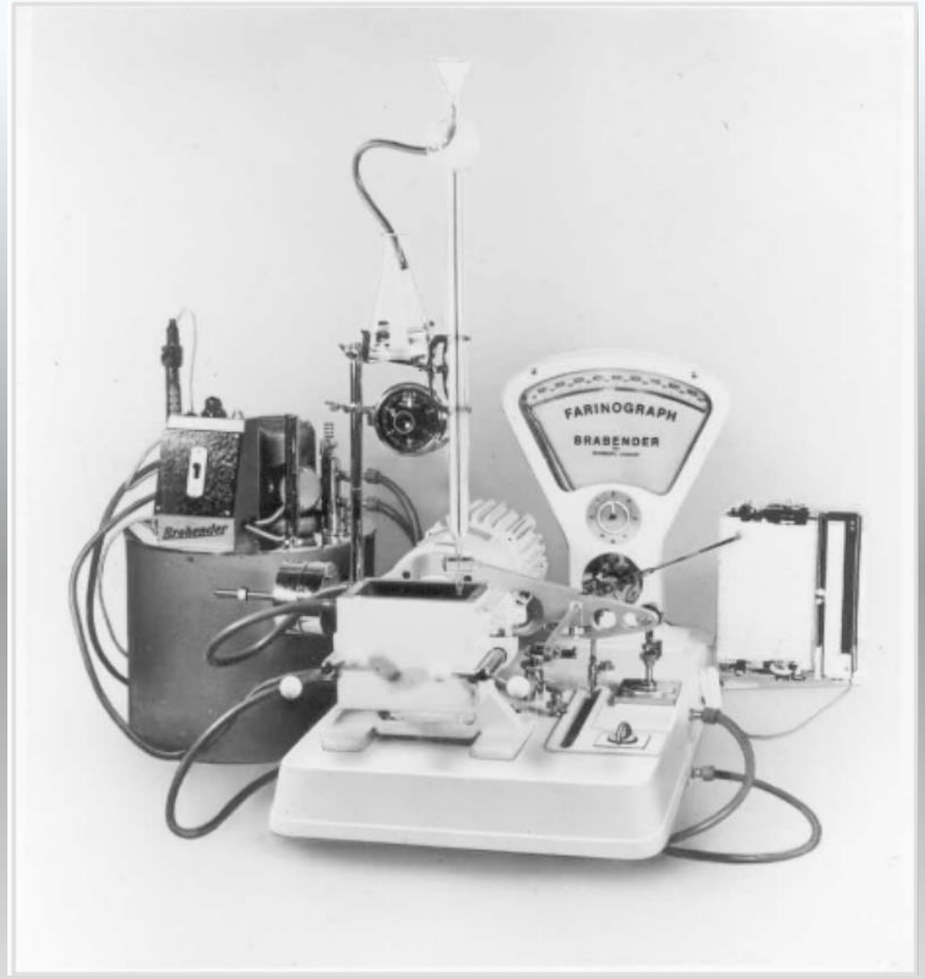
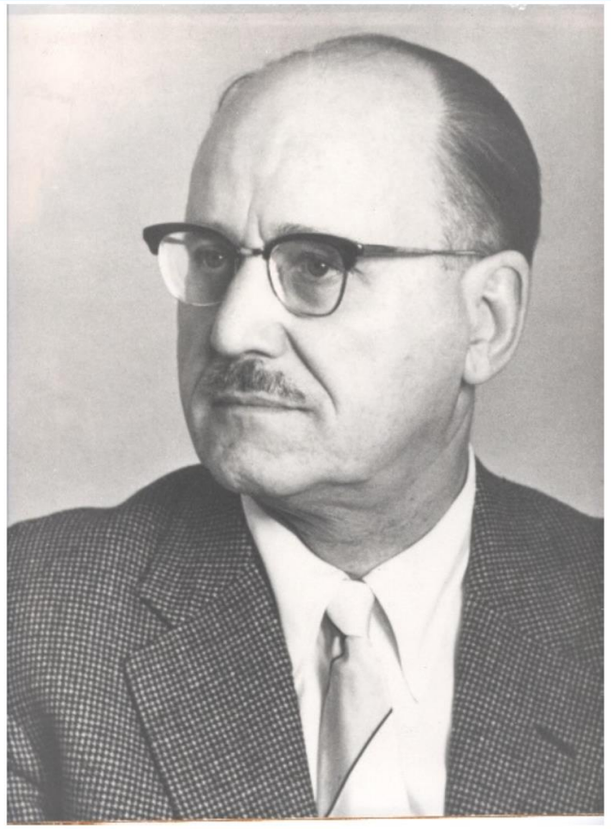
Farinograph Language

Prepared by: Eng. Mouhammed Kassomeh





Carl Wilhelm Brabender
(1897-1970)

Since the first Farinograph saw light in 1923 , this very reliable device becomes a very dependable tool to study the dough rheological properties for two reasons, first one is that the factors that can be measured from the Farinograph curve (Farinogram) have been of great importance of predicting baking quality, second the mixing action imparted to dough is reproducible so this will provide us that certain precautions are taken.

Accordingly, Farinograph now is the most widely accepted device around the world for testing the rheological properties of flour, and it has a wide presence in many national and international standards as:

- *ICC*
- *AACC*
- *ISO*
- *CEN EN*
- *DIN EN*
- *CCAT, IRAM*
- *China GB*
- *RACI F-1*
- *GOST ISO 51404-99*
- *Vietnam TCVN*

International Association for Cereal Science and Technology

American Association of Cereal Chemists

International Organization for Standardization

Gosudarstvennyy Standart

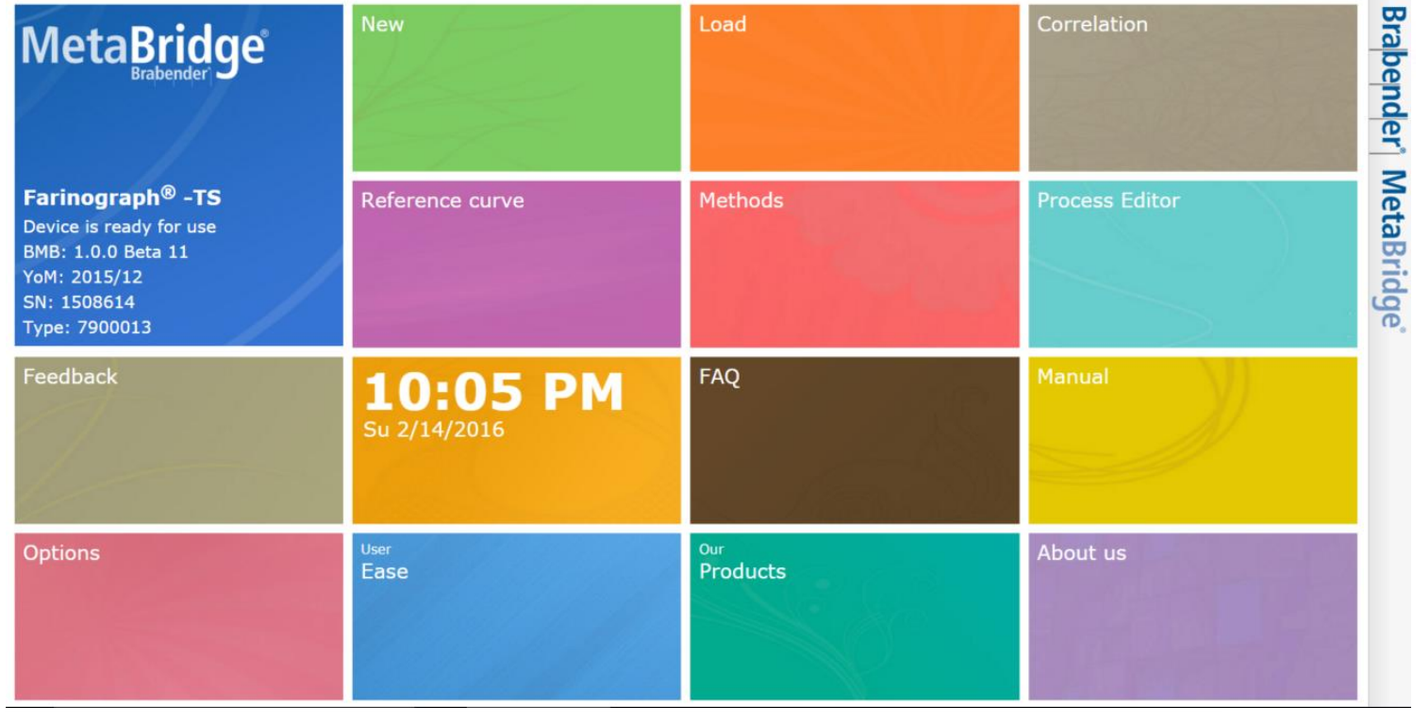
… and others

In this topic we will give a brief about this device and its applications, so expressions like:

