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VIBRATING SCREEN DESIGN OF 20 MICRON FINE PARTICLES WITH SPHERICAL AND CUBED MILLS

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ABSTRACT

The grinding of materials has long been of human interest. Man has to crush or crush some materials. In the industry, crushing the material is very important. In some industries, along with crushing of materials, other characteristics such as geometric shape and fine-grained dimensions are introduced. Many machines have been designed and made to grind and polish materials of any size to a geometric shape. Despite the high reliability of these devices, there are also advanced laboratories to check the output of these devices. An experiment on microscopic particles causes much time and money. The thesis is based on a three-piece machine, which has a micro-grinding ability of 20 microns in size, and then polishing twenty-micron materials in spherical geometric shapes and then grinding materials. Materials that fail to pass through are returned to the mill. This ensures that the quality of the fine-grained material can be removed from the machine. Also, in designing this device, considering the capacity of the screen and the speed of operation, the maximum has been attempted to increase the tonnage acceptable to the device. At the end of this research, the model of the proposed model is drawn up in the Solid Works simulation software, and the dimensions of the device are presented.

1. INTRODUCTION

Milling of materials smaller than 1 mm by vibrating hammer mills [1]. But there is no complete assurance about the output of the material inside the mill that all the materials have reached the desired dimensions. Hence, we have to make sure that the mill is working properly. So far, various grinding machines have been available for use in the industry [2, 3]. However, there are currently no grinding machines available. In this paper, to ensure proper grinding of the material by the mill and also to determine the geometric shape of the fine grains, a vibrating hammer mill along with a vibrating grinder is used to return the finely divided grinder to the mill entrance. In this paper, the geometric shape of the material that is being grinded is important. It should then be polished to a spherical shape by means of a spheroidal device having a self-shaped internal wall. Spherical materials are free of any sharp corners. This machine is hit by the pressure of fine particles to the wall of the machine to eliminate their corners. The output of this machine runs on the screen to sieve.Before describing the proposed scheme, the problem, milling records and assumptions are discussed, then in the third chapter of the project model, the Solid Work software will be drafted and explanations will be provided on the equipment used.

The following points should be considered regarding the selection of grinding mills for this project:

- The mill should be able to shred materials up to 20 microns in size.
- The screen should be able to screen small particles of 20 microns and smaller.
- The mill should be able to as close as possible to the geometric shape of fine grains to be cubic or spherical.

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According to these conditions, the mill should choose to crush the material. That is, by hammering it can divide the material into smaller particles. This split should be in the powder range. Jaw vibrating mills have the proper power and excellent speed in this regard. These mills have a reservoir with a central jaw center. When starting the milling mill, the inside of the mill is crushing the material by tapping the walls of the mill. Vibration in the reservoir is used to make the grinding to the optimum level. These vibrations also cause blows from the walls of the reservoir to the inner jaw. That is, the material between the inner jaw and the wall of the powder mill. These mills have the ability to produce fine particles at 2 microns. The largest particles that come out of these mills are in size less than 50 microns. (50 microns in size as human hair diameter)

By selecting the vibrating hammer mill, crushing of the material is possible to reach 20 microns. But it's very important to discuss the matter of crushed material in cubic or spherical geometric shapes. To convert the geometry of the material, the polishing method should be used. In polishing, materials are transformed into geometric shapes using sandblasting or similar devices. But polishing micro-microscopic material is a difficult task. Typically, fine grains that come out of a vibrating hammer mill have cubes and corners. But to convert these materials into a spherical geometry, we have to apply polishing action.

Small grains that come out of the mill have no particular stiffness, and their chemical compounds are virtually eliminated. They can then be placed inside a spherical enclosure that has soft, fine-walled walls. This chamber causes winding and rotating winds causing crushing of fine particles to the wall of the compartment as well as blows to other fine particles. Hence, the smudges cut the outer walls of fine grains and, as far as possible, eliminate the sharp edges of these fine grains. The material output from this chamber is spherical geometry.

Emerging electronic vibrations are used to recognize that the material outputs from the chamber are smaller than 20 microns in size and also have a spherical geometry. These meshes available in various mesh sizes, with mesh spherical mesh cavities, are capable of detecting and screening materials smaller than twenty microns and spherical ones.

