



The complexities of durum milling

Granulation of the finished product makes it more complicated than wheat flour milling

by Mark Fowler

Durum wheat processing is an ever-evolving art to produce the optimal semolina for the growing global pasta market. The durum milling process is more complex than hard wheat flour milling in several ways due to granulation of the finished product.

While durum flour and fine semolina are used in the Mediterranean and North Africa to bake many local bread varieties, durum semolina is most commonly used for pasta. The granulation requirements for semolina vary for various pasta manufacturing processes. Semolina granulation in the 600 to 300 microns range is preferred for traditional pasta extruders. Medium or fine semolina of less than 350 microns preferred in newer pasta extruders.

As durum wheat prices continue to rise, the need to increase the extraction rate of semolina to lower the cost of production requires new methods and is motivating a change in pasta production. Durum millers are reacting to the changing granulation requirements for semolina by creating more efficient flow diagrams. A review of the principles and practices for milling durum wheat demonstrates the evolution of the process.

CLEANING

When preparing durum wheat for processing, the cleaning process is critical. Since durum is milled into coarse, granular semolina rather than fine flour, impurities are more likely to negatively impact the quality of the semolina. Foreign seeds and discolored kernels remaining in the durum appear as brown and black specks discoloring the pasta.

Small stone particles and sand can damage the expensive extruder dies or block the die opening completely. Ergot is an especially serious concern for durum processors as well. The need for extensive cleaning to assure the removal of impurities may result in a long, expensive cleaning diagram and significant loss of good quality durum in older cleaning diagrams.

As a result, the durum milling industry quickly adopted the latest optical sorting technology. The latest generation of optical sorters uses both full color spectrum cameras and near-infrared technology to maximize the removal of dark



Mark Fowler reviews a flow diagram and roll settings during a durum milling course at the Northern Crops Institute, Fargo, North Dakota. Photos courtesy of Mark Fowler.



Examining stock from the mill during the durum milling course.

and discolored impurities while minimizing the removal of good quality durum kernels.

Wheat separators and destoners, or a combination cleaner and good aspiration, must be in the cleaning diagram first to remove dust and large impurities. Optical sorters are more efficient than disc or cylinder separators to remove foreign seeds, ergot-infected durum kernels and other discolored im-



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purities reducing the loss of expensive high quality durum wheat and improving semolina quality.

PRE-PROCESS CONDITIONING

The condition stage of durum processing is important to semolina quality and granulation. The bran of the durum wheat kernel is generally thinner than most hard wheat. Even though the target first break moisture for durum is between 16% and 17% to meet a target of 14% moisture in the finished semolina, the thinner bran coat combined with the desired coarse granulation of the semolina requires a shorter conditioning time than hard wheat. Conditioning time for a mill producing traditional semolina could be as short as 8-10 hours. For mills supplying finer semolina, longer conditioning time is required.

Due to the shape of the durum kernel and the extremely hard and vitreous endo-

sperm, peeling or pearling to remove the outer layers of bran provides many advantages. Peeling is the process of debranning using high friction, rubbing durum kernel against each other. Peeling can effectively remove 7% to 9% of the kernel.

Pearling is a more aggressive process of rubbing the durum against an abrasion stone and can remove up to 15% of the kernel. Both peeling and pearling improve the efficiency of durum processing by shortening the milling diagram, decreasing bran and ash content specks and reducing microbiological contamination in the finished semolina.

GRINDING

Traditional semolina flow diagrams are long on roll surface to gradually reduce the durum kernel while minimizing flour production. Most mill diagrams will include up to seven break passages to slowly open the kernel and extraction the endosperm

in large pieces minimizing flour and fine semolina production.

The number of break passages may be reduced when removing bran by peeling or pearling in the pre-process conditioning system. All of the primary grinding passages in durum semolina mills use corrugated or fluted rolls.

The first and second break passages most commonly are set to use dull-to-dull grinding action, while the remaining break passages and the sizings passages use sharp-to-sharp grinding action allowing for better precision of sizing of endosperm into the correct granulation of semolina.

The sizing system in the semolina diagram will include six or seven passages as compared to two or three in a flour mill. These sizing passages gradually reduce the endosperm separated from the bran in the break system and feed the extensive purification system.

The roll pack design found in many



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MILLING OPERATIONS

newer roll stands allows for more stable grinding and improved precision of granulation. Break and sizing passages can be precisely set to target grinding releases to gently grind and gradually reduce the endosperm optimizing semolina production.

Newer milling diagrams to produce the finer granulation semolina apply more grinding pressure to each roll and have fewer break and sizing passages reducing energy cost and improving milling efficiencies.

PURIFICATION

The purification system is the heart of a durum mill. As with any mill, purifiers in a durum mill are fed by sifters or by other purifiers. But unlike wheat flour mills, purifiers are the primary separator of the finished product. A purifier separates good endosperm from bran and compound particles using the principle of product stratification.

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.

Consistent product flow across the width of the purifier deck and balanced air flow through the sieves are essential for proper stratification of the product on the sieve deck. Using designed product runarounds is a common practice in durum flows to maintain a consistent load on critical purifiers.

Durum millers must be well trained to adjust and maintain purifiers. The sieve brushes must be working properly keeping product from sticking to the screens or allowing the surface of the sieve to “blind over.” To keep the purifiers in good operating condition producing quality product, sieves should be removed each day, hand-brushed and inspected.

The dependence on purifiers in the production of semolina requires an abundance of air. The control of the milling environment is an important part of successful durum milling. A low relative humidity of the milling environment will cause excessive drying of the semolina degrading product quality by increasing in the ash content, decreasing the moisture and increase in the production of fine product.

A managed air stabilization system improves relative humidity and temperature in the processing system improving product quality and improving milling efficiencies.