“ this flour is not a strong one”
“the stability of this flour is too short”
” the water absorption of this flour is 57%”

will be very clear to you, and you can speak and understand
“Farinograph Language”

First, let's present the latest model of Farinograph device which concludes of the main driving and torque rheometer unit in addition to the (300 g) mixing bowl, water circulation thermostat, and finally the automatic dosing unit aqua-inject ,and the operating web based software "MetaBridge"


MetaBridge
Brabender
Farinograph® -TS
Device is ready for use
BMB: 1.0.0 Beta 11
YoM: 2015/12
SN: 1508614
Type: 7900013
New
Load
Correlation
Reference curve
Methods
Process Editor
Feedback
10:05 PM
Su 2/14/2016
FAQ
Manual
Options
User
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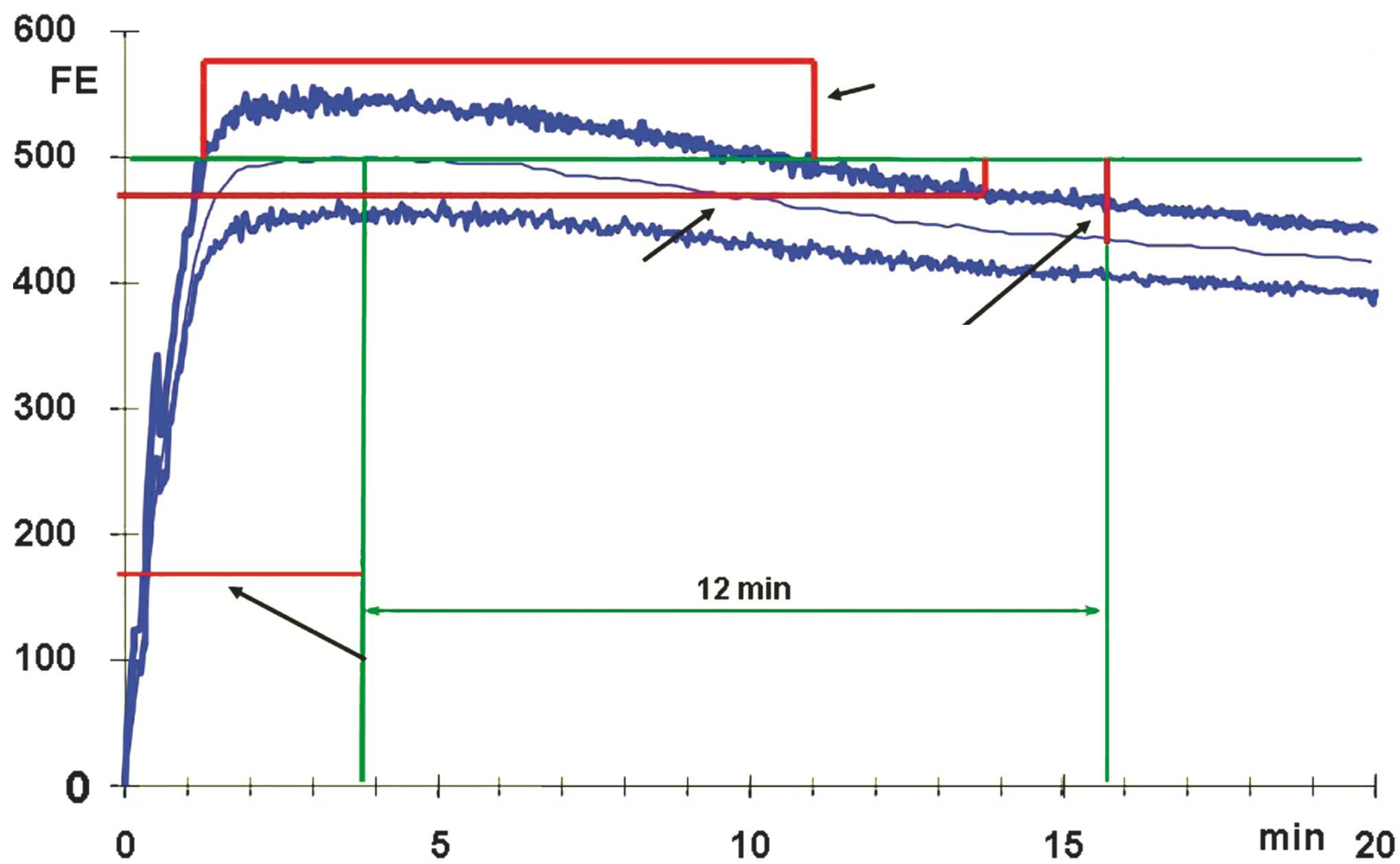
Our
Products
About us
Brabender MetaBridge


MetaBridge®
Brabender
User
test
Password
Forgot your password?
Please enter password...
Keep me logged in
Log in
No account? Sign up now.

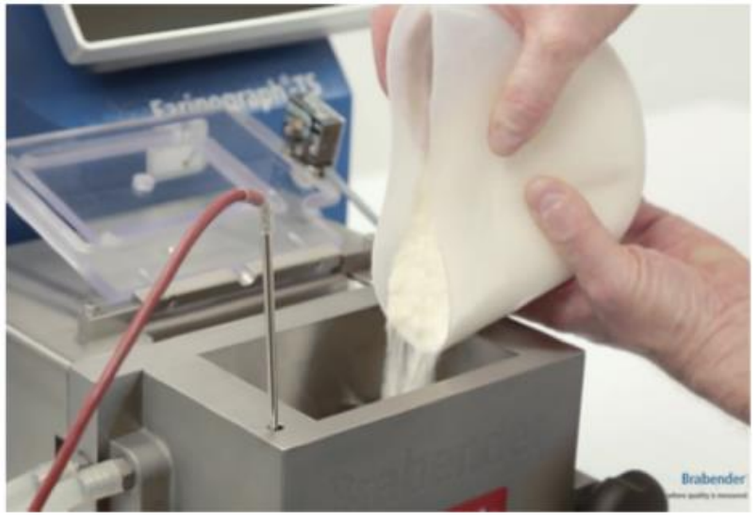
Although the Farinograph can be used to preform various types of tests , the flour-water curve (Farinogram) is the principle test used today by cereal chemists. The main methods which are worldwide adapted are the ICC No. 115/1 method and AACC No. 54-21.02 method which nearly have the same procedure:



