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UNIT-II BAKERY MACHINERY AND EQUIPMENTS

What is a Farinograph?

The farinograph is a tool to assess baking qualities and performance of wheat flour doughs. It records the resistance to deformation, or the consistency of dough mixed from flour and water.

To millers and bakers, farinographs are essential for:

- Adjusting dough mixing parameters: absorption, time, pre-hydration ratio
- Studying the effect of flour improvers dough handling properties
- Establishing quality control measures to properly handle wheat crop changeovers
- Preparing wheat and flour blends to comply with flour specifications

Origin

The invention of the farinograph dates back to 1928 when Carl Brabender of Germany established a method for measuring the baking qualities of bread flour.

How does it work?

Farinographs measure and record the resistance to deformation of a flour/water dough against the mixing action of blades over time and at a specific speed (rpm) and temperature. Dough resistance is expressed as motor torque, in dimensionless units known as Farinograph or Brabender Units (FU or BU). During the test, the dough is developed and further broken down.[1]

Resistance has traditionally been known as "consistency." The maximum consistency of the dough is adjusted to a fixed value (500 FU) by altering the quantity of water added (i.e. % absorption). This is a key measurement in dough rheology testing.

AACC International Method 54-21

Using this method:

- 300 g of flour (14% moisture basis) are placed in the farinograph bowl.
- Water is added from a burette.
- To ensure that farinograms from different samples can be compared, the midpoint of the farinograph bandwidth at the maximum resistance is always centered on the 500-FU line. This is accomplished by adjusting the amount of flour and water used.[1,2]

- The Farinograph records dough behavior under identical test conditions in which the mixing bowl is kept at constant temperature. Dough resistance against constant mechanical shear is recorded on a chart in the form of a torque-time curve.

Farinograph parameters

1. Water absorption (%)

The amount of water added to balance the farinograph curve on the 500-FU line, expressed as a percentage of the flour (14% mb). This parameter is useful in adjusting the water relationships in commercial doughs when flour changes.

2. Dough development time / mixing time or peak time

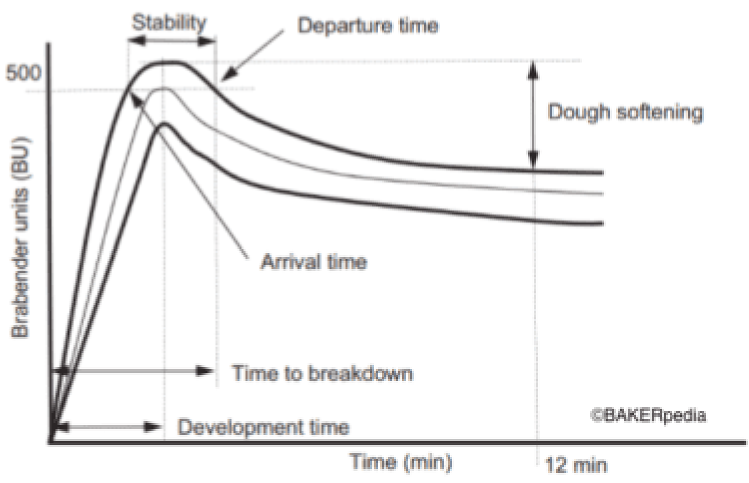
Provides the time (in minutes) between the origin (time zero) of the curve and its maximum (peak). It is used to make adjustments during mixing in commercial processes when the flour mixing requirements change. Stronger flours with higher protein content have a longer development time than weaker flours with equivalent particle size distribution.

3. Stability

Difference in minutes between the arrival time (the time at which the top of the curve reaches the 500-FU line) and departure time (the time at which the top of the curve falls below the 500-BU line). It is a measurement of how well a flour resists overmixing. Stronger flours are usually more stable than weaker ones from the same wheat class.

4. Mixing Tolerance Index (MTI)

Measured as the difference in Brabender units between the top of the curve at the optimum and the point on the curve 5 min later. The MTI indicates how fast the gluten structure breaks down after reaching its full development. Lower MTI values correspond to stronger flours, typically used in the production of high specific volume bread.



