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Wheat flour — Physical characteristics of doughs —

Part 1: Determination of water absorption and rheological properties using a farinograph

Farines de blé tendre — Caractéristiques physiques des pâtes —

Partie 1: Détermination de l'absorption d'eau et des caractéristiques rhéologiques au moyen du farinographe

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Foreword

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ISO 5530-1 was prepared by Technical Committee ISO/TC 34, *Food products*, Subcommittee SC 4, *Cereals and pulses*.

This third edition cancels and replaces the second edition (ISO 5530-1:1997), which has been technically revised.

ISO 5530 consists of the following parts, under the general title *Wheat flour — Physical characteristics of doughs*:

— *Part 1: Determination of water absorption and rheological properties using a farinograph*

— *Part 2: Determination of rheological properties using an extensograph*

— *Part 3: Determination of water absorption and rheological properties using a valorigraph*

Wheat flour — Physical characteristics of doughs —

Part 1:
Determination of water absorption and rheological properties using a farinograph

1 Scope

This part of ISO 5530 specifies a method, using a farinograph, for the determination of the water absorption of flours and the mixing behaviour of doughs made from them by a constant flour mass procedure, or by a constant dough mass procedure.

The method is applicable to experimental and commercial flour from wheat (*Triticum aestivum* L.).

NOTE This part of ISO 5530 is based on ICC 115/1[1] and AACC Method 54-21.2.[2]

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 712, *Cereals and cereal products — Determination of moisture content — Reference method*

3 Terms and definitions

For the purposes of this part of ISO 5530, the following terms and definitions apply.

3.1
consistency
resistance of a dough to being mixed in a farinograph at a specified constant speed

Note 1 to entry: It is expressed in farinograph arbitrary units (see 3.2).

3.2
farinograph unit
FU
arbitrary unit for consistency on the farinogram

Note 1 to entry: For the mathematical expression of farinograph units, see 6.1.

Note 2 to entry: It is also possible to define “farinograph unit (FU)” as a twisting moment of 100 g. cm, measured in the axis of the mixer.

3.3
maximum consistency
consistency measured at the end of dough development time

Note 1 to entry: For the mathematical expression of maximum consistency, see 9.2.

Note 2 to entry: It is expressed in farinograph units (FU).

Note 3 to entry: See 3.7.

3.4
water absorption of flour
volume of water required to produce a dough with a maximum consistency of 500 FU, under the specified operating conditions

Note 1 to entry: Water absorption is expressed in millilitres per 100 g of flour at 14 % (mass fraction) moisture content to an accuracy of 0,1 ml.

3.5
dough development time
DDT
peak time
time from the beginning of the addition of water to the point on the curve immediately before the first sign of the decrease of maximum consistency

Note 1 to entry: In those cases where two maxima are observed, use the second maximum to measure the dough development time.

Note 2 to entry: See Figure 1 and 9.3.

Note 3 to entry: It is expressed in minutes to the nearest 0,1 min.

3.6
stability
difference in time between the point where the top part of the curve intercepts, for the first time, the line of 500 FU and the last point where leaves this line

Note 1 to entry: This value, in general, gives some indication of the tolerance of the flour to mixing.

Note 2 to entry: When the maximum consistency deviates from the (500 ± 20) FU line, the line of this consistency should be used to read the interceptions.

Note 3 to entry: The stability is expressed in minutes, to an accuracy of 0,5 min.

3.7
degree of softening
difference between the centre of the curve at the point where it begins to decline and the centre of the curve 12 min after that point

Note 1 to entry: It is expressed in farinograph units (FU).

Note 2 to entry: In the case where two peaks appear, the second peak is considered.

Note 3 to entry: The degree of softening should be expressed to the nearest 5 FU.

Note 4 to entry: If another time is used to carry out this method, this has to be detailed in the report along with information on the reference standard applied. The definite time is usually 12 min.