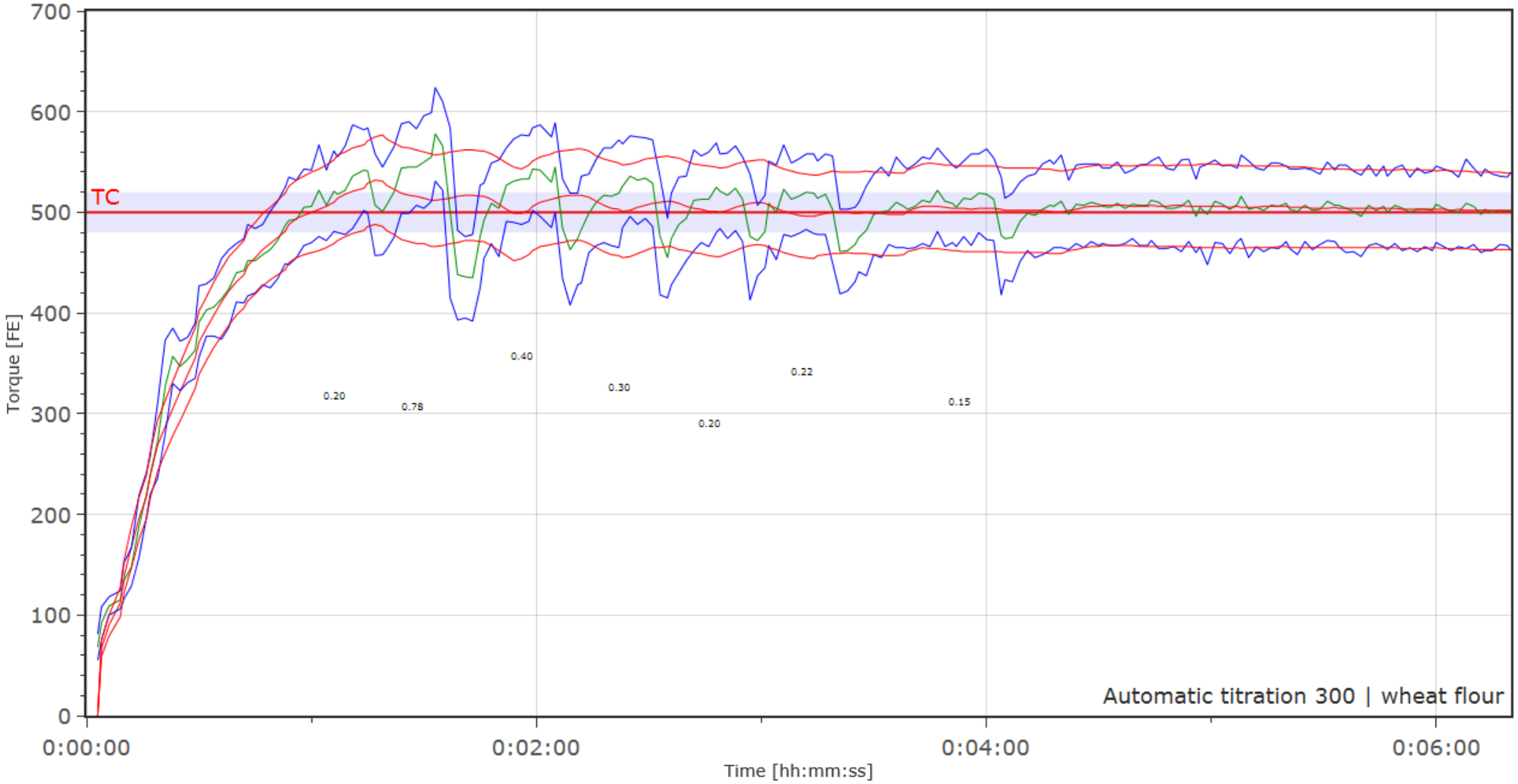
1-Determine the moisture content of the flour by ISO 712 method **.(accurate moisture values are very important)**

2- Check the temperature of the mixing bowl 30°C ± 0.2°

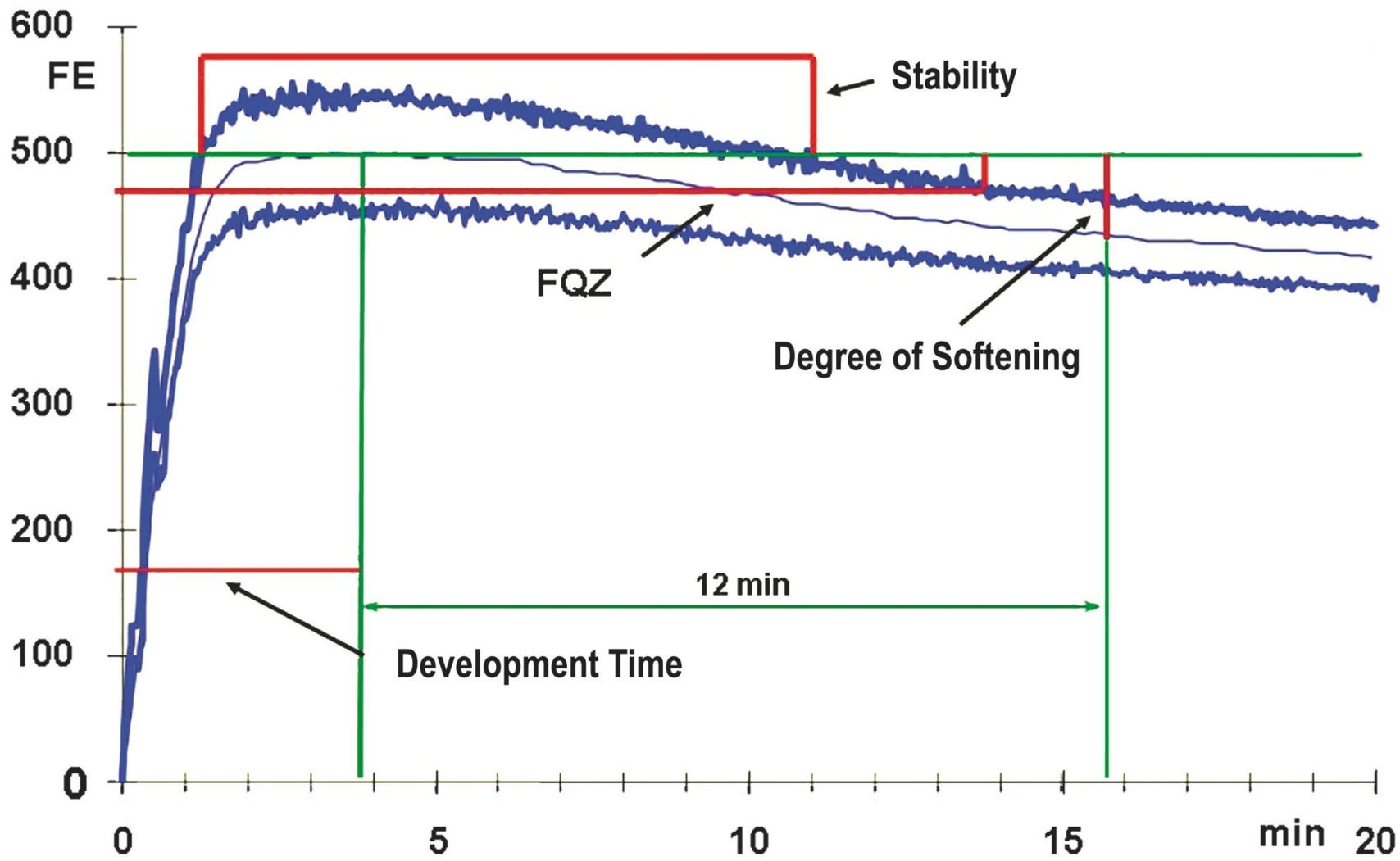
3- Place in the bowl the equivalent of 300 ± 0.1 g flour at 14% moisture , cover the bowl.