Application

Factors that affect farinograph parameters:

Water absorption	• Amount of starch damage • Gluten-forming proteins present • Amount of arabinoxylans / hemicellulose • Presence / absence of cellulosic fiber (bran) • Particle size distribution of flour
Development time	• Quality (chemical conformation of glutenins) • Particle size distribution of flour • Amount of arabinoxylans / hemicellulose
Stability	• Quality (chemical conformation of glutenins) • Presence / absence of cellulosic fiber (bran)
Mixing Tolerance Index	• Quality (chemical conformation of glutenins)

What is a Rapid Visco Analysis?

An Rapid Visco Analysis (RVA) is a quick, amylographic physical assessment of cereal-based products. This test is performed by the Rapid Visco Analyzer, which is a rotational (stirring) rheometer that measures apparent viscosity of starch-containing suspensions, and flour/water mixtures under variable and controlled heating (cooking), cooling, and shear stress conditions.

An RVA is used in the baking industry for assessing:

- Sprout (preharvest) damage of wheat kernels

- Quality fingerprinting of cereal flours
- Pasting/gelatinization characterization of starchy ingredients
- Stability of emulsions and foams
- Water absorption/holding capacity
- Assess starch damage (e.g., due to milling)
- Enzymatic activity
- Stability to freezing and thawing

The RVA device has a software that allows recording and plotting of the behavior (curve) of the product being analyzed as a function of temperature (°C), analysis time (min), and apparent viscosity (cP-Centipoise).

The obtained curve of the sample as a function of the apparent viscosity, temperature, shear stress, and time, allow to visualize the points where physical transitions and changes in the texture of the sample take place (e.g., gelatinization, retrogradation and re-ordering of starch molecules, and formation of final viscous gel/paste).

Relevance

An RVA is an important R&D tool. It allows for the physical characterization of flour-based products. The viscosity changes produced when heating and cooling the starch in water allows determination of the minimum energy required to cook and process the sample/product being tested, and the appropriate conditions for desired consistency and thickening effect.

An RVA is also a practical and important baking quality indicator, since there is a tight relationship between rheological and mixing properties of flour/water mixtures, e.g., dough strength/torque, water absorption, shear and temperature stability, falling number, and dough extensibility; all of them correlating with each other.

Application

A Rapid Visco Analyzer consists of a stirring paddle attached to a motor whose shaft rotates at constant speed, and the current (energy) required to drive it is monitored continuously by a microprocessor. An aluminum sample container is filled with a certain mass of powdered product and volume of water, and placed to surround the paddle, after which the motor is started.

A metal conductor at high temperature (>90°C) rapidly heats the mixture until the sample reaches the gelatinization temperature of the starch. Depending on the product, the test can take 2–15 minutes to be completed. Finally, the power required by the motor correlates directly with the apparent viscosity.

In order to draw proper conclusions about the quality and technological properties of foods being tested with an RVA, intrinsic and extrinsic factors must be taken into account:

- Intrinsic: Water content; amount and nature of total solids (proteins, complex carbohydrates/hydrocolloids, soluble sugars, fats, and minerals); amylose/amylopectin ratio; native presence of hydrolytic enzymes (e.g., pectin polygalacturonase, α/β amylases, maltase-glucoamylase)

- Extrinsic: Processing conditions (e.g., additives, addition of yeasts, temperature, acidity, pressure)

Steps for an RVA

1. Properly calibrate the equipment.
2. Configure the test parameters (shear, temperature, rpm, time) on the software menu.
3. Prepare/weigh the sample (dry product).
4. Enter relevant data regarding product moisture.
5. The equipment software (based on a mass balance calculation) automatically pours the exact amount of water required to process the sample.
6. Place canister inside the testing chamber.
7. Run the RVA.
8. Equipment automatically records and graphs data collected during test.
9. Analyze data.
10. Conclude and report.