2. METHOLOGY

2.1. Roller mill

This mill is made up of a moving plate [4, 5and 6]. This plate is constantly being developed by an electric motor. There are a number of jaws on this animated plate. These jaws are attached to the moving plate by bolts and nuts and are fixed. But the oscillations produced by the moving plate do not include the stagnation of these jaws. Inside these jaws are internal rollers that are spaced apart from the outer jaw. These rollers also create fluctuations using an electric motor. At the start of the mill, the fluctuations of the moving plate cause movement of the outer jaw and the roller fluctuations cause crushing of the inner material of the mill. Materials should be poured between the outer jaw and inner rollers. The fluctuations cause the jaw and rollers to come in contact with each other and the materials become fine-grained.

The strength and speed of this mill depends on the parameters such as the distance between the jaws and rollers, the rotational speed of the moving plate and the speed of rotation of the rollers. If the rotation speed of the moving plate and the inner rollers are high, it will surely grind at a shorter time, and the speed of the machine will increase. But this increases the stiffening of the jaw and roller, causing the mill to become worn sooner. After this value must be at an optimum level that damage to the lining of the jaw is missing as well as the speed of operation is desirable.

Also, if the spacing of the jaws and rollers is less, smaller fine grains are obtained, but if we increase this distance, larger fine particles will be produced, sometimes larger than 20 microns. But this distance represents the mill capacity. If this distance is low less material can be delivered as input to the mill and if this distance is high, input of the mill will be increased [7, 8].

2.2. Polishing fine grains

Materials that come out of the mill must have a certain geometric shape. Materials that are crushed by a jaw and roller have a cubic geometric shape [9]. Due to being crushed by the blast, these materials have sharp edges that are preserved in crystalline form and somewhat cuboid. If the exhaust material is required in the form of a cube, the material is directly discharged from the grinder; otherwise the material must first be molded into the machine and sent to the surface after the deformation.

The polishing machine can polish the materials with specially designed geometric shapes in the wall by means of wall molding [10, 11]. In this device, cubic and spherical geometric shapes are required. Cube shapes are made by the mill itself and geometric shapes should be produced by polishing machine. To turn the fine particles into spherical states, we need to clear the sharp corners of these fine grains. Since most mineral rocks are composed of crystals, after crushing the crystals by a mill, these crystals lose their hardness and become broken [12]. So, these crystals can be spherically geometrically shaped by a tamer. The polishing machine is in the shape of a sphere, with the interior walls of the globe completely covered with sandblasting. The material is transferred to the machine after the mill, and the machine rotates the interior material into the molds around it and smooth's the sharp corners of these crystals. The materials are spherical after leaving the device [13, 14].

2.3. Electronic vibrating screen

The vibrational vibrator that vibrates on the home screen by moving the fine particles on each other can pass the material from their plates and carry out sifting on the material [15, 16]. The force that pushes these assemblies to It can be driven by electricity and mechanical power. Electronic vibrational sabers that use electric power to drive gears and then the gearbox output force to vibrate on the screen are used to combine electric and mechanical power [17]. These sifters dilute materials by varying from about 70 to 100 times per second. There are a variety of different weapons, each of which sorts material. The mesh screens in this type of crevice have a gentle slope. This slope is considered as one of the most important parameters of the speed of abrasion. If this gradient is high, the material will consume less time from the moment it enters the screen, leaving the screen output also less. But if this slope is less, the material will become more accurate, but the operating speed will be reduced [18-20]. The project requires twenty microns. This is very tiny, and the speed of sneezing is also very slow. As the high tonnage mill was considered, there is also a high tonnage of the sink output. But the use of twenty microns brings down the speed. To solve this problem, we try to use the multi-layer. Multi-layer silhouette has several layers of mesh with different dimensions, each of which filters one size of fine grains. If a fine grained material passes through the first layer, it must pass through the second layer of the mesh, and this process continues until the last mesh of the house, which is twenty microns. The fines on the final mesh have dimensional finishes that can be easily filtered and the operation speed is somewhat reduced. In this project, the 600 mesh is required for the separation of fine twines with a diameter of 20 microns. From the direction in which the surface is to be considered multilayer, it is better to consider the 600 mesh for the separation of fine particles smaller than 20 microns and in the upper layer of the mesh 500 for the separation of 25 microns and in the upper layer for the separation of larger fine particles. The mesh number 400 is used. Small fine grains are then first passed through a grain size of less than 37 microns and then passed through a size smaller than 25 microns, and eventually twenty micrometers pass through and are provided as a sieve output. Small grains that have not crossed any of the layered layers are driven by a conveyor to the mill. These fine grains should be re-grinding and desirable.

