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Research Article

THE MOST IMPORTANT SOLUTION FOR IMPROVING ISSUES DRUM DRYERS

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ABSTRACT

The article analyzes the effect of rotation speed on the parameters of movement of materials in a drying drum: the degree of material distribution over the transverse surface of the apparatus, the average time of its stay in the apparatus and the degree of loading. As a model material in the experiments, we used a mineral fertilizer produced in the superphosphate shop of the different kind of factory.

KEYWORDS

Dryer drum, distribution degree, average residence time, load degree, fall length, mineral fertilizer.

INTRODUCTION

The rotary drum dryer manufactured also called dryer. It is widely used in building material, metallurgy, chemical engineering, and cement industries for the drying of slag lime stone, powdered coal, slag and clay. The drying machine has the features of reasonable structure, fine processing, high output, low energy consumption, and convenient running. This rotary drum dryer consists of rotary body, throwing filtch, transmission device, supporting device and sealing ring. As we know such kind of field attract majority of factory. Due to the fact that, the new

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inner structure strengthens the cleaning and heat conduction of the dispersed material, and eliminates the bonding in the inner drum wall. The adaptability to the material moisture and stickiness is stronger. As well as it adopts direct flow drying method. The gas fume and the material go to the dryer from the same side [1-3]. By using the hyperthermia gas fume, the evaporation strength is very high. With the low outlet temperature, the heat efficiency is very high. The operating parameter can be changed according to different materials. So that the material can form a stable fabric curtain and achieve fully heat exchange. In addition, the dryer is of strong overload capacity resistance, large process load, low fuel consumption, and low cost [4-9]. The zero level thrust of the dryer reduces the abrasion to the catch wheel and the riding wheel. The operation of the rotary drum is stable and reliable. The dryer adopts the riding wheel device, which make the riding wheel and the rolling ring linear touch all the time. Thus the abrasive and the power loss are greatly reduced. The new type feeding and discharging device solve the problem of feeding jam, discontinuous and uneven feeding, and returning charge which lighten the load of deducting system [8-11].

Analytical research method.

According to the scientific research drum devices are used for heat treatment and drying of dispersed materials. The theory and experimental data on the processing of dispersed material in the Internet and in the literature are different, and there is no generally accepted analysis by researchers. The model of material thermal treatment and drying in the investigated drum dryers is different from the processes mentioned in the literature. In this case, the dispersed material is located inside the cylindrical drum of the apparatus and in the gap between the rotating rotor. Visual observations showed that when the filling coefficient of the interstitial space is less than one, the granular material is in a drum state. The movement of the particles is as follows: the particles collide with the rotating blades and move towards the inner wall of the drum at different angles. Mixing of material particles occurs as a result of the interaction between individual particles and groups of particles, the wall and blade of the apparatus.

On the basis of theoretical and experimental research, mathematical equations of the processes formed in the dryer and the thermal treatment and drying process were proposed. At present, various devices are used for drying products in production enterprises. The advantage of widely used drying drums over other devices is their structural simplicity, ease of management and relatively low cost. The drying drum consists of a cylindrical body inclined to the horizon, and the processed product is loaded from one end and discharged from the other end. The amount of heat needed to dry the material is given by means of opposite or parallel directed heat agent. In order to improve the contact of the material with the heating air, special nozzles (nozzles) are installed inside the cylindrical drum. It can be achieved by using the energy of hot gases more fully to accelerate the processes of heat and mass exchange between the gas and solid phase in the drying drum. The solution to this problem is to increase the contact surface and time between the gas and solid phase. Among the various options considered, the following are the most important to ensure uniform distribution of the rain of material sprayed by nozzles along the cross section of the drum. Increasing the coefficient of filling the drum with material; - increasing the time of material particles being in the drying area. Knowing the amount of material in the nozzle and the amount of material raining from the nozzles is very important in determining the optimal loading coefficient of the device. If the amount of material in the drum is less than the optimal indicator, it leads to a decrease in its work efficiency. On the contrary, an excess amount of material leads to the formation of a layer that does not participate in the drying process in the apparatus and to overloading of the apparatus. This leads to a decrease in the intensity of the drying process and excessive energy costs. The form and value of the material rain from the nozzle is one of the factors that determine the efficiency of the drum.

Figure 1. The structure of Nozzles in the drum

First, the uneven distribution of the material from the nozzles in the dryer creates open zones in the rain of the product that is scattered along the cross section of the drum. The formation of this zone reduces the presence of an open path without resistance to the air flow and, as a result, the full, effective use of the heat agent, which reduces the amount of heat received by the material to be dried and the intensity of the drying process.

Secondly, due to the presence of an open zone in the dryer, the speed of the heat agent flow increases, which in turn increases the removal of small particles of the material with the flow of the heat agent, leads to an increase in the temperature of the gases coming out of the drum and inefficient consumption of the heating agent during the drying process.

