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# Determining the hydration capacity and elasticity of the dough using modern technology

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***Abstract***

To determine the elasticity and viscosity of dough using modern technology, several methods can be used. One of the most common methods is to use a texture analyzer, which measures the force required to compress a dough sample. This force can be used to calculate dough elasticity and viscosity. Another method is to use a rheometer, which measures the flow and deformation properties of the dough under stress, technique can provide more detailed information about the rheological properties of the dough, including its elasticity, viscosity, and viscoelastic behavior. In addition, computer simulations and modeling can also be used to determine dough elasticity and viscosity. These models can simulate dough behavior under various conditions, such as changes in temperature, moisture content, and mixing time, to provide information about dough properties and behavior. The use of modern technology has greatly improved our ability to accurately determine the elasticity and viscosity of dough.

**Keywords:** high quality, elasticity and viscosity, accuracy.

## 1. Introduction

In general, the use of modern technology has greatly improved our ability to accurately determine the elasticity and viscosity of dough, which is essential for the development of high-quality bakery products [1.2]. One of the modern technologies was designed by the Brabender team [3-5]. They have developed a modern system for determining the hydration capacity of viscosity and elasticity. The Farinograph is an instrument used in the baking industry to measure the consistency of dough during the mixing process [3]. It provides information about the dough's ability to withstand the mechanical stress of mixing, as well as its water absorption capacity, dough development time, and other parameters. The "TS" in "Farinograph TS" stands for "Total System", which refers to the latest version of the Farinograph that includes improvements to the measurement system, as well as enhanced software capabilities for data analysis and interpretation. The Farinograph TS measures the resistance of dough to mixing using a mixing arm that rotates at a constant speed, while a computer records the torque required to turn the arm. The resulting data is displayed in a graph called a Farinogram, which shows the dough's resistance to mixing over time. The Farinograph TS is a valuable tool for bakers and flour millers, as it allows them to optimize their processes for consistent quality and performance. By measuring dough properties such as water absorption, mixing time, and stability, the Farinograph TS can help manufacturers achieve desired dough characteristics, such as crumb texture, loaf volume, and dough extensibility

Determination of dough hydration and elasticity capabilities can be accomplished using modern technology such as rheological analyzes and physical measurements. These methods allow the evaluation of the rheological and mechanical properties of the dough, providing information on its hydration and elasticity [6].

The following techniques can be used to

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determine said capacities:

*Rheological analysis:* This technique measures the behavior of the fluid under different conditions of applied stress. To determine dough hydration and elasticity, a rheometer can be used, which applies different levels of stress to the dough and measures its response. There are several rheological methods used in dough evaluation, such as coupler rheometry, torsion rheometry, and oscillatory rheometry.

*Dough extensibility:* Dough extensibility is a measure of its ability to stretch before breaking. It can be assessed by using a strain gauge, which measures how far the dough can be stretched before it breaks. This property can be influenced by the amount of water in the dough and the amount of gluten (flour proteins).

*Water absorption:* To determine dough hydration, the amount of water absorbed by the flour used in the dough preparation process can be measured. This can be done by standardized methods such as the Farinograph method [7].

## 2. Methods and materials

The Farinograph® (Figure 1) is used for dynamic testing of the mixing properties of wheat or rye dough to evaluate the quality of the flour and the processing properties of this dough. The test procedure is standardized in international standards (ICC standard 115/1, ISO 5530-1, AACC standard no. 54-24).

The measurement principle is based on highlighting the resistance of the dough in contact with the rotating blades of the mixer. The torque proportional to this resistance is a measure of the viscosity and consistency of the dough.

The recorded diagram (Farinogram) gives us information about the water absorption capacity of the flour and about the process and the quality of the properties of the dough made from the respective flour.

The same principle can be applied to other materials such as chocolate, cocoa butter, cheese, fish. The density measurement during mixing gives us information about the properties of the samples.