Using more layers for vibrational shake will increase the accuracy and speed of operation, but it will also increase the build and maintain costs of the device.

3. RESULTS

To simulate this device, Solid Works software simulator is used. Side worth is computer-aided design engineering software running on Windows, developed and developed by the French Dassault Systems [21]. Figures 1 to 3 show three-dimensional views of grinding, abrasive, and vibrating mills in the Solid Works environment.

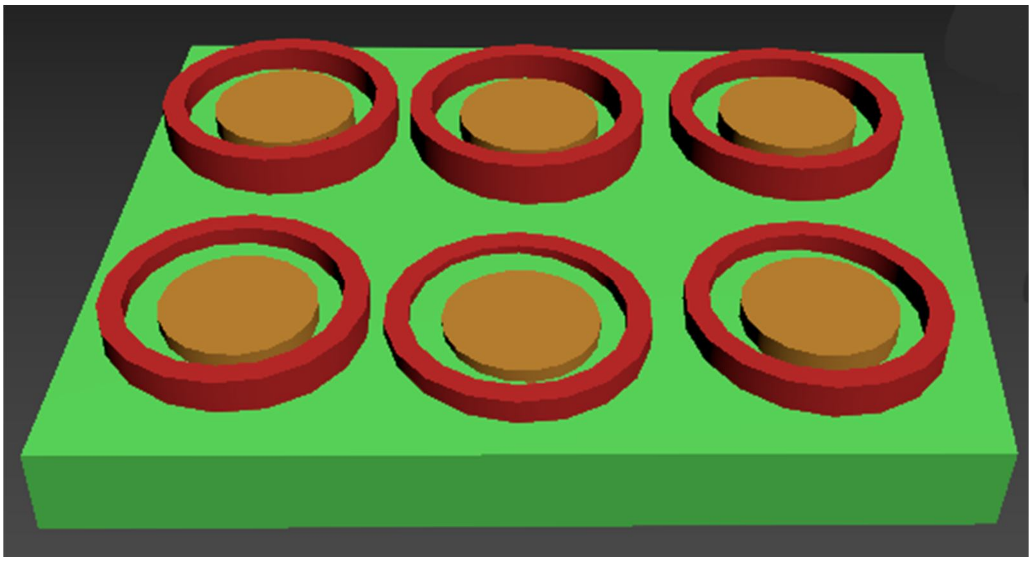

Figure 1 Designed from a roller mill in Solid Works

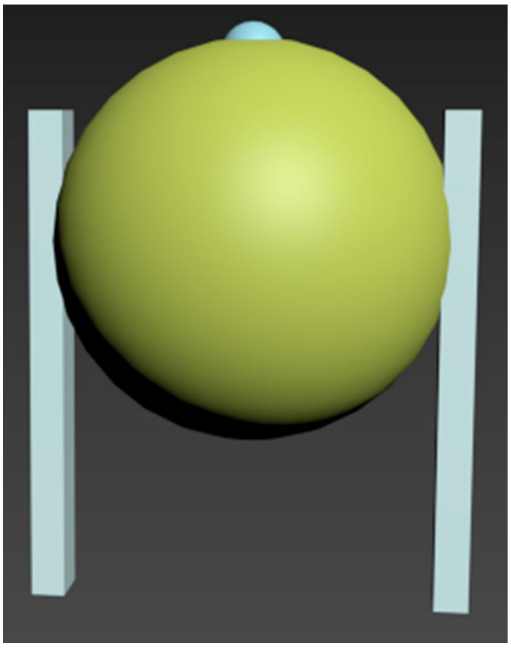

Figure 2 Designed from abrasive machine in Solid Works

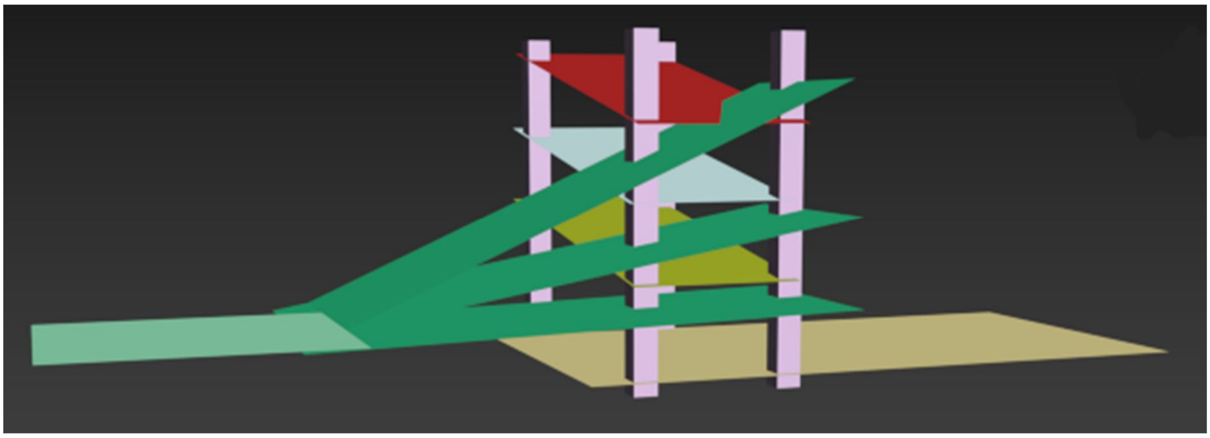

Figure 3 Vibrating Screen Designed in the Solid Works Software

In Figure 1, a jaw mill and a roller with 6 jaws are shown. In this mill, the materials between the jaw and rollers are poured into the powder, after 10 minutes of electronic oscillation. The input materials of this machine are fine particles with a maximum dimension of 1 mm. Materials must be converted into a millimeter fine-grained machine by a crusher mill before entering this machine. This speeds up the machine.

In Fig. 2, the material is inserted into the abrasive machine after leaving the mill, and the abrasive wheel rotates and rubbing material on each other and its welded walls, polishes the material and turns fine particles into a spherical shape. Make Exit materials from this stage are as inputs.

In Figure 3, a three-layer vibrating vibrator is shown. In this mesh first mesh, number 400, it filters the 37-micron fine particles and directs the fine particles with a diameter of more than 37 microns to the mill. The second mesh, number 500, filters the 25 micron fine grains and directs the rest to the mill. The third mesh separates 20 micron fine particles using the mesh number 600 and directs the materials that fail to pass through the mesh to the mill.

4. CONCLUSION