4- *Choose the Automatic titration 300 method from the metabridge software in which the dosing system (Aqua-Inject) will Automatically add a small amount of water gradually to centre the curve on 500 ± 20 BU at its peak, when dough forms scrape down the sides of the bowl with the plastic spatula, then stop mixing and clean the bowl.*



***5-** Make a second and further mixing depending on the correct water volume found by previous step, continue mixing till 12 minutes past of the peak.*
*This method is called **Constant flour mass procedure**.*



Other common methods

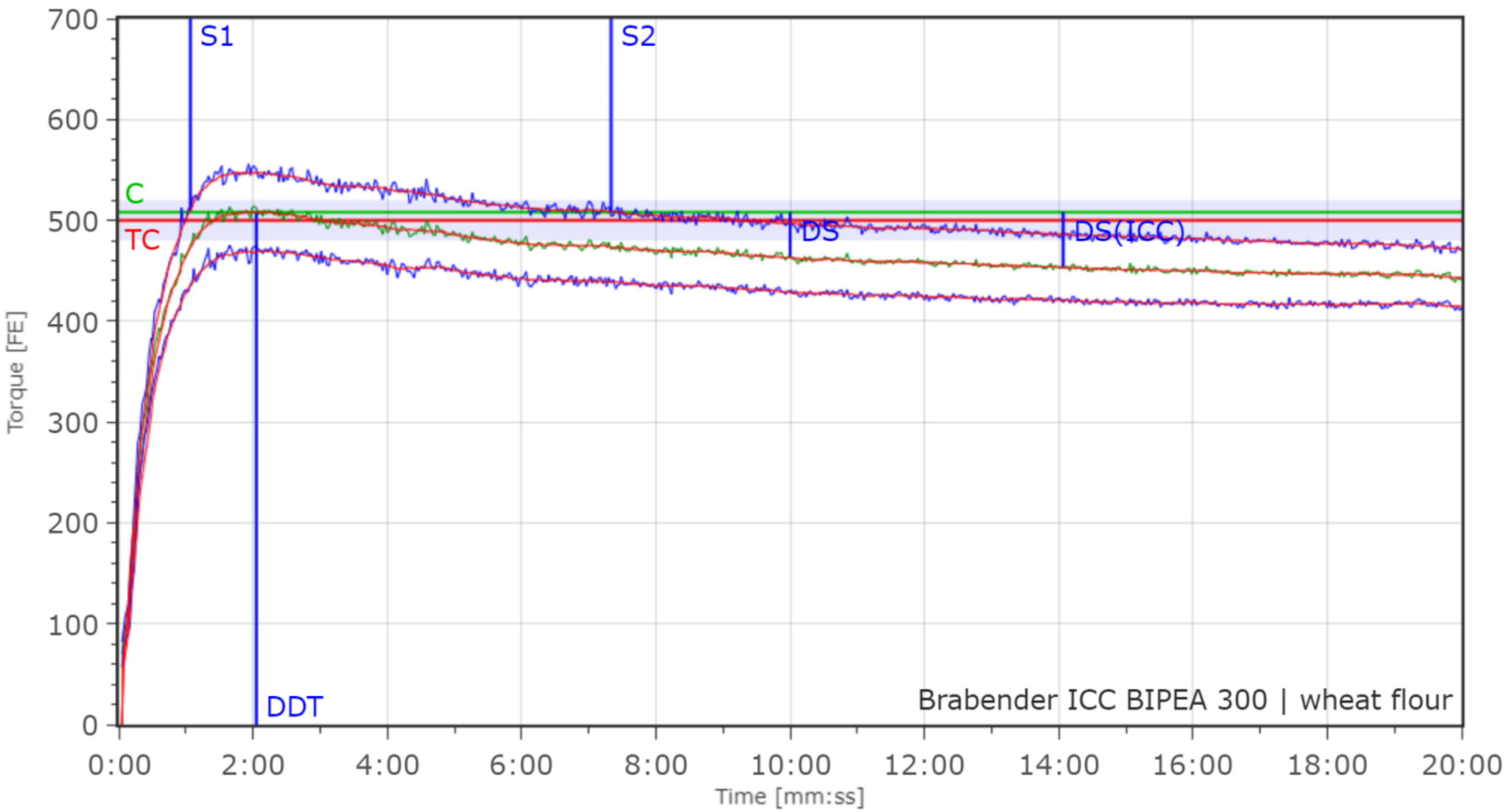
*When you go in the milling industry you can find some millers use another method called "**as is** " , in which you don't have to measure the moisture content of the flour at the beginning , and you make the test according to above mentioned procedure as if the moisture of the flour is 14% , in fact this method is less accurate than the first one , but it is widely used in bakeries where they need to have the actual exact water absorption of supplied flour prior to start production .*

*we have a third method called the **constant dough weight** , in which we change the amount of flour according to the water absorption , this method is commonly used in order to supply big bakeries in which they want to make a speedy test on the dough from the production line, so they collect 480 grams dough sample from the line and put it directly to the mixer.*

*There is also the **Royal Australian chemical Institute method** in which the flour should be sieved at least once on 16µm Mesh and the procedure like As Is method.*

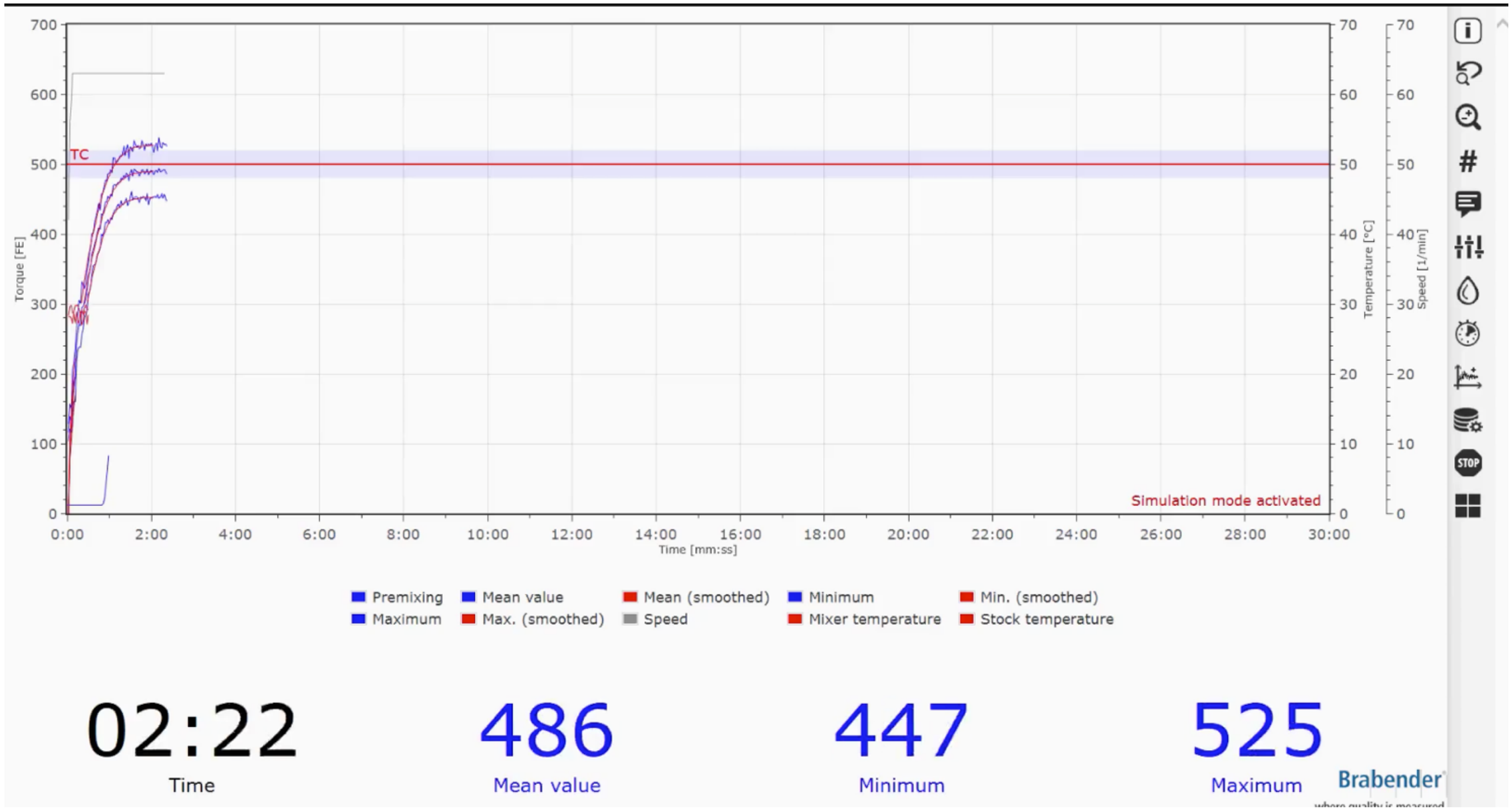
*The application with lower dough temperature is a special test method in some big manufactures of frozen dough products. In their production, the dough temperature sometimes is **only 20°C** and they run tests in the quality control by the Farino with 20 °C mixer temperature*

Now we have the (flour, water) graph called Farinogram, the x axe is for time in minutes and the Y axe is the consistency in BU unit.