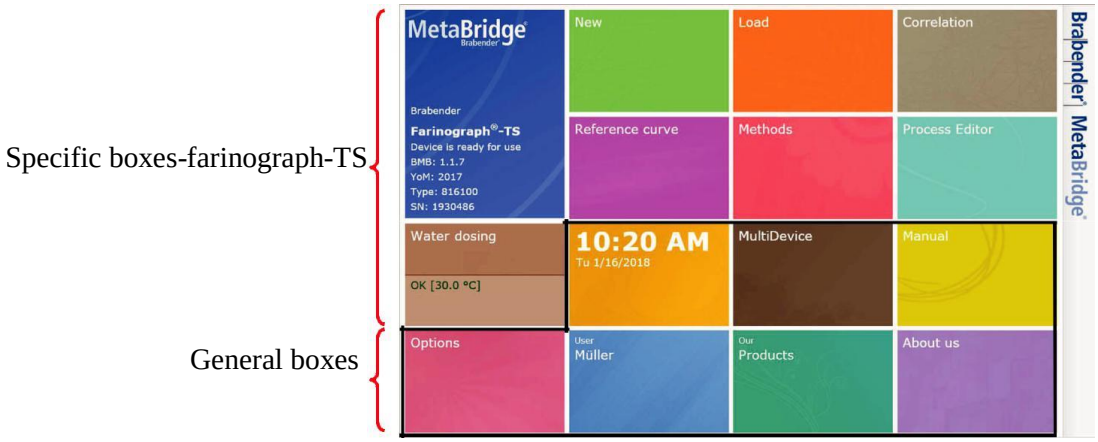
**Figure.1.** The Farinograph®

Brabender MetaBridge has been installed from the factory on the internal PC of the Brabender instrument or MetaBridge controller. The software is web-based, meaning multiple authorized users can log in at the same time and monitor live readings on their PC, tablet or smartphone from anywhere in the world over the network. The results can be evaluated, printed and exported using the software.

Brabender MetaBridge splash screen

Upon connection, the Brabender MetaBridge home screen appears (Figure 2).

In general, the start screen contains in the upper part some specific boxes for devices (Farinograph-TS/Extensograph-E) and some general boxes in the lower part, the software can be manipulated with the help of a mouse.



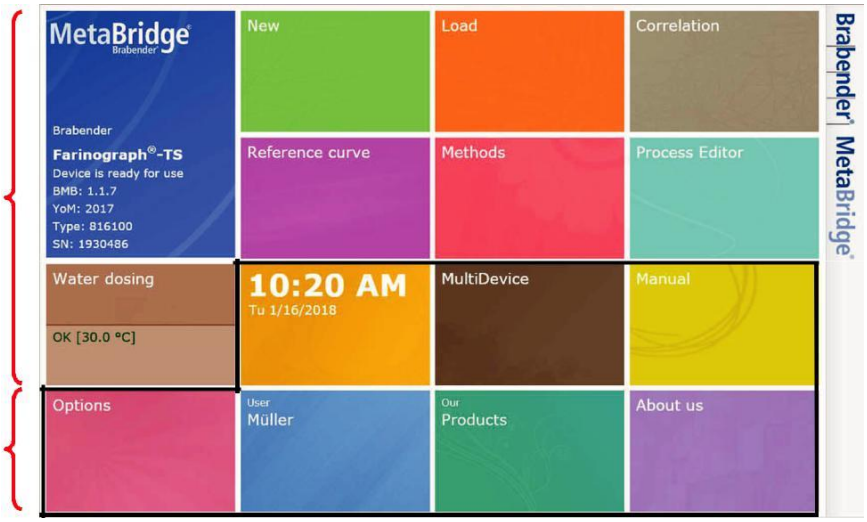



**Figure 2.** Brabender MetaBridge

The "New" box opens the window for entering parameters for a new test and for running and evaluating the new test.

Parameters window. Touching the "New" box opens the window for entering the test parameters for a new test (see image below). When the parameter window opens, it shows the test parameters of the previous measurement, so data that remains unchanged (eg user, method) does not need to be re-entered.

At the start of the test, the measurement window of the on-line chart presentation and, if selected, the numerical values of the test in progress appears (Figure 3).

