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METHOD OF CALCULATION OF GRAVITY TYPE WASHING EQUIPMENT

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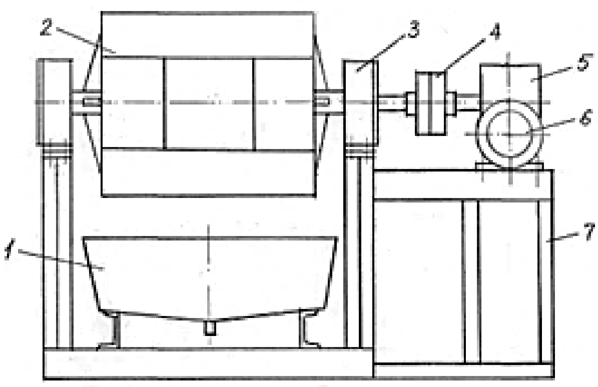
To remove products of corrosion, grease residues, asphalt-resin deposits from parts during machine repair, as well as burrs from the surfaces of newly manufactured parts, it is effective to use cleaning methods based on tumbling techniques. Small parts (valve rocker arms, pushers, valve spring seats, valve springs, etc.) and normals (bolts, nuts, studs) placed in a basket are poorly cleaned in jet installations, and therefore it is advisable to use the abrasive cleaning method for their cleaning.

The essence of abrasive cleaning is that the surfaces of parts are freed from contaminants due to mutual friction between themselves and the walls of a rotating drum, dynamic interaction with the abrasive, which has a large reserve of kinetic energy. This energy is spent on cutting contaminants in the form of small chips and on their grinding [1].

Abrasive fillers can be a porcelain cover, a battle of abrasive wheels, etc. Kinetic energy can be given to the abrasive in various ways. One of them is rotational-abrasive. With this cleaning method, the working mixture is placed in a drum or container that rotates with a constant or variable angular velocity. Depending on the kinematic schemes, rotational-abrasive equipment is classified into gravitational, centrifugal-gravity and centrifugal-inertial [1]. Gravity-type equipment is simple in design and versatile. The main working elements of such equipment are rotating drums, inside which the working mixture of parts and filler is cascaded and moves freely.

Installations for gravity cleaning of parts consist of a frame, a drum and a drive. The frame is a welded structure to which the bearing housings, an electric motor and a gearbox are bolted (Fig. 1). The drum of cylindrical or polyhedral shape can be located horizontally, vertically, at an angle to the axis of rotation and is driven by an electric motor.



1 – pallet, 2 – drum, 3 – support, 4 – coupling, 5 – gearbox, 6 – electric motor, 7 – frame

Fig. 1. Kinematic diagram of the washing plant

In the case of wet tumbling, a washing solution is added to the drums, along with the abrasive particles, which softens the cutting action of the abrasive and ensures the removal of contaminants. The drums are loaded with 70...80% of their volume of the abrasive mixture.

To select an electric motor, the required installation power is determined. $P_{ДВ}$, W, by the formula

$$P_{ДВ} = T \cdot \omega / \eta \,, \tag{1}$$

where T – torque on the shaft of the washing unit, N m;

ω – angular velocity of the drum, rad/s;

η – overall drive efficiency.

$$T = m_g \cdot g \cdot r, \tag{2}$$

where m_g – weight of one load of parts into the drum, kg;

g − acceleration of free fall;

r – inner radius of the drum.

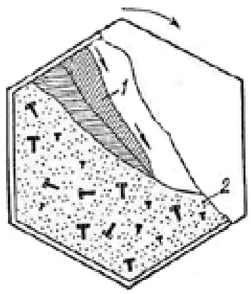
The angular velocity of the drum depends on the drum rotation frequency n, rpm.

The drum rotation frequency is selected based on the analysis of the phases of motion of the elements of the working mixture. At a low rotation frequency, a cascade movement is observed, in which the surface layers of the mixture in the upper part of the drum gradually collapse. An increase in the rotation frequency causes a breakthrough of the moving mixture, which begins to fall off in a flow. This state is called critical. A further increase in the rotation frequency leads to a state of equilibrium and a complete cessation of the movement of the working mixture relative to the walls of the drum. In this case, the force of gravity and the centripetal force acting on the element of the mixture are equalized (Fig. 2). The drum rotation frequency corresponding to this case is determined by the formula

$$n = \frac{C}{\sqrt{D}}, \tag{3}$$

where c = 42,3 – constant [2],

D − inner diameter of the drum, m.



1 – active zone, 2 – “dead” zone

Fig. 2. Scheme of the process of rolling parts in a hexagonal drum

According to experimental data [2], the optimal number of drum revolutions is taken to be 35…40% lower than the value obtained by calculation according to the formula.

The nominal power is selected according to the table, the closest, larger value $P_{ДВ}$, to wit $P_{НОМ}$ ³ $P_{ДВ}$.

Despite the disadvantages of drum tumbling machines (high noise level during operation, low processing speed, etc.), the undoubted advantages of this type of equipment include relatively low cost, simple design, and easy maintenance.

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