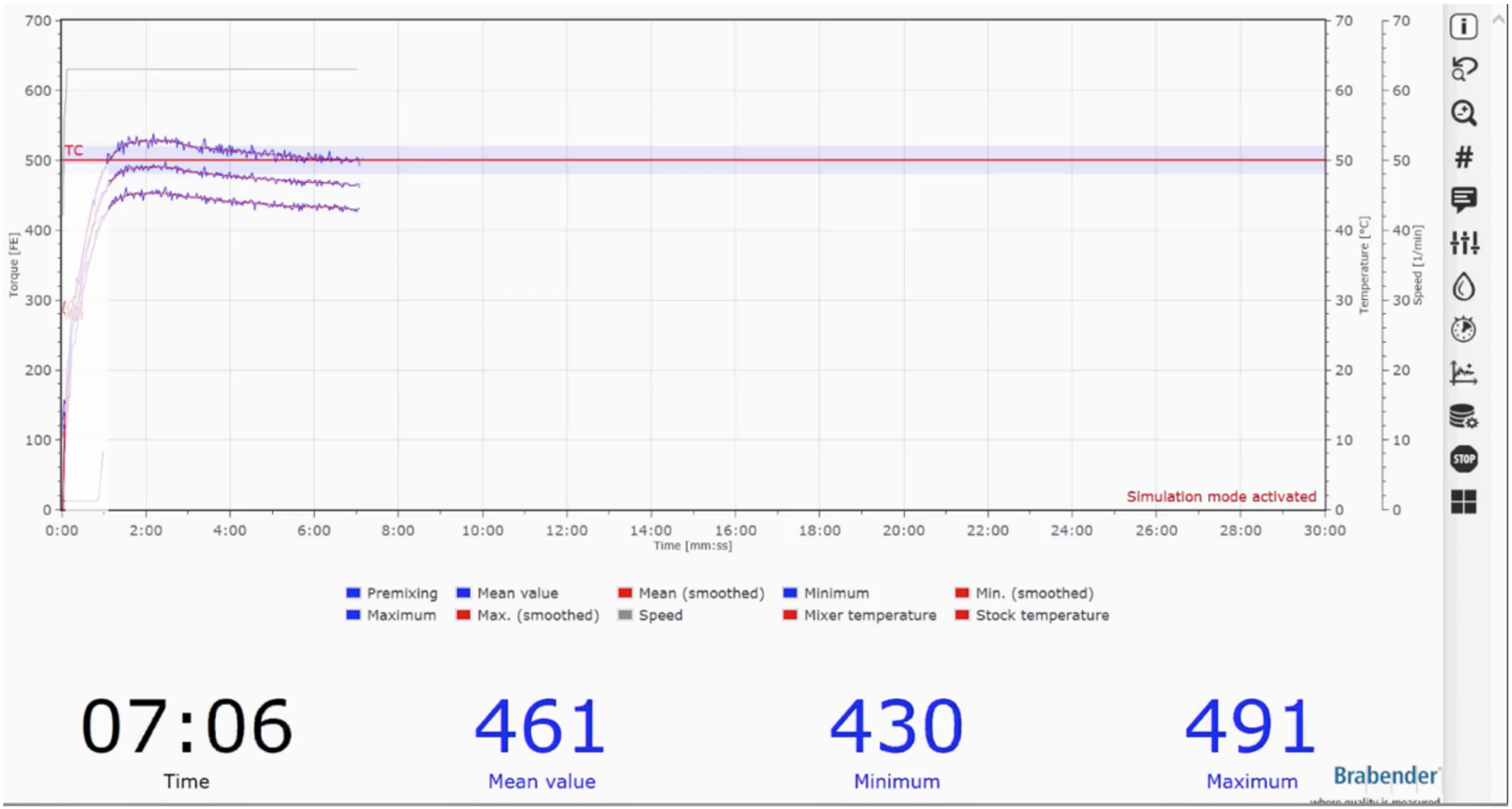
This graph consists of three phases :

The absorption phase *from the time from zero till the time of to the point of maximum consistency*