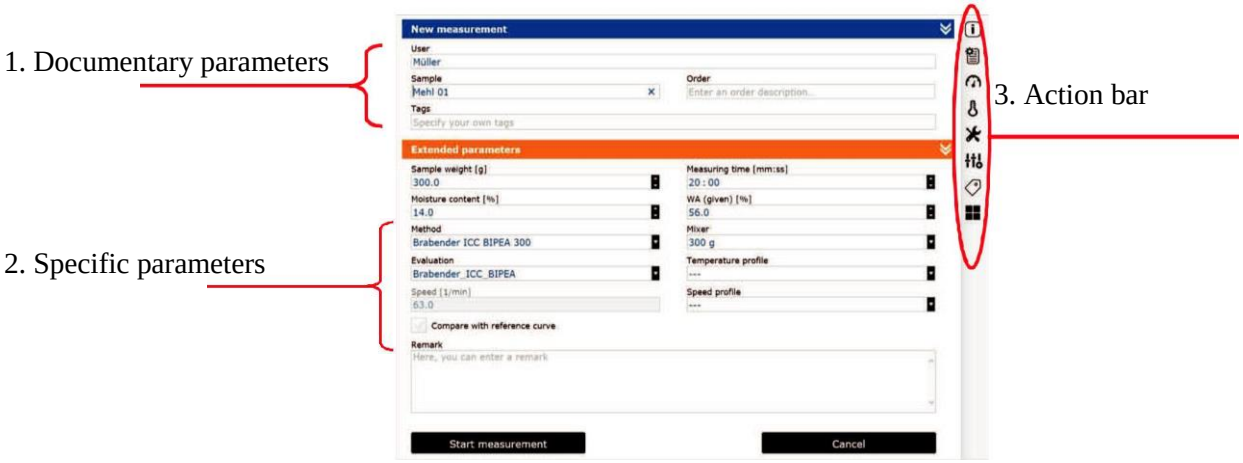



**Figure 3.** Documentary and specific parameters

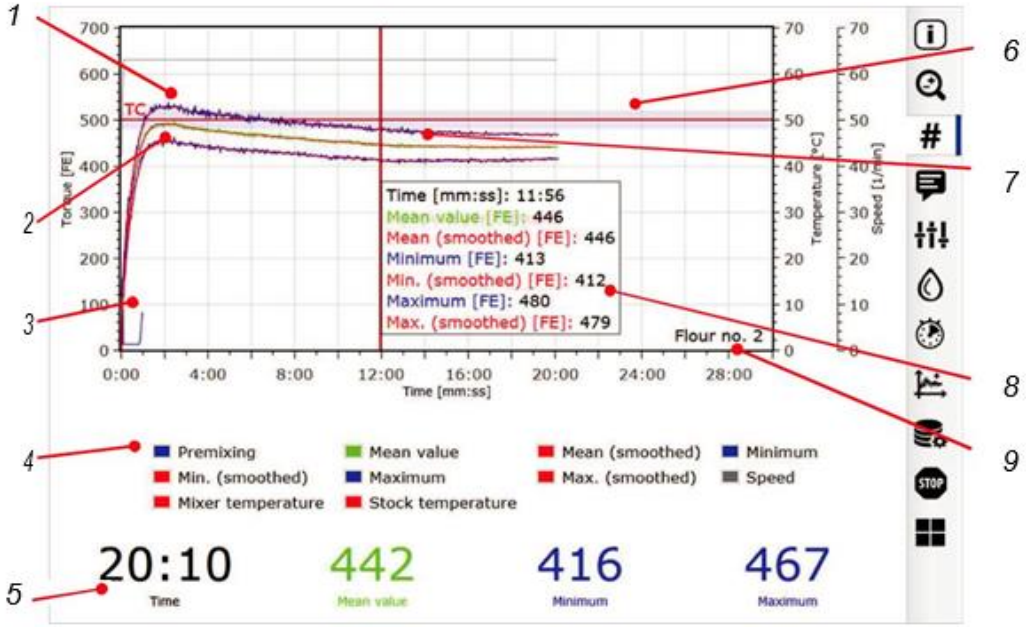



**Figure 4.** Farinoggraph parameters : *1. Maximum line, 2 The minimum line, 3 Premixing, 4 Legend, 5 Time, 6 Consistency line, 7 Calculated average line, 8 Numerical details, 9 Method /Test / (Max. torque)*

During the measurement, the Farinogram (upper and lower border line of the torque curve measured) is shown on-line (Figure 5).

· The consistency line is drawn as a horizontal line in the diagram.

· The mean value line is calculated and displayed as well.

· Every 2 seconds, a new measuring point is added.