Crushing operations are sometimes used to crush minerals in very small sizes. For example, for the production of concentrates in copper ore condensation operations, materials must be dimensionally sized to 3 microns in size. Crumbling is an extremely difficult task, including mineral rock, including copper rock, which can sometimes reach up to 8 Mohs. On the other hand, if this grinding does not reach the desired diameter in micron, its grinding operation is not successful and no good concentrate is obtained. So in mincing, such minerals should be used with the utmost precision and speed so that the output of the crusher does not reduce the production efficiency of the concentrate.

Crushed crusher in Iran's copper factories is perforated. In these crusher minerals first turn into pieces of 1 cm in diameter or less. The crusher converts the material into heavy materials by heavyweight hammer and then passes through the crevices. In the secondary stage, the crusher converts the material to a diameter of less than twenty microns and sends it as an input to the condensing plant. At this stage, the control room experts should ensure the grain size and diameter of the input materials of the condenser tricks. If the diameter of this material is more than twenty microns, then the material must be returned to the mill. Also, the type of condensation depends on the fineness of fines. The materials should be either completely cuboidal or completely spherical. Concentrating experts issue a confirmation of the entry of substances into tickner, taking into account some of the condensate input fines and performing microscopic experiments on them.

Now, if these materials are more than twenty microns in diameter, or fine-grained cubes and spheres are mixed, the result of the production of concentrate is not desirable, and this error is determined during the melting of the concentrate. At the time of melting, if the quality of the concentrate is not optimal, the materials are known as low-grade and removed from the melt furnace. Therefore, the importance of graining and ensuring fine grain diameter is very important.

In this thesis, for the purpose of solving possible errors in determining the quality of materials for the output of a secondary crusher, there is an idea that only sends materials as outputs, which must have a diameter of less than 20 microns and the same aggregate. In this dissertation, a multi-part machine is provided that has the ability to crush, rub, and smoothen fine grains together. In this machine, the material is submerged to the crusher by a primary crusher with a small diameter after crushing. In the secondary crusher, the material is converted into a powder by roller mill. This device has a moving plate, which creates fluctuations by an electric motor with a minimum of 400 rpm. On this moving plate, there are fixed jaws that maintain their stability on the movable plate by bolts and nuts. Moving the movable plate, these jaws are spinning. Inside these jaws there are rollers that are oscillating individually. These rollers are also rotated with electric motors at a range of at least 800 rpm. Materials brought into the machine that are obtained from the primary crusher are placed between the jaw and rollers. The device generates at least 1200 bpm on the material by creating fluctuations in the moving plate and rollers. These materials are converted into powder when they are in the toughest condition after ten seconds. The powdered material inside the mill is not very hard because of its crystalline form, and has a special softness instead. By breaking the crystals of these materials, there are sharp corners around them. These corners make the material geometrically cubic. Now the material enters a wearing device. This abrasive machine is a spherical knife whose inner wall is soft. The material inside this wheel, rubbing on the surface of each other and on the wall of this device, lost its sharp corners and turned into spherical shape. After the twenty micron spherical fine particles of the abrasive machine come out, they enter the surface. The vibrating vibrator, which uses electrical and mechanical energy to spray materials, consists of three mesh screens. The front plate with mesh 400 shrinks material that is smaller than 37 microns and returns the rest of the material to the mill. The second plate with the mesh 500 brushes up to 25 microns and returns the rest of the material to the mill. The third page, with mesh 600, will shrink the material smaller than twenty microns and return the rest of the material to the mill. With this account materials that exit the third page have dimensions smaller than twenty microns. Therefore, the complete assurance of the grain size and size of fine grains on this machine can be achieved by the vibrating screen of the machine itself, and it can be safely assumed that the material will be used as an input of concentrate production.

Using three screens in this device to increase the speed of the screen. Because materials that have a diameter of more than 37 microns do not pass through the first mesh and do not heavier the meshes. In the second mesh, materials that are larger than 25 microns can not reach the third mesh. Other advantages of this device are reliability. This machine increases the speed and the ability to detect fine particles because it does not pass through materials that do not pass through the mill. On the other hand, the exhaust material must pass through the 600 mesh, so these materials have a diameter of less than twenty microns.

To maximize the tonnage of materials that could be crushed in this machine, we considered the distance between the jaw and rollers in the mill as much as possible. The distance of 13 cm, at an altitude of 70 cm and an area of 5717 cm 2, has a capacity of about 5700 grams of material. There are also six of these jaws on a moving plate, which collects a total of 35 kg of material in one step. To shave this, we consider three-mesh meshes with dimensions of 35 centimeters in width and 50 centimeters in length. These meshes are capable of grinding up to 35 kg of fine grained material.

۳۵cm * 50 cm in 2 mm = 35000 mm = 35 kg

۲mm for the height of the fine-grained planes that are placed on each other. The reason for limitation is the lack of access to the desired mesh in the market. These meshes are very difficult to find and it is better to use smaller weights considering the breakdown of these meshes. By increasing the distance between the rollers and the jaw in the mill, more weight of the material can be added to the powder mill. But this weight is more likely to cause a rupture of the mesh and should be limited to this.

Since the hardest rock material for minerals is converted to powder after 10 minutes, and in each 10-minute period, 35 kg of material is converted into powder, then it can be poured 210 kg per hour, and this The amount for each day is about 5 tons. This amount is negligible for works like copper condensation. These factories produce at least one thousand tons of concentrate daily, and this does not provide feed for 1 hour of the plant. On the other hand, more capacity for this device is not possible because the meshes are very delicate. In order to solve this problem, it is recommended to use several mills together to produce powder in condensing factories.

The main advantages of this device include the following:

- Increasing precision in crushing and grading operations of fine-grained mineral materials
- Reduce overhead costs for testing on copper concentrating powder mills
- Increase the speed of powder production from minerals
- The cost of making the machine is estimated at thirteen thousand dollars and for the maintenance of the machine costs five thousand dollars. The cost of doing experiments and employing experts is negligible.

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