3.8
mixing tolerance index
MTI
difference from the top of the curve at peak (DDT) to the top of the curve measured at 5 min after peak is reached

Note 1 to entry: It is expressed in farinograph units (FU).

3.9
farinograph quality number
FQN
length, along the time axis, between the point of the addition of water and the point where the height of the centre of the curve has decreased by 30 FU, compared to the height of the centre of the curve at DDT

Note 1 to entry: It is expressed in millimetres to an accuracy of 1 mm.

4 Principle

Measuring and recording, by means of a farinograph, the consistency of a dough as it is formed from flour and water, as it is developed, and as it changes with time.

NOTE The maximum consistency of the dough is adjusted to a fixed value by adapting the quantity of water added. The correct water addition, which is called the water absorption, is used to obtain a complete mixing curve, the various features of which are a guide to the rheological properties (strength) of the dough.

5 Reagent

Use only distilled or demineralized water or water of equivalent purity.

6 Apparatus

The usual laboratory apparatus and, in particular, the following:

6.1 Farinograph[1)] (see Annex A), with the following operating characteristics:

— slow blade rotational frequency: (63 ± 2) min^{-1} (rev/min); the ratio of the rotational frequencies of the mixing blades shall be 1,50 ± 0,01;

— torque per farinograph unit:

  — for a 300 g mixer: (9,8 ± 0,2) mN·m/FU [(100 ± 2) gf·cm/FU];

  — for a 50 g mixer: (1,96 ± 0,04) mN·m/FU [(20 ± 0,4) gf·cm/FU];

  — chart speed: (1,00 ± 0,03) cm/min.

6.1.1 Burettes.

a) for a 300 g mixer, graduated from 135 ml to 225 ml in 0,2 ml divisions.

b) for a 50 g mixer, graduated from 22,5 ml to 37,5 ml in 0,1 ml divisions.

6.1.2 Thermostat, with circulating water for constant temperature (30 °± 0,2) °C.

6.2 Balance, capable of weighing to the nearest ±0,1 g.

6.3 Spatula, thin, made of soft plastic.

7 Sampling

Sampling is not part of the method specified in this part of ISO 5530. A recommended sampling method is given in ISO 24333.[3]

It is important that the laboratory receive a sample which is truly representative and which has not been damaged or changed during transport and storage.

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1) This part of ISO 5530 has been drawn up on the basis of the Brabender Farinograph, which is an example of a suitable product available commercially. This information is given for the convenience of users of this part of ISO 5530 and does not constitute an endorsement by ISO of this product. Other equipment may be used if it can be shown to give comparable results.

8 Procedure

8.1 Determination of the moisture content of the flour

Determine the moisture content of the flour using the method specified in ISO 712.

8.2 Preparation of farinograph

NOTE See details of electronic farinograph characteristics and procedure in A.4.

8.2.1 Turn on the thermostat of the farinograph (6.1.2) and circulate the water, until the required temperature is reached, prior to using the instrument. Before and during use, check the temperatures of the thermostat and of the mixing bowl, the latter in the hole provided for this purpose. The temperature of the mixing bowl shall be (30 ± 0,2) °C.

The laboratory temperature should be between 18 °C and 30 °C.

8.2.2 Uncouple the mixer from the driving shaft and adjust the position of the counterweight(s) so as to obtain zero deflection of the pointer with the motor running at the specified rotational frequency (see 6.1). Switch off the motor and then couple the mixer.

8.2.3 Lubricate the mixer with a drop of water between the back-plate and each of the blades. Check that the deflection of the pointer is within the range (0 ± 5) FU with the mixing blades rotating at the specified rotational frequency in the empty, clean bowl. If the deflection exceeds 5 FU, clean the mixer more thoroughly or eliminate other causes of friction.

8.2.4 Adjust the arm of the pen so as to obtain identical readings from the pointer and the recording pen.

8.2.5 Adjust the damper so that, with the motor running, the time required for the pointer to go from 1 000 FU to 100 FU is (1,0 ± 0,2) s. This should result in a bandwidth of approximately 60 FU to 90 FU.

