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CALCULATION OF POWER CONSUMPTION OF PUMPING AGGREGATES

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Annotation. This research paper provides equations for calculating the power spent on the processing of water in pumping aggregates. When analysing the models of fast rotation, a theoretical equation is presented to determine the amount of energy spent on the formation in an active mode in the process of water processing.
Key words: pumping aggregate, water processing, power consumption.
Аннотация. В данной статье приведены уравнения для расчета мощности, затрачиваемой на переработку воды в насосных агрегатах. При анализе моделей быстро вращение приведено теоретическое уравнение для определения количества энергии, затрачиваемой на формирование в активном режиме в процессе переработку воды.
Ключевые слова: насосный агрегат, водоподготовка, энергопотребление.
Ушбу илмий мақолада насос агрегатларида сувни қайта ишлашга сарфланган қувватни ҳисоблаш учун тенгламалар келтирилган. Шунингдек, тез айланиш моделларини таҳлил қилишда сувни қайта ишлаш жараёнида фаол режимда қатламга сарфланган енергия миқдорини аниқлаш учун назарий тенглама келтирилган.
Калит сўзлар: насос агрегати, сувни тозалаш,энергия сарфи.

Introduction

It is well known that centrifugal pumps are one of the largest groups of consumers of electrical energy. They are widely used in all industries. In particular, TsN are often used in pumping hot and cold water supply in cities, in pumping oil at oil pumping stations, where the power of the drive motors reaches up to 1.5-2.5 MW. Centrifugal pumps have a wide range of power and drive motors.

In the process of supplying and distributing water in the city water and heat supply networks, a significant amount of electrical energy is consumed, depending on the mode of operation of the pumping units. Pumping units supplying water to the urban network operate under conditions of a wide variation in the range of loads. For these conditions, the choice of their effective, energy-saving control method, appropriate parameters is difficult. The electricity consumed by centrifugal pumps is spent to a greater extent on overcoming the forces of hydraulic friction in the valves, friction forces in the oil seals, bearings, at the height of the liquid rise, in pipelines, etc. Dryers differ in their design[1,2,3,4]. A number of dryers are used in the industry, such as cabinet, chamber, corridor, shaft, drum, tubular, screw, cylindrical, turbine, rotary, conveyor, pneumatic, sprinkler, etc.

Methods of research

Contact dryers used today in production, unlike other dryers with high efficiency, do not allow product loss and environmental pollution. In high speed rotary rotor contact dryers, the inner surface of the drum can be fully utilized by increasing the rotation speed. The device consists of a rotating rotor in a stationary heated housing mounted on the rotor blades. The wet material is fed into the device through the auger, and the dried product exits the device through the outlet nozzle. Secondary vapors generated during the drying process exit the nozzle. The rotary movement of the rotor is provided by an electric drive[5,6,7,8]. This equipment works as follows. The rotor blades mix the material, scattering it along the inner wall of the drum, and the resulting centrifugal force throws the material against the wall of the equipment. The number of revolutions of the rotor is determined so that when material particles collide with particles, the centrifugal force created by the speed with which they perceive the particles must be greater than the force of gravity. As a result, the material particles are evenly distributed on the inside of the equipment wall under the action of centrifugal force. The distribution of material occurs not only along the inner wall of the drum, but also along the axis of the material fittings. As a result of this distribution of material, the particles to be dried move from the inlet to the outlet of the device. In such an apparatus, the material is heated through the wall of the drum[9,10]. In such drum dryers, maintaining a stable layer of dispersed material on the inner surface of the drum requires a continuous supply of energy from the outside. The layer of material in the range can be in the form of a dense or abstract layer, depending on the size of the particles and the characteristics of the technological process. Studies carried out during the formation of a material layer have shown that the energy required to create a material layer on the market depends on many parameters: for example, on the specific properties of the material, as well as on the conditions for the formation of the layer. When drying small materials less than 1 mm in size, it is preferable to form an abstract layer. The energy consumption for mixing and transporting the abstract laminate is minimal and may not be considered in the energy balance of the drying process.

However, as the diameter and physical density of the material to be dried increases, as well as the load-bearing capacity of the material increases, the energy required to form the layer increases dramatically. In this case, the energy required to create a layer can be up to 21% of the energy spent on drying. The period of free moisture removal is characterized by the fact that the desiccant on the surface of the material is in a saturated state and evaporation continues according to the laws of free evaporation of liquid. The drying process during this period is mainly determined by the rate of heat transfer from the drying agent to the material to be dried by convection.

Fig.1. Power consumption of pumping aggregates

Results

One of the most important parameters that determine the drying mode is the temperature of the drying agent. During continuous drying, the temperature of the dryer changes along the length of the dryer as liquid evaporates and heat is transferred to heat the material, blades and drum walls. The calculation of the period for the removal of bound moisture differs from the calculation of the period of free moisture loss, since the relative humidity of the drying agent on the surface of the material is less than one, so the temperature rise of the material must be calculated using the equilibrium ratio between the dryer and the drying material. Considering that this energy is ultimately dissipated into thermal energy for the formation of the layer, it is necessary to take into account the energy dissipation of the energy of the formation of the material layer in the overall heat balance of the drying process.

Conclusion

Dispersed material accumulated in the gap between the inner surface of the cylindrical pump drum and the outer end of the rotating blades is considered a quasi-homogeneous medium in which mechanical energy dissipates. It was believed that the viscosity equation for a homogenized medium can be described similarly to the Mooney equation for dispersed materials [2]:

$$\mu = \mu_0 \exp(x\phi), \quad (1)$$

here: μ_0 - the viscosity of the dispersed medium is in our example: vapor or air; φ - volumetric concentration of solid particles in the layer;

x - a coefficient depending on the shape of the dispersed phase particles.

In this case, the force acting on the paddle:

$$F = 2\pi RL\mu \frac{\omega r_л}{\delta}, \quad (2)$$

Here r, - the outer radius of the paddles; δ - the thickness of the gap between the paddles and the drum. Visual observations and experiments show that the concentration of particles in the field is constant, which allows us to write the following equation:

$$M = F \cdot r_л = 2\pi\omega\mu RL \frac{r_л^{\ 2}}{\delta}$$

In this case, the force required to create and maintain a layer of dispersed material is determined by the following ratio:

$$P = A\omega^m RL \frac{r^2_л}{\delta} \mu_0 \exp(x\phi), \qquad (3)$$

Where: m_1 - for laminar motion mode, and m_2 = for turbulent motion mode; the value of m in general can be determined experimentally. The value of A is also determined in experiments conducted to determine power consumption.

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