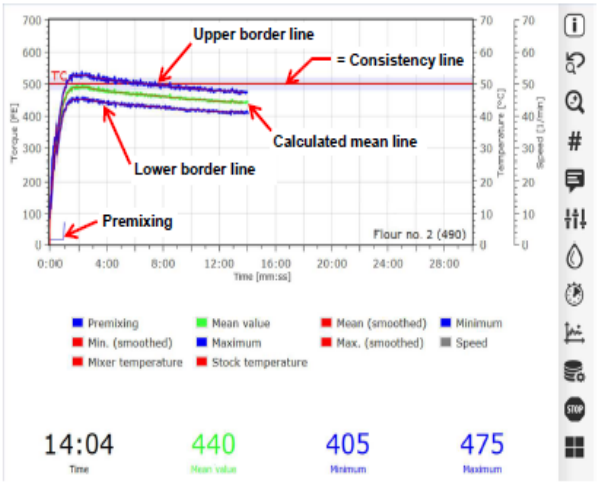
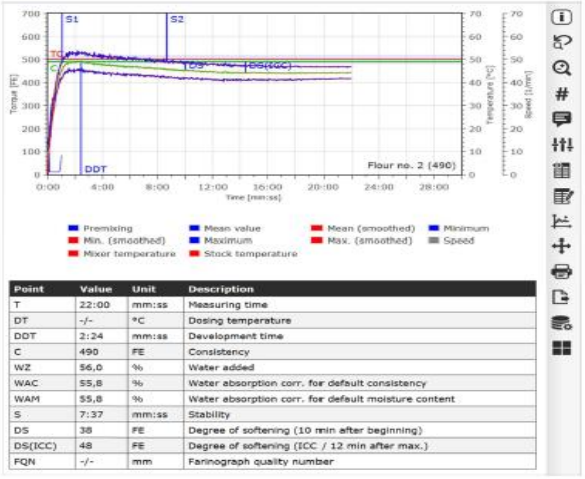



**Figure 5.** Farinograph curve

Upon expiry of the test time set in the parameter window, data transmission from the Farinograph®-TS to the internal PC is stopped automatically and the evaluation is shown. The test is saved automatically in the list of tests and can be seen and loaded immediately by all users logged in from all over the world.

## 3. Results and discussion

In figure 6 is presented the farinogram obtained for wheat flour 650. It was analysed 3 lots.



| Point | Value | Unit | Description |
|---|---|---|---|
| T | 22:00 | mm:ss | Measuring time |
| DT | -/- | °C | Dosing temperature |
| DDT | 2:24 | mm:ss | Development time |
| C | 490 | FE | Consistency |
| WZ | 56,0 | % | Water added |
| WAC | 55,8 | % | Water absorption corr. for default consistency |
| WAM | 55,8 | % | Water absorption corr. for default moisture content |
| S | 7:37 | mm:ss | Stability |
| DS | 38 | FE | Degree of softening (10 min after beginning) |
| DS(ICC) | 48 | FE | Degree of softening (ICC / 12 min after max.) |
| FQN | -/- | mm | Farinograph quality number |

**Figure 6.** Farinograph curve for wheat flour 650

In general, the hydration capacity of flour is higher at making dough without salt. On average, the difference is 2%, but varies between 0 – 4 %. For this reason, in the case of the farinogram, where the preparation of the dough is done without salt, the hydration capacity a of flour is higher than in the case of the extensogram, where the preparation the dough is made with salt.

Dough development time and dough stability time when kneading are the important

parameters, but they must be taken into account that the values determined in the laboratory are only indicative, because in practice are strongly influenced by the characteristics of the mixer.
The duration of dough development is dependent on both:

- the characteristics of the wheat or the wheat mixture;
- the fineness of the flour;
- the ash content of the flour.

White, fine flour shortens the development time of the dough, and flour with large grain size and high ash content prolongs the development time of the dough. The duration of dough stability and the fall of dough consistency decisively influences the tolerance to flour processing.
From the data presented for flour type 650 lot 1 (Figure 6), it is possible appreciate:

- according to the hydration capacity, the flour falls into the group satisfactory to good;
- dough development time - the dough develops accelerated 1.7 – 2.0 minutes;
- dough stability is between 2.9 - 4.1 which it means that the dough loses water quickly;
- the softening of the dough after 12 minutes in the farinogram indicates us that we have a satisfactory dough value between 65 – 80 UF.

From the data presented for flour type 650 lot 2, it can be appreciated that after:

- the hydration capacity of the flour falls into the group satisfactory to good;
- dough development time - the dough develops accelerated 2 – 2.3 minutes;
- the stability of the dough means that we have a stable dough, normal;
- the softening of the dough after 12 minutes indicates that we have a dough satisfactory to good.