8.2.6 Fill the burette (6.1.1) with water at 30 °C. The time to flow from 0 ml to 225 ml or from 0 ml to 37,5 ml, respectively, shall be not more than 20 s.

8.3 Test portion

If necessary, bring the flour to a temperature of between 25 °C and 30 °C.

8.3.1 Constant flour mass procedure

Weigh (6.2), to the nearest 0,1 g, the equivalent of 300 g (for a 300 g mixer) or 50 g (for a 50 g mixer) of flour having a moisture content of 14 % mass fraction. Let this mass, in grams, be *m;* see Table 1 for *m* as a function of moisture content.

Place the test portion in the mixer. Cover the mixer, and keep it covered until the end of mixing except, for the shortest possible time, when water has to be added and the dough has to be scraped down. Switch on the thermostatically controlled heating.

Table 1 — Mass of flour, in grams, equivalent to 300 g and 50 g at a moisture content of 14 % mass fraction

Moisture content	**Mass, *m*, of flour equivalent to**	
% mass fraction	**300 g**	**50 g**
9,0	283,5	47,3
9,1	283,8	47,3

Table 1 *(continued)*

Moisture content	**Mass, *m*, of flour equivalent to**	
% mass fraction	**300 g**	**50 g**
9,2	284,1	47,4
9,3	284,5	47,4
9,4	284,8	47,5
9,5	285,1	47,5
9,6	285,4	47,6
9,7	285,7	47,6
9,8	286,0	47,7
9,9	286,3	47,7
10,0	286,7	47,8
10,1	287,0	47,8
10,2	287,3	47,9
10,3	287,6	47,9
10,4	287,9	48,0
10,5	288,3	48,0
10,6	288,6	48,1
10,7	288,9	48,2
10,8	289,2	48,2
10,9	289,6	48,3
11,0	289,9	48,3
11,1	290,2	48,4
11,2	290,5	48,4
11,3	290,9	48,5
11,4	291,2	48,5
11,5	291,5	48,6
11,6	291,9	48,6
11,7	292,2	48,7
11,8	292,5	48,8
11,9	292,8	48,8
12,0	293,2	48,9
12,1	293,5	48,9
12,2	293,8	49,0
12,3	294,2	49,0
12,4	294,5	49,1
12,5	294,9	49,1
12,6	295,2	49,2
12,7	295,5	49,3
12,8	295,9	49,3
12,9	296,2	49,4
13,0	296,6	49,4
13,1	296,9	49,5

Table 1 *(continued)*

Moisture content	Mass, *m*, of flour equivalent to	
% mass fraction	**300 g**	**50 g**
13,2	297,2	49,5
13,3	297,6	49,6
13,4	297,9	49,7
13,5	298,3	49,7
13,6	298,6	49,8
13,7	299,0	49,8
13,8	299,3	49,9
13,9	299,7	49,9
14,0	300,0	50,0
14,1	300,3	50,1
14,2	300,7	50,1
14,3	301,1	50,2
14,4	301,4	50,2
14,5	301,8	50,3
14,6	302,1	50,4
14,7	302,5	50,4
14,8	302,8	50,5
14,9	303,2	50,5
15,0	303,5	50,6
15,1	303,9	50,6
15,2	304,2	50,7
15,3	304,6	50,8
15,4	305,0	50,8
15,5	305,3	50,9
15,6	305,7	50,9
15,7	306,0	51,0
15,8	306,4	51,1
15,9	306,8	51,1
16,0	307,1	51,2
16,1	307,5	51,3
16,2	307,9	51,3
16,3	308,2	51,4
16,4	308,6	51,4
16,5	309,0	51,5
16,6	309,4	51,6
16,7	309,7	51,6
16,8	310,1	51,7
16,9	310,5	51,7
17,0	310,8	51,8
17,1	311,2	51,9

