carried out providing its efficiency.

Calculation of respective scoop capacity is made in terms of efficiency calculation formula (Shpanskiy and Buyanov, 1996):

$$? = \frac{T_{oc} k_2 Q}{3600 T k_3 k_4 \gamma} \text{ m}^3$$

Where:

T_{oc} = Operational cycle duration of loading equipment (T_u = 45 sec)
K_2 = Coefficient of rocks loosening in the scoop, K_p= 1.9 (for heavy mineral (Kornev *et al*., 2000)
K_h = Coefficient of scoop filling (K_h = 1.05)
K_3 = Equipment employment coefficient of main working operation (K_h= 0.6)

$$E = \frac{40 \times 1.9 \times 220}{3600 \times 1.05 \times 0.6 \times 2.6} = 2.8 \text{ m}^3$$

So, capacity of loading equipment meets trouble-free service and is not <2.8 m^3. Crawler diggers and front wheeled loaders are employed as loading equipments for feed hopper loading, cone output discharging and site cleaning as well as for auxiliary operations.

Process flow diagram of loader operation providing the most efficiency of mobile crusher-screening plants has been considered within this investigation (Efremov, 2013).

Now a days, there is a great variety trademark of front loaders. Taken into account scoop capacity for this

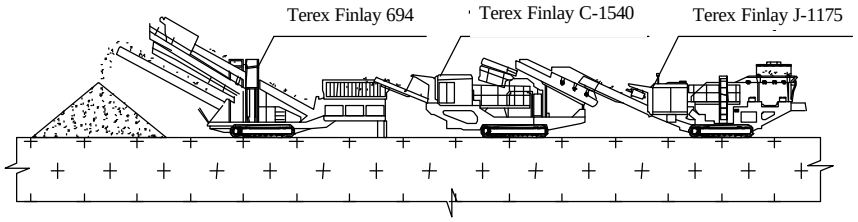

Fig. 1: Process flow diagram of crushing rocks production, Terex finlay units

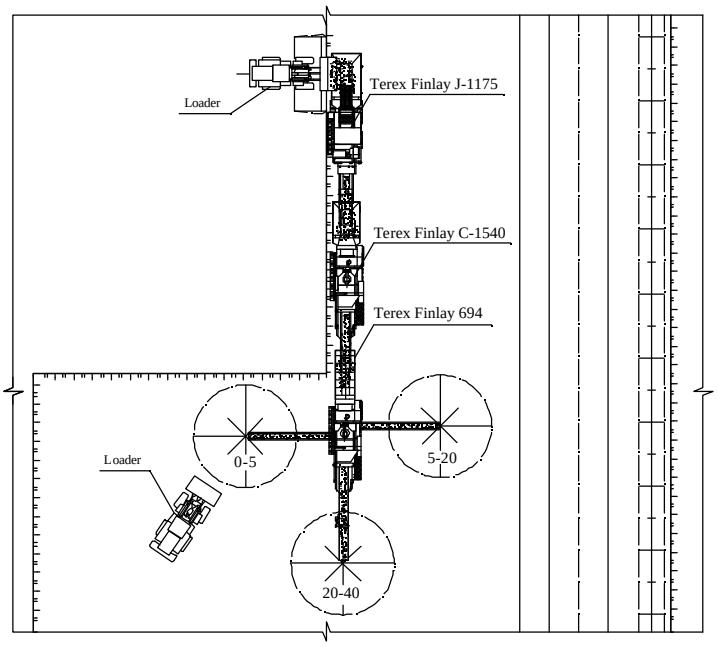

Fig. 2: Operation scheme on the site of crushed rock processing

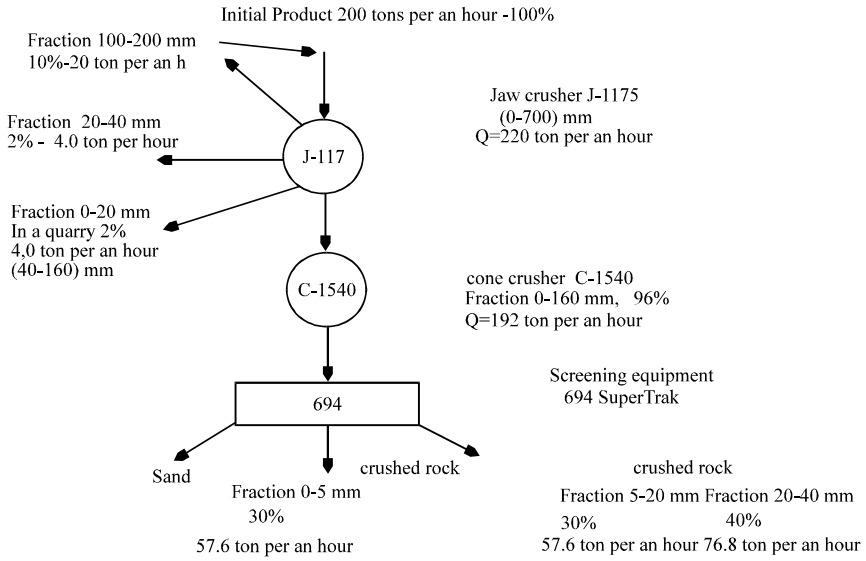

Fig. 3: Qualitative-quantitative scheme of crushing and screening equipment, Terex finlay

mobile crushing-screening plant, the following equipments: Volvo L120G (scoop capacity is 3.0 m^{-3}, Liebherr 550 (scoop capacity is 3.2 cubic meter), Caterpillar 966H (scoop capacity is 3.5m^{-3}) can be recommended.

Two loaders operation scheme of crushed rocks processing on the site of minimal width has been presented in Fig. 2.

Figure 3 presents qualitative-quantitative scheme of crushing and screening equipment. It helps to forecast productivity and quality of end product to consider additional work coupled with repeated crushing.

CONCLUSION

Thus, the methods of selecting devices to set up the mobile crushing and screening plant processing granite into crushed rocks of (0-5, 5-20, 20-40 mm) have been presented on the base of Terex equipments in the study. Depending on the market production of crushed rocks using this techniques permits to customize without material and labor expenditures with high efficiency.

The Finlay range of crushers are designed to meet the toughest demands of primary crushing applications with their impressive power, reliability and proven performance. High mobility of plants, especially pneumatic-tyred, permits to transfer them from one location to another one in short period time. Time spending is defined with the distance of transportation is constituted some h up to day.

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