УДК 622.271

Shmalko Serhii, st. gr. 133м-24-2
Scientific supervisor: Andrii Bondarenko D.Sc. (Tech.), Professor of the Department of Engineering and Design in Machinery Industry, Professor
Dnipro University of Technology, Dnipro, Ukraine

DETERMINATION OF PARAMETERS AND DESIGN OF A QUARTZ CLAY SAND TRANSPORTATION UNIT WITH A CAPACITY OF 30 T/H

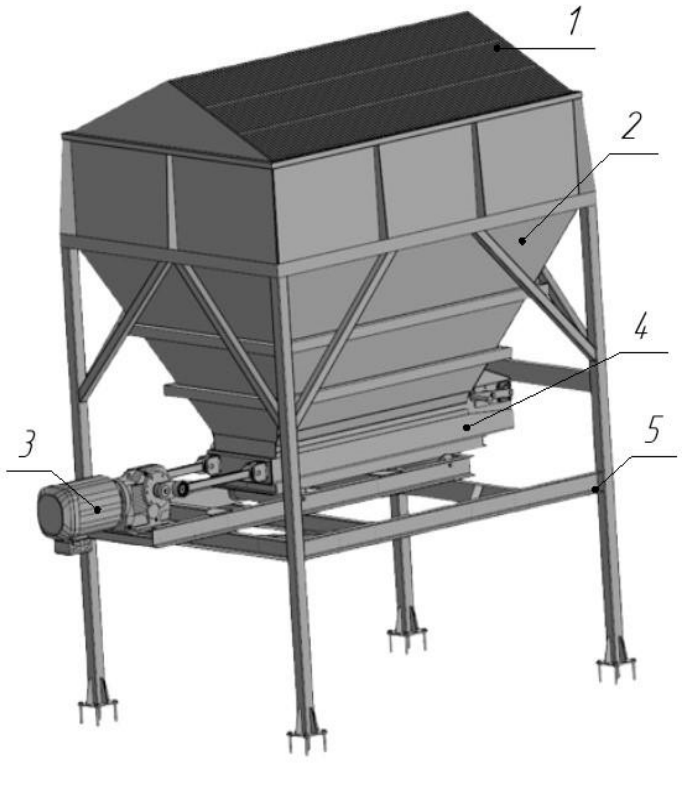

Figure – The tray feeder with a capacity of 30 t/h
1 – grate; 2 – hopper; 3 – drive with a crank mechanism; 4 – tray; 5 – tray feeder support frame.

The tray feeder is designed for uniform feeding of quartzite clay sand from the hopper for further processing by technological equipment - for example, a screen, crusher, hydroclassifier, belt conveyor or washing plan. The operation of the tray feeder is based on a combination of gravity and forced oscillations, which ensure the translational movement of bulk material along the tray with its simultaneous loosening.

The working tray of the tray feeder is driven into oscillating motion using a 0.75 kW EV050 worm gear motor. The torque from the engine is transmitted through a crank mechanism, which generates an oscillatory motion with a frequency of 400–600 oscillations per minute. The amplitude of oscillations is on average 3–6 mm. Such parameters of the oscillations of the tray of the tray feeder ensure effective displacement of material particles from their place, their smooth movement from the hopper forward and prevention of clay particles from sticking together.

When the tray moves forward, the sand particles, due to the force of inertia, slide along the bottom of the tray, and during the reverse movement, they are partially detached from the surface, which reduces friction and promotes mixing. Thanks to this action, the material moves in a stepwise, uniform flow, without the formation of blockages or voids.

A feature of the supply of quartzite-clay sand is its tendency to caking, so it is important to maintain a constant rhythm of oscillations and a slight inclination of the tray at an angle of 5–10°. This creates favorable conditions for the gravity movement of the material, enhances the process of sieving fine particles and prevents the accumulation of moisture in the sand layer.

Thus, the tray feeder performs several functions at once:

- uniform material supply to the production line;
- partial loosening and mixing of loose mass;
- preliminary separation of clay clumps from quartz grains;
- stabilization of material flow at the equipment inlet.

The uniformity of the feed directly affects the efficiency of subsequent operations - washing, screening, enrichment. If the material flow is uneven, the following units will experience overloads or shortages of raw materials, which will reduce the overall productivity of the line.

The use of a 30 t/h tray feeder eliminates these disadvantages, ensuring a stable and controlled material flow with minimal energy consumption.

One of the main parameters that affects the technological performance of the tray feeder, as well as its design parameters, is the speed of movement of the raw material flow through the tray. Quartzite-clay sand with a grain size of up to 5 mm has its own characteristics that must be taken into account when designing a tray feeder. Therefore, when feeding this material with particles up to 5 mm, the speed of the raw material flow through the tray is determined by the formula

$$v = \frac{Q}{LB} = \frac{0{,}0052}{1 \cdot 0{,}6} = 0{,}00868 \ \frac{m}{s},$$

where $Q = 0{,}0052\ m^3/s$ (equivalent to 30 t/h at ρ = 1600 kg/m³) – tray feeder capacity;

$L = 1{,}0$ – calculated tray length, m;

$B = 0{,}6$ – calculated tray width, m.

The obtained value of the speed of movement of the raw material flow through the tray indicates that the movement of particles occurs evenly without stagnation of the material, and the design parameters of the tray feeder are selected correctly.

In this work, a solid-state model was developed in SolidWorks, the technological and design characteristics of a tray feeder with a capacity of 30 t/h were calculated, and the parameters of its main elements were justified.

References

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