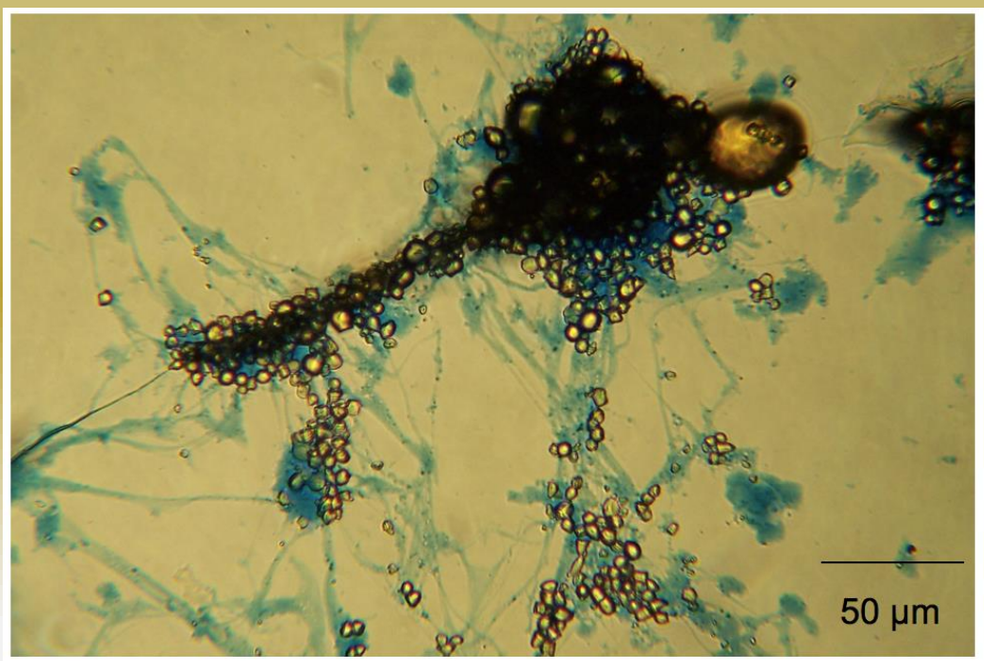


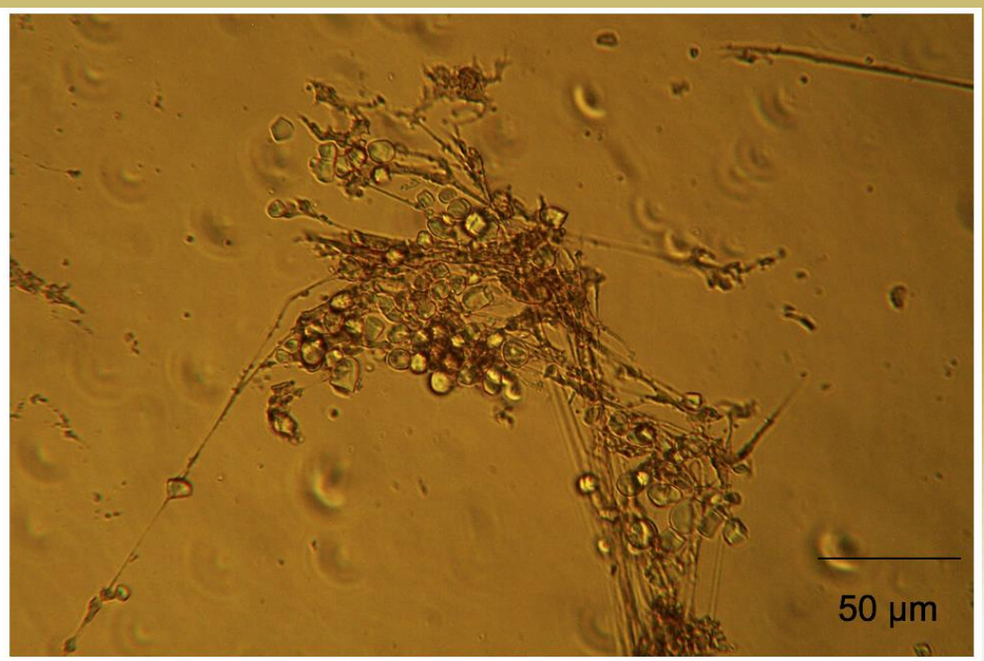
The breakdown phase *(departure phase) : it is from the point in which the top of the curve begins to drop below the 500 BU*

The last phase is between the above two phases which we call it ***the stability phase****: 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"*



*In the **first phase** of the Farinogram you can see the rapid increase of the consistency which is a result of increase in viscosity of the major components of flour as they imbibe water and to the "work - free" formation and interaction of protein fibrils that lead to the development of the gluten complex upon further mixing*





If wheat flour particles come in contact with water, protein fibers are built right away

*In the **stability phase** the dough has a smooth and homogenise appearance and appears to have optimum elastic and viscous properties for the retention of gas*

Further mixing leads the dough to ***breakdown phase*** *in which the dough becomes wet and sticky which is related to the rheodestructions of the laminar fibril structure .*

For the numerical characterization of those three phases we have the following readings:

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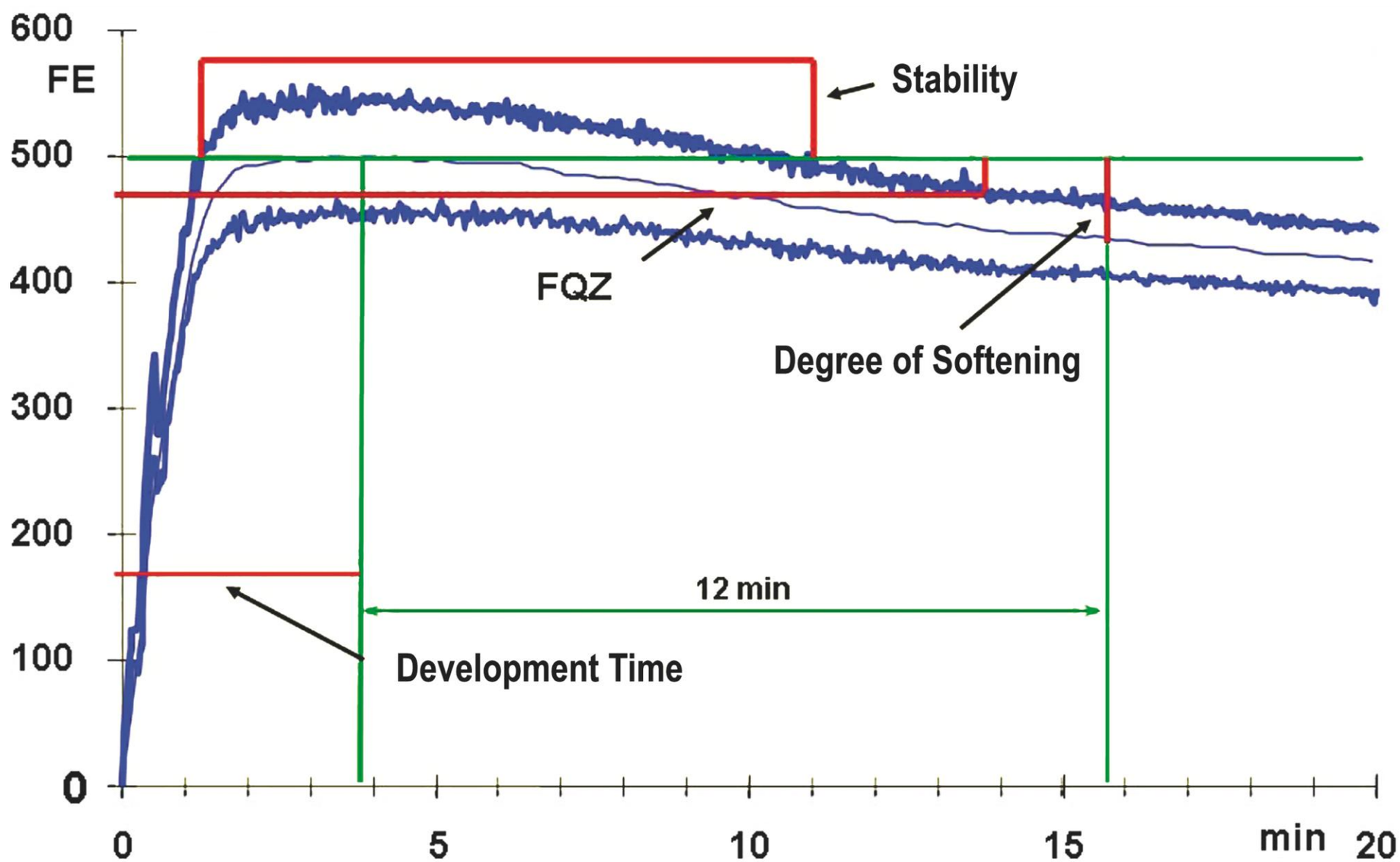
1- ***Water absorption*** *: is the most commonly used and widely accepted farinograph measurements, It is one of the most important factor affecting the farinogram, absorption is defined as the amount of water required to centre the farinogram on the 500 -BU, in fact, this definition was put according to hundreds of studies but this doesn't mean that this is the typical water absorption that all bakeries should adopt, one study showed that the typical water absorption for bakeries is when consistency is 580 BU and one study showed that the typical for bakeries is when consistency is 380 BU, and I say that in preview this definition was put in order to give as a standard, but every bakery should has its own correlation according to its processing condition.*