SEMOLINA QUALITY

The most critical quality characteristics for semolina are particle size, starch damage, color and gluten strength. As mentioned throughout this article, semolina granulation requirements are changing as pasta extrusion technology improves. Traditional semolina granulation allows no flour in the finished product. In finer granulation semolina, a portion of flour is acceptable, but may vary for different customers. This allows for a higher extraction rate from the durum wheat reducing the cost of production. Regardless of the specification, the granulation of the finished semolina needs



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to be as consistent as possible.

The rate of water hydration by the semolina is a critical characteristic for mixing and extrusion of pasta. Fine particles absorb water at a faster rate than larger particles. Starch damage impacts semolina quality in a similar way. Damaged starch in semolina absorbs water at a faster rate than undamaged starch.

Inconsistent hydration of semolina due to either granulation or starch damages negatively impacts pasta quality. Excessive water absorption makes it difficult for the pasta to maintain its shape and causes cracking and breaking of the pasta during the drying process.

Durum is preferred for pasta due to its color. Commonly measured by the Minolta method, the golden, yellow color of the semolina creates the bright yellow, translucent appearance of pasta. The number of brown and black speck is also an important measure of color and quality.

Durum is also preferred for pasta production due to its high percentage of quality protein. The extensibility of the durum protein allows for optimal extrusion and drying qualities. The inelastic properties, which make durum a poor bread making wheat, allow the pasta to maintain its shape better out of the extruder and during the drying process.

LOOKING AHEAD

The future of durum wheat processing will be determined by its ability to continue to evolve. Durum wheat prices continue to raise forcing pasta manufacturers to increase the amount of hard wheat traditionally used for bread making to make pasta and noodles.

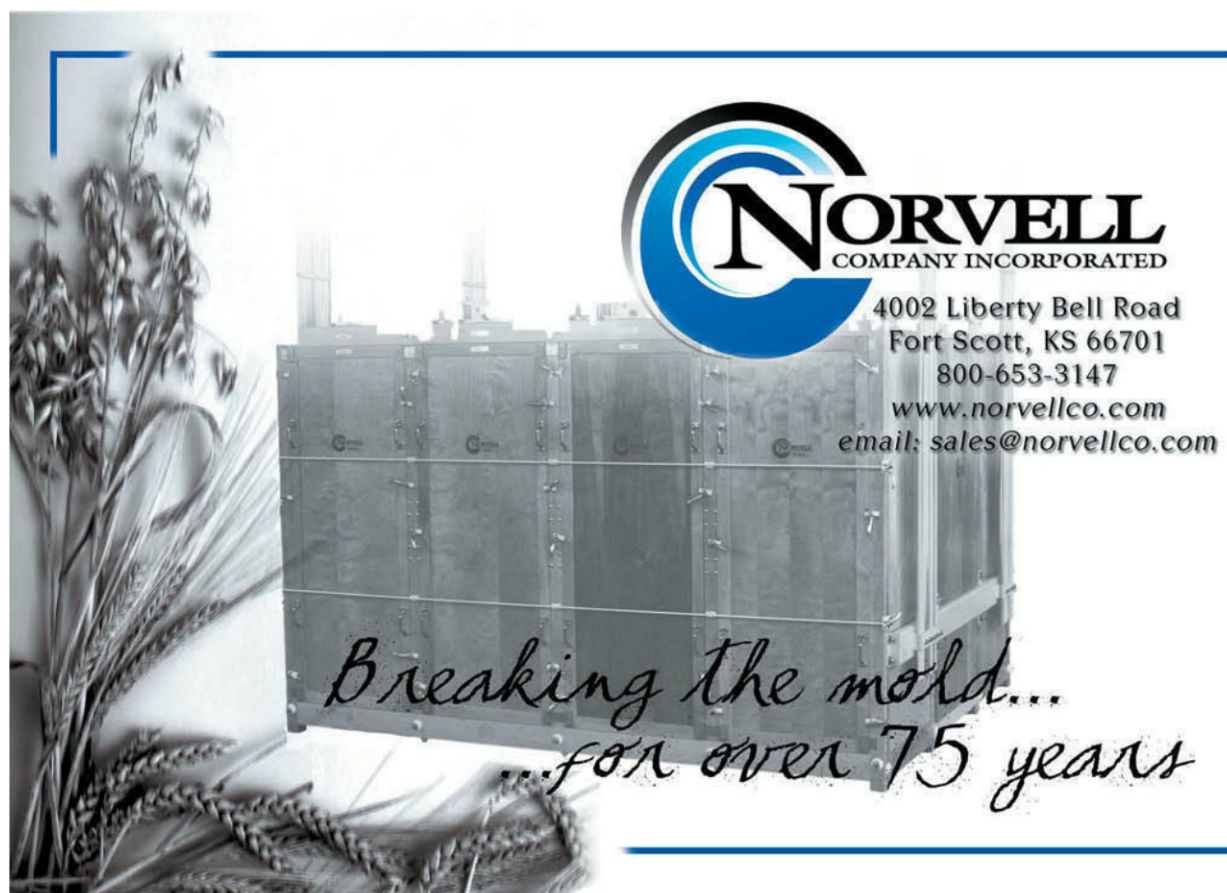
Improved extrusion technology, allowing a finer granulation of semolina, increases the extraction percentage lowering the cost of production helping to keep the cost of durum competitive in the

market. Durum millers reacting to changing granulation requirements are creating shorter, more efficient flow diagrams.

Using peeling or pearling methods in the pre-process conditioning phase of semolina production helps to reduce the number of roll passages required. The finer semolina granulation allows for less purification passage. These changes from a traditional semolina flow diagram reduce energy and maintenance costs helping durum miller and pasta manufacturers to remain competitive and producing a high quality product for pasta lovers across the globe. **WG**

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