Introduction to what is a hammer mill engineering essay

It is a machine used to shred material into fine particles (size reduction). They have many sorts of applications in many industries, including:

Milling grain, Ethanol plants (corn), Grinding used shipping pallets for mulch, Sawmills, size reduction of trim scrap and planer shavings into boiler fuel or mulch, A farm machine, which mills grain into coarse flour to be fed to livestock.

Operation

The principle of hammermill is straightforward. A hammermill is a steel drum containing a vertical or horizontal rotating shaft or drum on which hammers are mounted. The hammers are free to swing on the ends of the cross, or fixed to the central rotor. The rotor is spun at a high speed inside the drum while material is fed into a feed hopper. The material is impacted by the hammer bars and is thereby shredded and expelled through screens in the drum of a selected size.

Hammer mill apple shredder for juicing.

Small grain hammermills are operated on household current. Large automobile shredders could use one or more 2000 horsepower (1. 5 MW) diesel engines to power the hammermill.

The Screenless hammer mill uses air flow to separate small particles from larger ones. It is designed to be more reliable, much cheaper & more energy efficient than regular hammermills.

In the feed processing process there may be a number of ingredients that require some form of processing. These include coarse cereal grains, corn

that requires particle size reduction which will improve the ingredient performance & increase the nutritive value. One of the methods to achieve this particle size reduction is using hammer-mills.

Both hammering and rolling can achieve the desired result of achieving adequately ground ingredients, but other factors also need to be looked at before choosing the suitable method to grind. Excessive size reduction can lead to wasted electrical energy, unnecessary wear on mechanical equipment and possible digestive problems in livestock and poultry. For more in depth information regarding what actually occurs to the ingredients during size reduction please refer to this link: particle size reduction.

Mechanism of action:

Hammer mills reduce the particle size of materials by impacting a slow moving target, such as a cereal grain, with a rapidly moving hammer. The target has low kinetic energy, whereas the hammer has high kinetic energy. The transfer of energy resulting from the collision fractures the grain into many pieces.

Since impact is the primary force used in a Hammer mill to reduce the size of the particles, so, whatever increases the chance of a collision between a hammer and a target, increases the magnitude of the collision, would be an enhancer to particle size reduction.

Particles produced using a hammermill are spherical in shape with a polished surface. A wide variation in the particle size distribution would occur where there will be some large-sized and many small-sized particles.

Advantages:

- being to produce a wide range of particle sizes

- suitable for friable material and fiber

- easy to use

- lower cost when compared with a roller mill

- easy to maintain

- particles produced are spherical, with a surface that appears polished.

Disadvantages:

- Less energy efficient than roller mill

- May generate heat so considered as a source of energy loss.

- Greater particle size variability (less uniform)

- Noisy & generate dust pollution

General Design

The major components of these hammermills, include:

A delivery device: used to introduce the material to be ground into the path of the hammers. A rotor comprised of a series of machined disks mounted on the horizontal shaft performs this task. - Free-swinging hammers that are suspended from rods running parallel to the shaft and through the rotor

disks. The hammers carry out the function of smashing the ingredients in order to reduce their particle size. - A perforated screen and either gravity- or air-assisted removal of ground product. Acts to screen the particle size of the hammer mill to ensure particles meet a specified maximum mesh size.

Feeder design

Materials are introduced into the paths of the hammers by a variable speed vein feeder. This type of feeder can have its motor slaved by a programmable controller to the main drive motor of the hammer mill. The operational speed of the feeder is controlled to maintain optimum amperage loading of the main motor.

Hammer design and configuration

The design is determined by operating parameters such as rotor speed, motor horsepower, & open area in the screen. Optimal hammer design provides maximum contact with the feed ingredient. Hammer mills in which the rotor speed is approximately 1, 800 rpm, should be using hammers which are around 25cm (~ 10 inches) long, 6. 35cm (~2. 5 inches) wide, & 6. 4mm (0. 25 inches) thick. A rotor speed of about 3, 600 rpm, hammers should be 15 to 20 cm (~ 6-8 inches long, 5 cm (~ 2 inches) wide, & 6. 4 mm (0. 25 inches) thick.

