HAMMER MILLING

Hammer mills are typically equipped with a hopper and a rotor with hammers mounted at equidistance surrounded by a perforated screen. As the rotor spins at high speeds, the hammers swing and impact the grain flowing from the hopper. The maximum particle size of the flour is dependent on the size of the perforations in the screen and therefore it is possible to produce a variety of flours varying from fine to coarse granulation. Other designs of hammer mills use an air flow stream rather than perforated screens to separate milled material based on size.

There are many advantages of using a hammer mill to produce pulse flours. Hammer mills are capable of grinding the tough hull of the seed, are easy to operate, have a relatively low initial cost to purchase and install, and maintenance requirements are minimal. One disadvantage to hammer milling is that when milling conditions are not optimized there will be higher energy costs associated with the operation of the mill. In addition, if the desired flour granulation is very fine, heat may be generated during milling which can affect flour properties. The greatest limitation to hammer milling is the wide range of particle sizes produced in the flour.

PIN MILLING

Pin mills are impact mills which are equipped with 2 disks of interlocking round pins. Impact is the main force involved in the breakdown of the particles, fracturing the grain along axes of least resistance. No screens are used and generally, ultrafine flour particles are produced. The particle size of the flour can be altered by changing the speed of the rotation of the disk(s). Where possible, relatively finer flours may be produced when disks are counter rotated rather than when one disk is held stationary while one disk rotates.

ROLLER MILLING

Roller mills are the most common grinding method for the reduction of grain, particularly wheat, into flour. This method involves the gradual reduction of the endosperm into flour using a series of pairs of rotating steel rollers, counter rotating toward each other, either corrugated (break rolls) or smooth (reduction rolls) and sieving steps to separate the flour from the bran or in the case of pulses, the hull fraction. The paired rolls rotate at a speed differential. The forces involved in the reduction of the grain are due to abrasion, shear and compression. The aggressiveness of these forces can be altered with a change in the cut, depth, and spiral of the corrugation, together with the rotation differential. Following every pass of material through a set of rolls, a mill stream of flour is produced. Each of these streams may vary in their physical and functional characteristics. Streams can be blended in order to produce flour grades to achieve specific properties for certain end us purposes. The term “straight-grade flour” of “refined flour” refers to a

single grade of flour that is formed by combining the flour streams but omits the over stream of flour consisting of material too large to pass through flour sifters (typically hull material).

STONE MILLING

Stone mills are one of the oldest methods of attrition mills used in size reduction of grains. Compression, shear and abrasion forces are responsible for reduction of the grain into flour.

Stone mills are typically equipped with a hopper and 2 horizontal or vertical stones lying parallel to one another. One stone remains stationary while the other stone rotates at a set speed, the latter is known as the running stone. In order to adjust the maximum particle size of the flours, the gap width between the stones is adjusted. A narrower gap produces flours of a smaller maximum particle size while a wider gap produces flours of a larger maximum particle size. A hopper delivers the grain into the center of the stone where the grain settles into furrows which have been cut into the surface of the stationary stone. As the running stone rotates, the grain moves radially through the furrows and is reduced in size until it is exits at the circumference of the stone.

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