Table 1 *(continued)*

Moisture content	Mass, *m*, of flour equivalent to	
% mass fraction	**300 g**	**50 g**
17,2	311,6	51,9
17,3	312,0	52,0
17,4	312,3	52,1
17,5	312,7	52,1
17,6	313,1	52,2
17,7	313,5	52,2
17,8	313,9	52,3
17,9	314,3	52,4
18,0	314,6	52,4

NOTE The values in this table are calculated using the following formulae:

a) for the mass, in grams, equivalent to 300 g at 14 % mass fraction moisture content

$$m = \frac{25\ 800}{100 - H}$$

b) for the mass, in grams, equivalent to 50 g at 14 % mass fraction moisture content:

$$m = \frac{4\,300}{100 - H}$$

where H is the moisture content of the sample, as a percentage by mass.

8.3.2 Constant dough mass procedure

Calculate the necessary mass of flour, *m*, in grams, according to Formula (1):

$$m = \frac{C_m}{100 \pm W_a} \quad (1)$$

where

C_m is a constant number, which is 48 000 using a large bowl and 8 000 using a small bowl;

W_a is the water absorption of the flour, expressed in millilitres per 100 g of flour at 14 % (mass fraction) moisture content (determined by 9.2).

Calculate the necessary volume of water, *V*, in millilitres, according to Formula (2):

$$V = C_V - m \quad (2)$$

where C_V is a constant number, which is 480 using a large bowl and 80 using a small bowl.

Weigh (6.2), to the nearest 0,1 g the calculated mass of flour, *m*, and place the test portion in the bowl.

Fill the burette (6.1.1) with water of room temperature. Start the mixer and recording mechanism, and 1 min later, add the calculated volume of water to the flour. In this case, the maximum consistency of the dough will be (500 ± 20) FU.

NOTE W_a versus *m*, calculated by Formula (1) using the large or small bowl, respectively (in the water absorption range from 54 % to 77 %), is given.[1]

8.4 Common rules of determination

For the steps of the operation not specified in this part of ISO 5530, follow the manufacturer's instructions.

8.4.1 Mix at the specified rotational frequency for 1 min or slightly longer. Start adding water from the burette into the right-hand front corner of the mixer within 25 s, when a whole-minute line on the recorder paper passes by the pen.

NOTE In order to reduce the waiting time, the recorder paper can be moved forward during the mixing of the flour. Do not move it backwards.

Add a volume of water close to that expected to produce a maximum consistency (9.2) of 500 FU. When the dough forms, scrape down the sides of the bowl with the spatula (6.3) adding any adhering particles to the dough, without stopping the mixer. If the consistency is too high, add a little more water to obtain a maximum consistency of approximately 500 FU. Stop mixing and clean the mixer.

8.4.2 Carry out additional mixings as necessary, until two mixings are available

— in which the water addition has been completed within 25 s,

— the maximum consistencies of which are between 480 FU and 520 FU, and

— the recording of which has been continued for sufficient time to calculate all reported terms of the selected method.

Stop mixing and clean the mixer.

9 Evaluation of the farinogram and calculation of the derived rheological characteristics

9.1 General

From each sample, two determinations shall be carried out. Read directly or calculate the values of each rheological characteristic to be determined from both farinograms. Express the results as the mean value of the relevant data.

NOTE To facilitate the calculations, a computer can be used. In that case, it would be necessary to modify the farinograph by adding an electrical output for transferring the data to the computer.

9.2 Water absorption of flour

In order to obtain the water absorption of flour (see 3.4) first from each of the mixings with maximum consistencies (see 3.3) between 480 FU and 520 FU, derive the corrected volume, V_c, in millilitres, of water corresponding to a maximum consistency of 500 FU, by means of Formulae (3) and (4):

a) for a 300 g mixer:

$$V_c = V + 0{,}096(C - 500) \quad (3)$$

b) for a 50 g mixer: