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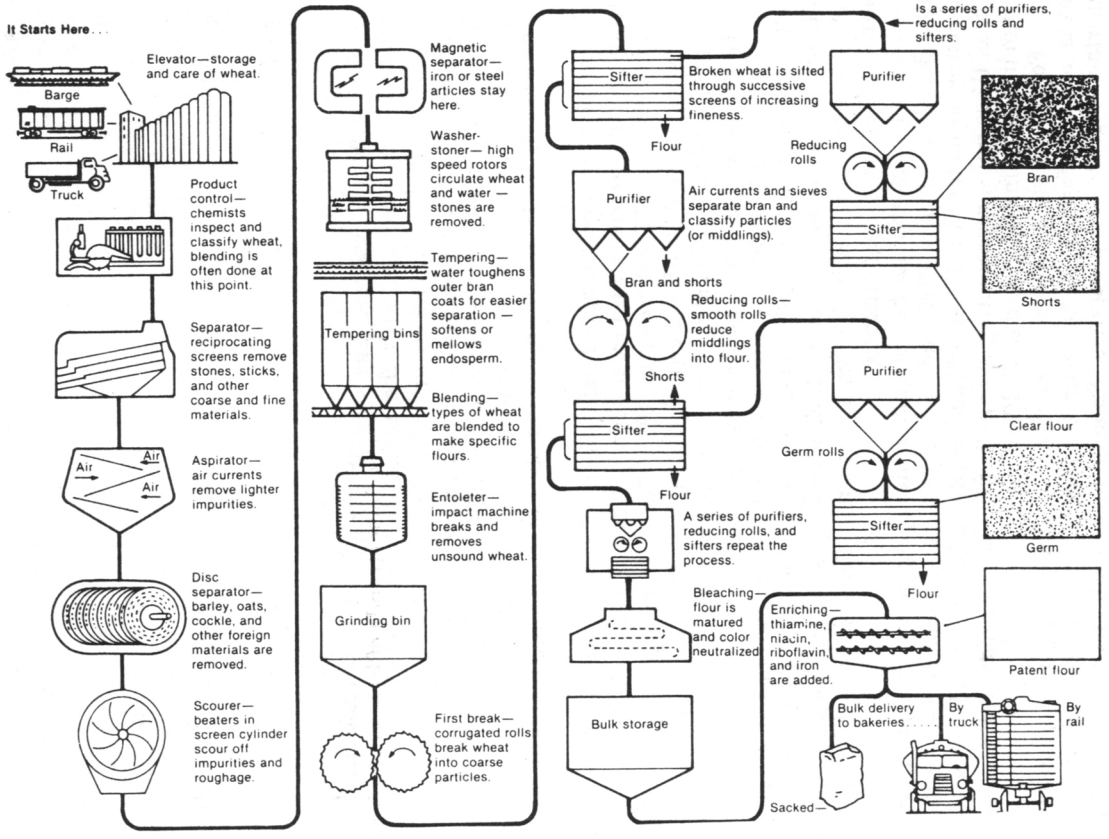

Fig. 11.1 The major processing steps in flour milling.

consumption.

A method for upgrading random wheat lots by classifying the kernels according to size was patented by Phillips and Schlesinger (1974). The invention is based on the discovery that there is a direct correlation between the size of the wheat kernels and their protein content. I would assume this would have to be restricted to lots consisting essentially of one variety grown under about the same conditions. The wheat is classified by screening, or other suitable size classification method. The inventors state the fraction of lowest protein content is that in which the kernels are retained on a screen having an opening between adjacent wires of from 0.10 inch to about 0.13 inch.

Tempering or conditioning.—Tempering, as the word is used in the U.S., refers to the addition of water to the bran and endosperm of the kernel. As a result, the bran becomes tough and rubbery, while the endosperm becomes less vitreous. These changes greatly improve milling efficiency. In European circles, the concept of tempering has been broadened to include not only measures taken to toughen the bran but also the changing of chemical and physical characteristics of the endosperm during milling. This broader concept of tempering is called conditioning. In conditioning, a controlled heating process is employed in addition to the moistening procedure.

Wheats are broadly classified into the types of hard wheat and soft wheat according to their milling characteristics. The former takes about 20% more horsepower to grind the grain to a given particle size. When hard wheats and soft wheats are found in the same mill mix—and this is quite common, particularly in European countries—the miller is confronted with a difficult problem. He will have to decide whether to set the rolls close and overgrind the soft wheat or set them farther apart and undergrind the hard wheat. He would prefer to do neither. Conditioning provides a partial answer to the problem.

If hard wheats are maintained in the presence of moisture under the proper conditions and for appropriate periods of time, the endosperm chunks become softer. They grind more like soft wheats because the water has penetrated the endosperm and the internal grain structure becomes mellower. By such techniques the milling problems of hard and soft wheat mixtures are considerably simplified.

According to traditional U.S. practices, tempering involves adding water to grain to raise the moisture to the 15 to 19% level for hard wheats and 14.5 to 17% for soft wheats. The wheat is then placed in tempering bins (having little or no temperature control) for periods of from 18 to 72 hours. During this time, the added water enters the bran then diffuses inward causing the bran to lose its friability and become leathery in texture. Usually, tempering is done in successive steps since it is impractical to add more than a few percent of water to wheat at one time.

Conditioning, in contrast to tempering, always involves the use of

and the fine middlings are returned to the fine roll, while the flour is removed from the milling system for packing or further treatment.

Purifiers are often used behind the coarse reduction rolls. The purpose in this case is separation by size classes rather than purification, and purifiers are sometimes superior to plansifters for these separation requirements.

The miller must be careful to avoid overgrinding the flour in the reduction system. Overgrinding tends to damage the starch granules and harms the flour's baking quality. Overgrinding can be detected by various tests, including the maltose value determination, which will show unusually high values for overground flours. Overgrinding should not be confused with grinding too fine. It is possible to produce flour of fine particle size if the grinding is done gradually using moderate pressure increases at each successive reduction stand. Heavy grinding pressures cause breakage of starch granules, which is definitely harmful to baking quality.

The scratch system.—In addition to the break system and the reduction system, some mills have a standby operation called the scratch (or sizing) system. If the mill is operating properly—that is, the tempering is such that good release of endosperm is obtained on the break—the scratch system can be bypassed. If this is not the case, the scratch system is put into play to improve the release of endosperm from bran. It is apparent that the scratch system is in reality an extension of the break system and it has been termed a mini-break or rebreak process. The branny stock is ground lightly on corrugated rolls to improve separation of the bran from the endosperm. If the purified stock is suitable, it may be sent to the reduction system, otherwise it is returned to the sizings rolls.

The conveying system.—Older mills depended on gravity transport to carry mill streams from one machine to another, and this made it necessary to construct high buildings. Wheat, flour, and intermediate products were moved to the top of the mill by bucket elevators, then the material flowed by chutes and tubes (usually called "spouts") to the rolls and sifters. Bucket elevators have two serious disadvantages: they create and disperse dust, and they provide harborages for insects. Recognizing these drawbacks, flour mills have converted to the air conveying of flour wherever possible.

Pneumatic conveying is the term applied to air conveying as it is used in flour mills. The higher power costs of pneumatic conveying are offset by cheaper construction, less mill clean up, less infestation, cooler flour stock, and metal rather than wood spouting. Pneumatic conveying depends on the fluidizing effect of air flowing through a bed of particulate matter. The conveying force may come from air forced in by fans at the entrance to the conveyor, in which case it is called a "positive pressure system," or it may come from atmospheric-pressure air entering the roller mills as a result of air pumps withdrawing air from the exit of the conveyor, in which case it is