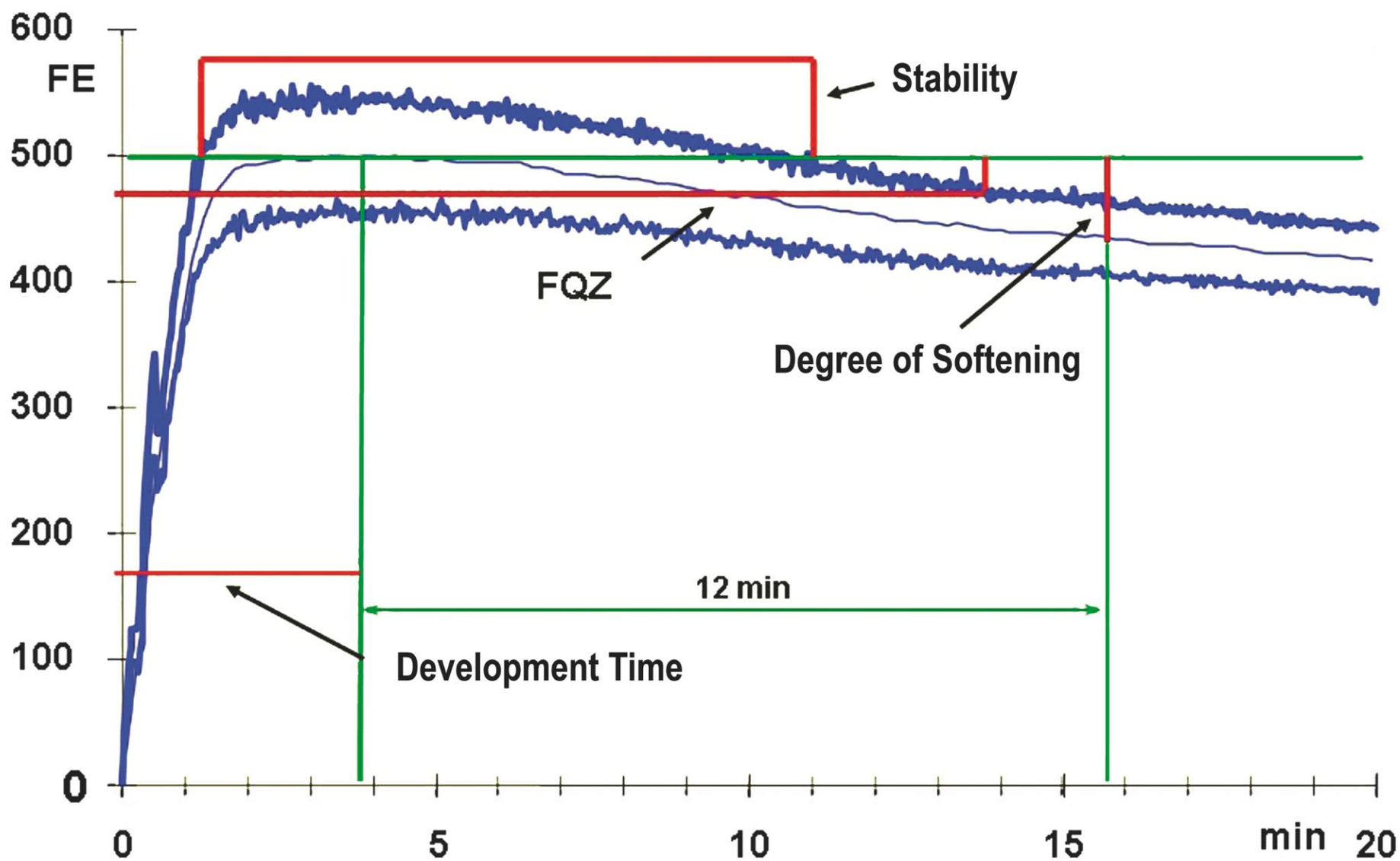
Benefit for a bakery because of controling the water absorption

- Consumption of flour per day 60 t
- Bread price in Lebanon approx. 2 USD per kg
- With Farinograph® tests higher water absorption of 0,5 [%]
- eg instead of 57% you get 57.5%
- 60.000 kg flour = 300 kg more Dough
- Baking loss approx. 15% = 45 kg
- 255 more baking product / bread
  - ⇒ 510 USD per day
  - ⇒ 153,000 USD after 300 days
  - ⇒ 230 M Lira

Date of price data: 09/2019

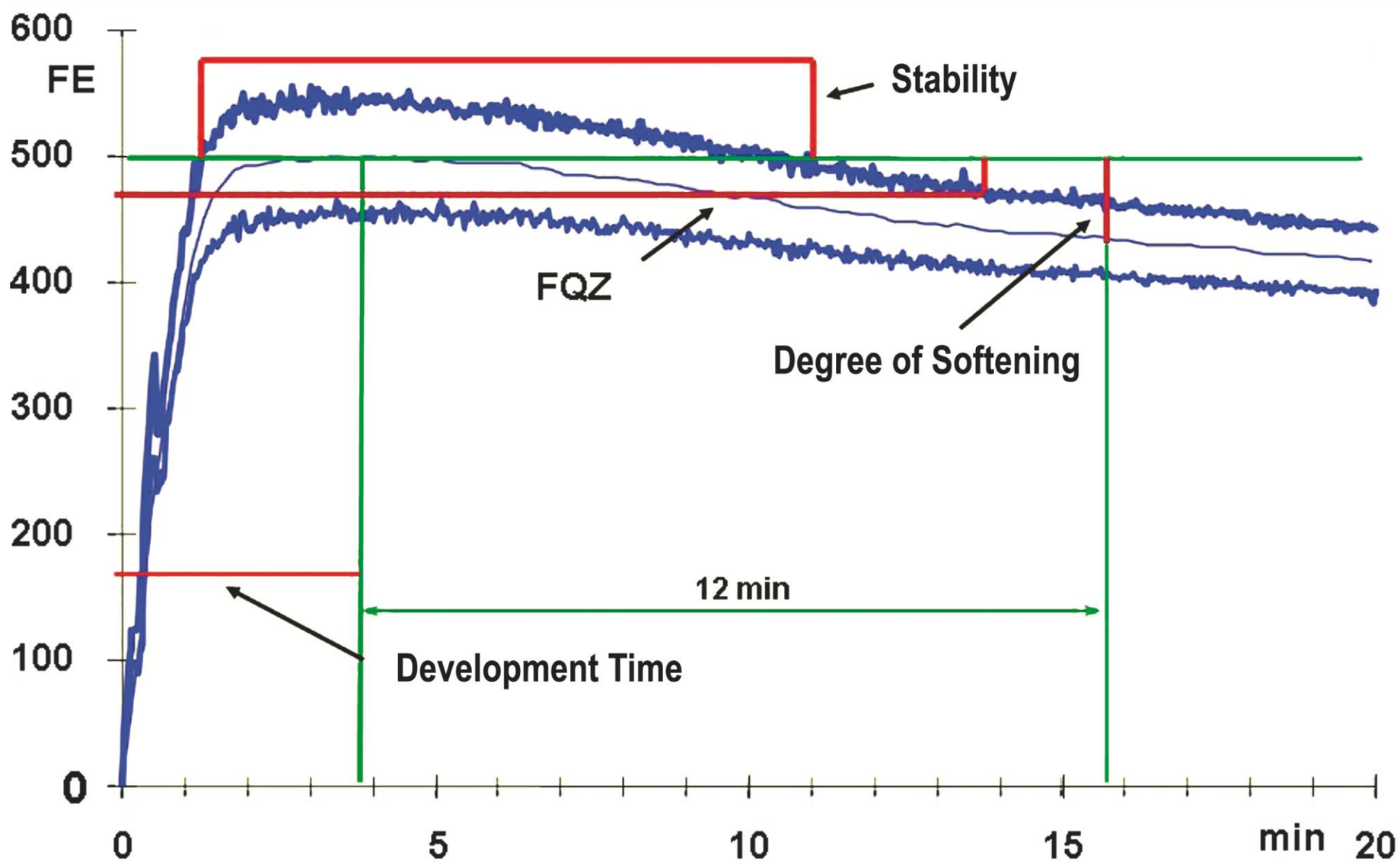
For the numerical characterization of those three phases we have the following readings:

2- ***Development time****: the time between the first addition of the water and the development of the dough's maximum consistency, this value also referred to as "****Mixing Time****", "****Peak time****"*



For the numerical characterization of those three phases we have the following readings:

*3- **Stability time**: defined as the difference in time between the point at which the top of the curve first intercepts the 500-BU line and the point at which the top of the curve leaves the 500-BU line*