Therefore, the form and value of the material rain from the nozzle is one of the factors that determine the efficiency of the drum. Researches

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have been conducted by researchers for nozzles of various constructions and their quantities. For example, N. J. Fernandez and his colleagues proposed the following equations to determine the coefficient of surface filling for a three-component nozzle.

$$S = \frac{R^2}{2}[\beta\text{-}\sin(\beta)] + \frac{1}{2}\left|x_A y_B + x_B y_C - x_C y_B + x_C y_W - x_W y_C\right| \quad (1)$$

Depending on the location of the nozzle in the cross-section of the drum, the time the particle stays in the air varies. Taking into account that the drying process mainly takes place while the particle is in hot air. The length of the particle from the end of the nozzle to the bottom of the drum can be determined by the following equation:

$$Y_q = \frac{Y_0 + \sqrt{R^2 - X_0^2}}{\cos(\alpha)} \quad (2)$$

The number of nozzles is also important in order to completely cover the drum's transverse surface. In cases where the number of nozzles is small, open zones are formed in the cross-section of the drum, which reduces the efficiency of the drying process. The excess number of nozzles leads to their destruction, that is, in the process of filling the nozzles with material and the rain of material flowing from the nozzles intersecting with each other. When rain of material intersects with each other, the rain zone becomes denser and its contact with air decreases, as a result of which the heat exchange process slows down. According to our hypothesis, there should be minimal disturbance between the streams of rain of material. The complexity of the solution to this problem depends on the design of the nozzle, the different physico-chemical properties of the material being dried, and must be solved for the specific material.

The results of these studies are analyzed. In this case, from the point of view of the uniformity of the distribution of material rain, U-shaped nozzles show a clear advantage, because in this case, the coverage of the drum surface of the material distribution was more valuable than other types of nozzles. Therefore, we made different types of U-shaped nozzles and made different experiments. I have shown these results above. I can tell you about the plants that we made and experimented.

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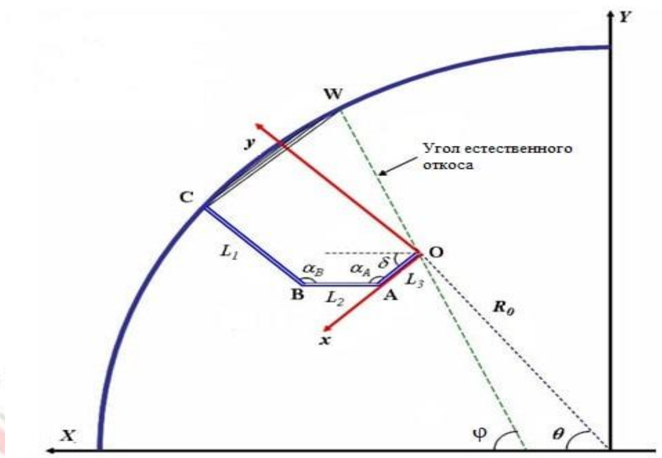

Figure-2. The layout of the nozzle on the drum.

Table1

Shape №	L_1	L_2	L_3	α_S	α_V	α_A
1	10	5	-	90	90	-
2	10	7	-	90	135	-
3	10	10	-	90	90	-
4	10	7	5	90	90	135
5	10	7	7	90	90	135
6	10	7	5	90	100	120
7	10	7	7	90	130	130

According to the table, power supply rarely provides equal distribution. Therefore, to determine the construction of the nozzle, which ensured the uniform distribution of the material in the apparatus of our research. The numerical values of the transformation of the prepared experimental nozzles to the drum and the inspection of the test nozzle are given in Table 1. Since the purpose of our experiment was to determine the optimal nozzle shape for a certain material, superphosphate mineral fertilizer was chosen as a model material. In the study, the effect of the shape of the nozzle on the speed of material scattering and the distribution of materials in the cross section of the dryer were studied. We assumed that the distribution of materials in the cross-section of the drum is not affected by the angle of inclination of the drum and the speed of the heating agent. To study the distribution of material on the cross-sectional surface, the work of one nozzle was studied. The nozzles work independently of each other, and if the distribution function of the material from one nozzle of a certain shape is assumed to be the

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same for nozzles of the same shape, it is clear that the nozzle system will remain the same in operation. First, the mass of the material in the nozzle (in kilograms) was measured. Then the drum is rotated slowly. In order to experimentally study the distribution function, 11 boxes were installed on the base. The nozzle is initially loaded to the maximum with the material. Then the device was set in motion at a certain speed. In this case, the material is completely discharged from the nozzle during rotation, the mass of the discharged material in each section of the sample box is weighed, and we find the distribution function of the material depending on the rotation, knowing the step of these sections. Such experiments were conducted for different nozzle shapes and the packing efficiency was evaluated by distribution function values. Examples of fertilizer spreading experiments from nozzles are shown in the following pictures.

Figure-3. processes of mineral fertilizer spillage from the nozzle

In order to determine the optimal design of the drum nozzle, research was conducted with 7 different types of nozzles. When the drum segment is rotated with a nozzle filled with material, the material starts to be dispensed from the nozzle and spread into 11 boxes on the base mounted inside the drum. In this case, the shape of the nozzles should evenly distribute the drying material along the cross section of the drum.

Conclusion

From figure it can be seen that an increase in the productivity of the drum leads to an increase in the coefficient of distribution of material over the cross section of the drum by an average of 8-10%. In addition, an increase in the number of rotations of the drum leads to an increase in the material curtain coefficient over the cross section of the drum by an average of 7-8%.

From figure it can be seen that an increase in the productivity of the drum leads to a decrease in the residence time of the material in the drum by an average of 14-17%. In addition, an increase in the number of rotations of the drum leads to a decrease in the residence time of the material in the drum by an average of 27-38%. Our experimental data are in good agreement with the equation E.B. Aruda by the average residence time of the material in the drum.

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