From the analysis of the data presented in the figures for flour type 650 type 3, we can appreciate that after:

- the hydration capacity of the flour belongs to the good group 57 - 59%;
- dough development time - the dough develops optimal;
- dough stability is good between values 9.9-12.9 minute;
- the softening of the dough after 12 minutes indicates that we have a good dough

Brabender® measuring instruments are manufactured and calibrated according to the state of art. Nevertheless, failures, e.g. due to failures or defective parts in the heating/cooling system, at temperature sensors, or hoses, cannot be excluded.
Accuracy and reproducibility of the measuring results are influenced, among others, by:
- nature of the sample material (temperature distribution, foreign
particles, water content of the flour, etc.)
- heating/cooling of the measuring mixer
- temperature of the mixer blades
- cleanness of the measuring mixer
- operability of all system components
- errors during entry of test parameters
- wear of blades and/or bushings
- wear of the inner surfaces of the mixer bowl
- observation of test specifications [5].

The hydration capacity of flour is particularly important in the dough preparation process, as it affects the texture, taste and appearance of the finished product. Hydration is the ability of flour to absorb water and form strong bonds with gluten molecules, resulting in dough formation.
Here are some importances of flour's ability to hydrate:
Gluten is a protein present in flour that gives elasticity and consistency to dough. During hydration, the gluten forms a network of bonds, which gives strength and flexibility to the dough. The right amount of water in the dough is crucial for the formation of a proper gluten structure. (Ghencea Sabina)
The hydration capacity of flour can vary depending on the type and size of flour particles, gluten content and other factors. By adjusting the amount of water in the dough, the desired consistency of the finished product, such as fluffy bread or crispy pretzels, can be achieved [6].
Proper hydration of the flour plays an important role in controlling the rise of the dough. The amount of water influences how the dough rises during fermentation, affecting the volume and texture of the finished product. Too much water can result in a dense and underbaked final product, while too little water can result in a compact and dry bread [1].
The hydration capacity of flour affects the dough's viscosity and workability. A dough with higher hydration will be stickier and softer, while a dough with lower hydration will be drier and easier to handle. Depending on the desired final product, the hydration level can be adjusted accordingly to achieve the desired dough consistency [7].
Note that the level of hydration required may

vary depending on the recipe and the type of baked product desired. Performing flour hydration tests and level adjustments can help manufacturers achieve consistent results and the desired quality of finished products.

## 4. Conclusions

The farinograph is a tool used in the food industry to evaluate the rheological properties of flour and dough. Here are some advantages of using the farinograph:

Accurate measurements: Farinograph uses an automated system to control and record data precisely. This helps to achieve consistent and reliable results.

Reduced testing time: The farinograph allows rapid testing, making it ideal for mass production. This instrument can measure the rheological properties of flour in just a few minutes.

Hydration evaluation: The farinograph can provide information on the ability of flour to absorb water and form dough, essential aspects in baking and pastry. Thus, manufacturers can adjust the level of hydration to achieve the desired quality of the finished product.

Determination of dough strength: By using the farinograph, the rheological properties such as dough strength, elasticity and extensibility can be evaluated. This information is essential in determining the quality of bakery products and can be used to optimize production processes.

Quality standards: The farinograph is often used in accordance with international standards and protocols, which allows the comparability and evaluation of the quality of flour and dough in an objective way.

The use of the farinograph in the bakery production process is essential to ensure optimal dough consistency, quality and performance.

## References

1. Banu, C. (**2002**). Controlul și asigurarea calității produselor alimentare pag 152-163. București : Ed. AGIR.
2. Banu, C. s. (**2000**). Biotehnologii in industria alimentara pag 425-453 . *Bucuresti: Tehnica.*
3. Brabender. (**2016**). Farinograph Technical, pag 55-64. *Duisburg · Germany: Brabender® GmbH & Co. KG · Kulturstr.*
4. Brabender. (**2016**). Technical Book Farinograph pag 71-80. Duisburg · Germany: Brabender® GmbH & Co. KG.
5. Brabender. (**2016**). Technical Book, pag 49-50. Duisburg · *Germany: Brabender® GmbH & Co. KG · Kulturstr.*
6. Dowell, F. M. (**2008**). Relationship of bread quality to kernel, flour, and dough properties, pag 85, 82-91. *Chimia cerealelor.*
7. Sivaramakrishnan, H. S. (**2004**). Rheological properties of rice dough for making rice bread .pp.37- 45. *J Food Eng.* 62,