Transforming wheat into flour

The numerous and varied tools for preparing laboratory samples

by Olivier Le Brun, Product & Application Specialist, Chopin, France

The transformation of wheat into flour is a key step in many laboratory analyses (Alveograph, Mixolab, Farinograph, for example) and in many unique manufacturing processes of different baked goods (breads, cookies, crackers).

The tools used to transform wheat into flour are numerous and varied, and it is not always easy to find one's way. Based on the type of flours produced, it is nevertheless possible to classify these tools in three main categories, which are grinders, laboratory mills and pilot mills.

Grinders are simple tools that are designed to perform only one operation: the fractionation of the grain into finer particles. Thus, after a test on a Grinder, only one product is recovered: the grist. The yield of the operation is therefore very close to 100 percent.

The grist is mainly characterised by its granulometry (lower than a predefined limit) and gathers all the different tissues of the wheat grain (envelopes, endosperm and germ). The composition of this grist is almost identical to that of the wheat grain from which it comes from, even if a reduction in water content is often observed due to the mechanical heating generated by the size reduction operation itself.

Hammer grinders (such as the Grinder-Chopin) are the most commonly used in the grain industry. Their operating principle is relatively basic: the wheat grains are projected at high speed against a wall on which they are crushed by splitting.

The finest parts are then evacuated through a grid with a defined opening diameter (usually 0.8mm), while the largest particles are recovered and fractionated again by projection, until they reach the desired size.

Hammer grinders are mainly used for quantitative analyses, such as the determination of Hagberg Falling Number on wheat. In the case of the Grinder-Chopin, most samples are ready in about one minute.

Laboratory mills are more complete tools that are especially useful for producing purified flour (sometimes also called white flour) by combining 2 types of operations: a size reduction and a separation by sifting.

The objective of this milling is to separate the wheat's floury kernel (or endosperm) from the envelopes, in order to produce a flour as representative as possible of the one produced by an industrial mill.

A laboratory mill simulates the operation of an industrial mill on a reduced scale and consists of a succession of grain size reductions by passing between cylinders and sieving to sort the particles, and eventually send them to other cylinder machines. At the end of a milling process on a laboratory mill, several products are obtained: flour, bran and shorts.

Supporting commercial transactions

The primary objective of a laboratory mill is to produce flours intended to undergo laboratory analyses such as Alveograph, Mixolab, Farinograph, or Extensograph tests, which will often be the support for commercial transactions based on international standards.

The primary qualities of a laboratory mill must therefore be repeatability and reproducibility. In order to achieve this, the milling diagram must be fixed, and correspond to a good compromise: it must be long enough to produce a sufficient quantity of flour that is sufficiently representative of an industrial milling process; it must be short enough to limit the factors of variation from one test to the next and from one machine to the next.

Thus, in the field, most laboratory mills are composed of two-to-four passages of cylinders and provide flour yields around 55 to 65 percent. Note that the representativeness of a laboratory mill also depends on the type of cylinders used: the instruments combining grooved and smooth cylinders are undoubtedly those that are closest to an industrial mill.

For example, the Chopin Technologies CD1 Mill is composed of a breaking part (2 superimposed passages between 3 grooved cylinders), and a reduction part (1 passage between 2 smooth cylinders), each associated with a centrifugal sieve.

It allows to obtain 2 distinct flours (1 break flour and 1 reduction flour) which will be generally joined and homogenized before being tested on Alveograph, Farinograph, etc.

The CD1 is the reference mill which strictly meets the NF EN ISO 27971 standard concerning the realisation of Alveograph on wheat. It also provides a reliable and indisputable tool for commercial wheat transactions to assess the intrinsic quality of wheat (results will be the same as wheat milled by the seller or buyer).

Pilot mills are the most advanced small-scale milling tools. Like laboratory mills, they allow the production of purified flours and combine size reduction by passage between rolls and separation by sieving.

However, they are equipped with a longer milling diagram (more cylinders, more sieves), which allows them to have higher extraction rates (typically between 65 and 75%) and a flour that is even more representative of industrial mills (by recovering proteins and enzymes from the most peripheral layers of the grain, such as the aleurone layer).

The pilot mill is the ideal tool to produce flours intended for long tests (bread-making test for example or the evaluation of the addition of exogenous enzymes, for example) for which the enzymatic component plays a major role.

In addition to a long diagram, pilot mills generally offer additional possibilities of adjustment which allows them to adjust to more specific needs.

The Chopin Technologies LabMill, a pilot mill, has a patented six-stage milling diagram:

- Two breaking steps, between grooved cylinders, to obtain flour, fine middlings, coarse middlings and coarse bran.
- One sizing step, between smooth cylinders, to reduce the coarse middlings into flour, fine middlings and fine bran.
- Three reduction steps, between smooth cylinders, to reduce fine middlings to flour.

The LabMill also has the advantage of being a pilot mill with manual recovery, which allows an excellent vision of the milling behavior of wheat (quantitative and qualitative distribution of the different flours), also called milling value.

Sample analysis made simply

Precise and reproducible grinding and milling are necessary for producing flours representative of industrial milling or simulating full industrial milling on a sample or pilot scale. No matter the type of flour you are aiming to produce, or the size of your mill, there are options available to save you time and take the guesswork out of the process.

The Chopin brand of products – offered by KPM Analytics – has a long legacy of providing robust, turnkey, and easy-to-use instruments to simplify milling and flour sample preparation.

As for any industrial mill, the quantity and the quality of the flours produced by a Laboratory Mill or a Pilot Mill, will also strongly depend on the way the wheat is prepared. This preparation of wheat includes cleaning (elimination of all elements likely to damage the mill or to alter the quality of the flours produced) and conditioning (targeted level of hydration and resting time).