The number of hammers used for a hammer mill of 1, 800 rpm, should be 1 for every 2. 5 to 3. 5 horsepower, and for 3, 600 rpm, one for every 1 to 2 horsepower. Hammers should be balanced on the rods so that they won’t

trail one another. The distance between hammer and screen should be 12 to 14 mm (~ 1/2 inch) for size reduction of cereal grains.

The velocity is important for proper size reduction. Tip speed is the speed of the hammer at its furthest edge(tip) from the rotor, and is calculated by :

Range of tip speeds seen in hammermills is commonly in the range between 5, 000 and 7, 000 m/min (~ 16, 000 and 23, 000 feet per minute). When the tip speeds exceed 23, 000 feet per minute, consideration must be given to the design of the hammer mill, the materials used, and the fabrication of components. Changing the rotational speed of the drive source is not a recommended method of increasing hammer speed in excess of 23, 000 feet per minute.

The primary force used in hammermill is the impact, which increases the chance of a collision between a hammer and a target provides an advantage in particle size reduction. The magnitude of the collision is increased by increasing the speed of the hammers.

Screen Design

The amount of open area in a hammer mill screen controls the particle size and grinding efficiency. The screen must be designed to provide the greatest amount of open area.

Recommended ratio for grains would be 55 cm2 (~ 8-9 inches square) per horsepower (Bliss, 1990).

The removal of sized material from a hammermill is a critical design feature. Proper output of material affects not only the efficiency of operation, but also particle size. When the correct ratio of screen area to horsepower is used and proper distance between hammers and screen face is maintained. Excessive size reduction is anti-productive. Energy is wasted in the heat production, throughput is restricted, resulting in the particles becoming too small.

Most newer hammermills are equipped with an air-assist system that draws air into the hammer mill with the product to be ground. Systems are designed to provide reduced pressure on the exit side of the screen to disrupt the fluidized bed of material on the face of the screen, thus allowing particles to exit through screen holes. Some full circle hammer mills are designed so the screen is in two pieces. It is possible to use a larger hole size on the upward arc of the hammers to further reduce the amount of material on the face of the screen.

Hammer Mill Perforated Screens

Hammer mills screens are used inside a hammer mill to seperate particle sizes. Particle of small diameter that has been grinded by the hammer mill passes through the screen and leaves the hammer mill with the aid of the pneumatic system.

Application:

Hammer Mills - Uses and Advantages in Grinding Oil Seeds & Other Materials

Availability

Hammer Mills are known as the best grinding machine for all kinds of material, besides oil seeds. A wide assortment of highly developed and advanced Hammer Mills / Disintegrators are available in the market today. They are fabricated to have a strong and sturdy body and are also available in different types, size, and capacities. These come with automatic controls, which makes the machines very easy to use. The number of hammers can also be customized as however the user requires it. Its use increases the output by a large quantity, thus saving more time and energy.

Oil Seeds Grinding

Grinding of seeds with Hammer Mills increases the quality level of the seeds. Some of the seeds that can be grinded and disintegrated using Hammer Mills are as follows:

Cotton seeds

Ground nuts

Copra

Soybeans, etc.

Advantages of Using Hammer Mill in oil seed grinding:

* Efficient grinding at the shortest time.

* Time and Effort saving.

* Less electricity power consumption.

* Available in different capacities & sizes.

* Very low maintenance.

Conclusion:

Hammer Mill is the most common equipment used for the purpose of particle size reduction. It has wide scale of applications in grinding seeds, nuts, and beans and other materials for more industrial purposes.

It has the advantage of High efficacy in the shortest time. Thus, considered time saving and less consuming for the human efforts. Beside the low energy consumption, high availability and ease of use and maintenance.

It has some drawbacks the most important of which are energy loss, less uniform product and being noisy & dust polluting.

Its mechanism of action had been explained above in details that it acts to reduce the size of the particles, so, whatever increases the chance of a collision between a hammer and a target, increases the magnitude of the collision, would be an enhancer to particle size reduction.