Fine tuning the purification process

Purifiers play a vital role in the production of low ash, bright color flour

In a wheat mill, purification is achieved when fine bran and germ are separated from endosperm particles to increase the purity of coarse endosperm (farina or semolina). In durum semolina production, purifiers are essential to finished product quality and work by removing fine bran and compound particles (large endosperm with attached bran) from the finished semolina.

In a flour mill, the objective of the purification system is to separate clean farina, or coarse endosperm, from fine bran or compound particles to feed the primary reduction rolls. This purification step allows the miller to maximize extraction of low ash, bright color flour. While a purifier is the most common component of a mill purification system, purification may be achieved in all mills with and without additional purification equipment.

Using roller mills and sifters

Purification is achieved in the milling process by using roller mills and sifters. Using smooth rolls to gently grind key collection stocks commonly referred to as Quality or Sizings passages in most American flow diagrams, small bran and germ particles are flattened while endosperm particles are further reduced.

The gentle compression from a smooth roll with low differential increases the particle size of bran and germ allowing each to be removed with the top scalping sieves of the sifter. Many soft wheat flour mills rely solely on purification from rolls and sifters since the soft endosperm breaks down more easily into small particles or flour.

This milling characteristic of soft wheat yields few coarse particles, or farina, which would be suitable for purification with the purifier, therefore making the use of purifiers less effective. One challenge is managing the grinding practices as the natural tendency is to grind too hard on these key passages breaking the bran and germ, eliminating opportunity to remove them in the sifter and purify the stock. In most other cases a purifier is necessary to produce low ash flour and bran-free semolina, and proper set-up is important for optimal separation.

Stratification of the stock

When using a purifier to separate good endosperm from bran and compound particles, the key is proper stratification of the stock. Stratification, or layering of the stock in the purifier, is achieved by combining a reciprocating or vibratory agitation with the gentle upward flow of air evenly through the product.

The principle of terminal velocity is the resistance to air flow particles have depending on their shape. Irregularly shaped or flat particles have greater resistance to air flow than round particles. Larger particles of similar density will have greater resistance to air flow than smaller particles.

For a purifier to be effective, stock of similar-sized particles is fed from a sifter. The stock has a range of particle shapes and densities. When the stock is exposed to the mild agitation and upward air flow, lighter particles float to the surface and the heavier particles will sink to the bottom. Small, heavier particles fall faster, allowing the purifier to grade farina into particle size ranges for efficient grinding.

The smallest, cleanest farina falls through the air current and sieves at the front or head of the purifier, while slightly larger farina falls through the end of the purifier sieve deck. The irregular shaped compound particles and flat bran particle float to the end of the purifier decks and tail over.

Controlling the air through the purifier is critical to its operation. Stratification of material in the purifier is destroyed by intense agitation, often the result of too much air being drawn through the mixture of particles. With too little air, the stock will not separate.

A visual inspection by the miller of the stock feeding the purifier as compared to the stock leaving the purifier can confirm that the stock is being properly stratified. When the stock in the purifier is properly stratified, the first product through the head sieves will be the cleanest endosperm and the smallest particle size. The product through the tail sieves will be clean endosperm, but larger in particle size.

This happens as the larger particles of the same density have a lower terminal velocity. As for the stock tailing over the three sieve decks, the stock tailing over the bottom deck should look similar to the stock feeding the purifier. The stock on the top deck should be the coarsest bran, and the middle should be smaller, but similar in purity when compared to the top deck.

This rule of thumb works well for break purifiers. However, as the average particle size of material feeding a purifier gets smaller, maintaining a good separation of stock in the purifier is more difficult.

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Mark Fowler, center, examines stock from purifier streams with course participants in the Hal Ross Flour Mill at Kansas State University.

Loading of purifiers

Proper loading and clothing of the purifier sieves is critical to the effectiveness of the separations made by the purifier. Purifier capacity is determined by the width of the deck and is measured in pounds or kilogram per hour per inch or millimeter of deck width.

The load is dependent on the particle size of the stock as well. Purifiers must always be fed from a sifter or from another purifier. The larger the average particle size, the greater the load may be to the purifier. To optimize the separation from the purifier, a smaller micron range of the stock

feeding the purifier is preferred. Generally a range of 200 to 400 microns from the sifter is optimal.

Purifiers may be classified in two general categories based on what type of mill stock is feeding them. Break purifiers receive stock from break sifters. Generally, coarse middlings or sizings stock come from primary breaks, but fine middlings from secondary break passages may be sent to purifiers as well. Reduction purifiers receive stock from sizings sifters or from other purifiers.

The purifier clothing must be sized to match the stock. As a general rule, the clothing of the first purifier sieve should be two to four grit gauze numbers coarser (50 to 70 microns) than the sifter sieve clothing that the stock passed over. The intermediate purifier sieves should be evenly spaced with the last purifier sieve approximately two grit gauze sizes coarser than the sifter sieve clothing which the stock came through.

Conditions for effective purifiers

For purifiers to effectively separate and grade stock, the balance of air and

A flour milling course participant checks tailing stock from a purifier in the Hall Ross Flour Mill at K.S.U.

product must be consistently maintained. This balance starts with the feeder gate to the purifier. The stock must be fed across the entire width of the sieve and it must travel evenly down the full length of the sieve.

The purifier clothing on the sieves must be in good condition, free of patches and holes.

The sieve cleaners, either brushes or ball, must operate effectively to keep the sieve surface free from buildup and blinding over.

Air flow is critical, and air always will flow to the path of least resistance. Any inconsistency in the flow of stock or the condition of the sieves will result in inconsistency of air flow.

To check and maintain effective purification, sieves should be hand brushed weekly and air chambers should be checked regularly for the build-up of dead stock.

Deciding on purification

Few modern flow diagrams have no purifiers in the process and many diagrams use several purifier passages. There are several advantages and disadvantages to be considered when deciding how to use purifiers in a mill flow.

A significant advantage is the ability to grade stock and balance the load to various roll passages while the mill is operating. Unlike a sifter, purifier sieves may be pulled out and changed while the mill is running under load. Purifier tips or valves may be adjusted as necessary to redirect stock based on mill load or quality if there is a change in the wheat or mill environment impacting mill balance.

Purifiers help to increase flour production of low ash flour at the head end of the mill. By removing fine bran, purifiers enable the use of impact mills on certain stock without significant change to flour quality. The use of purifiers also allows for the production of high quality farina as a finished product if desired.

There are several disadvantages to using purifiers as well. As stated at the beginning of this article, smooth rolls may serve the same purpose as purifiers in many cases depending on wheat type and the quality desired of the finished flour. Purifiers will dry out the stock if the environment of the mill is not controlled appropriately. Purifiers require training for millers to understand how to monitor their operation and the attention it takes to keep the sieves clean and working properly.

Added maintenance, air and filter requirements, electrical usage and capital expense must all be considered when deciding how much purification is needed to produce the quality of flour desired. MBN

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