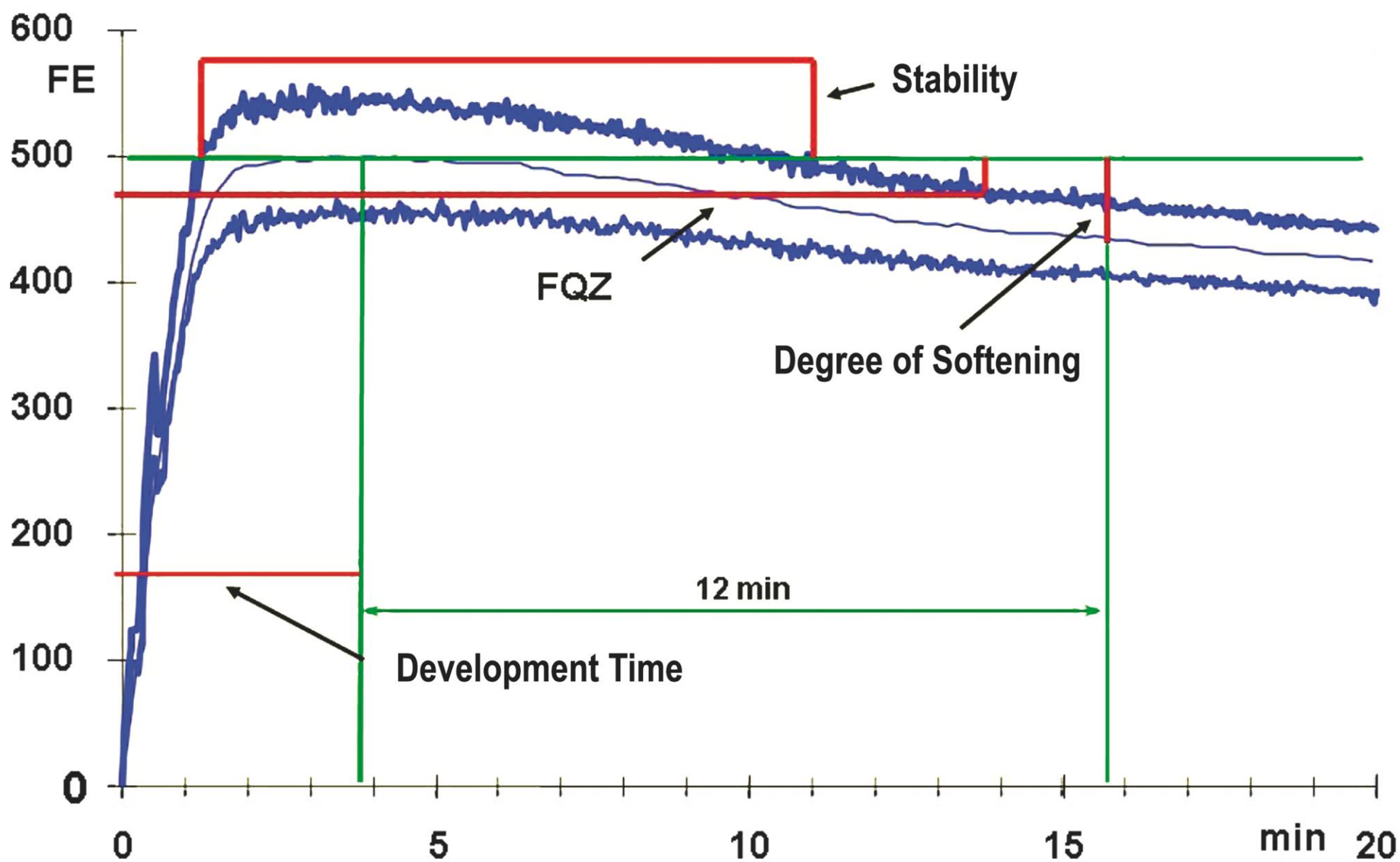


For the numerical characterization of those three phases we have the following readings:

*4- **Degree of Softening** : here we have two different definitions according to ICC and AACC*

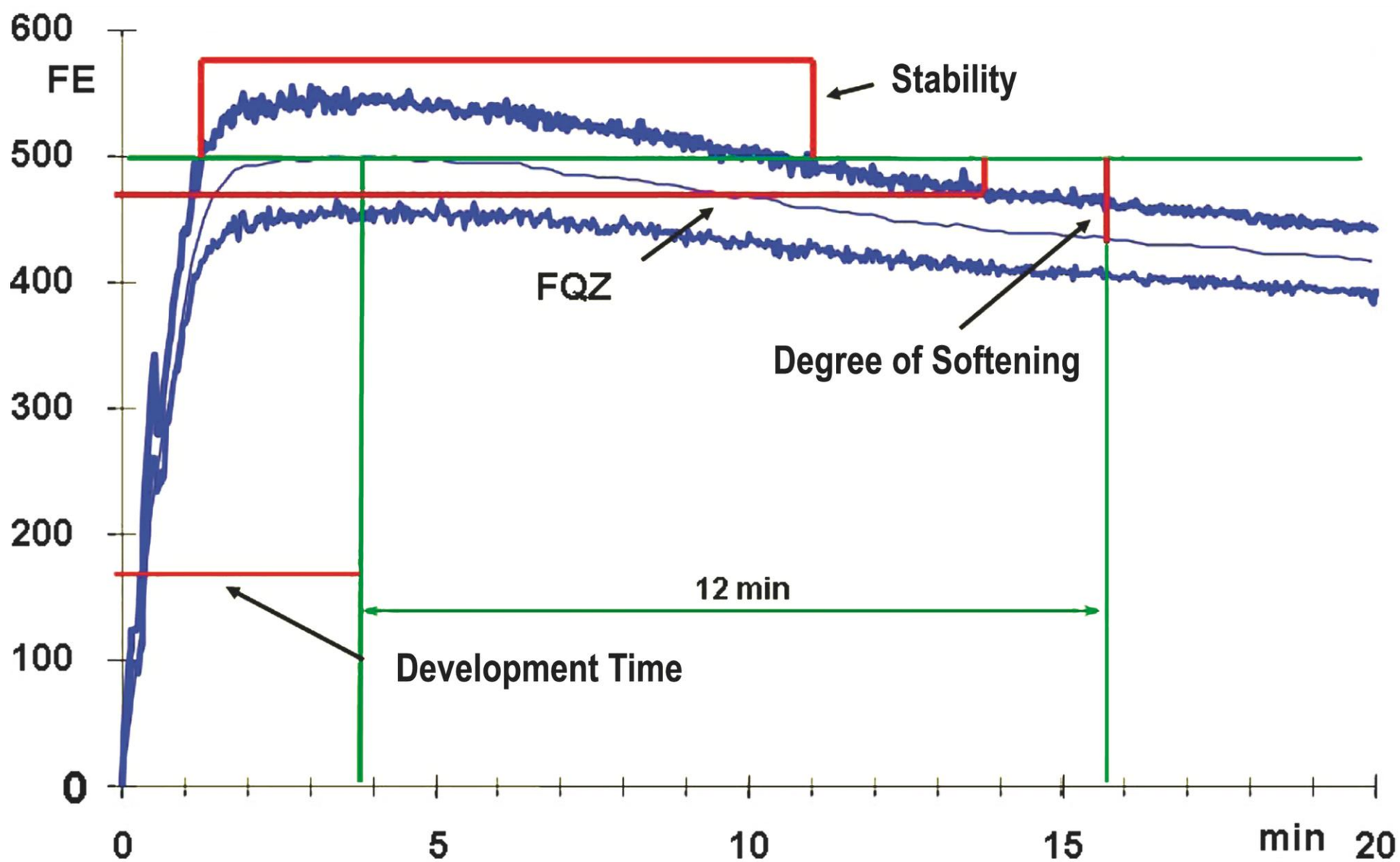
a) (DS ACC) is the difference between the consistency value of the curve center at the end of the developing time and the curve centre 10min after starting the test.

b) (DS ICC) is related to ICC Standard 115/1 and describes the difference between the consistency value of the curve centre at the end of the developing time and the curve centre 12min after the developing time.



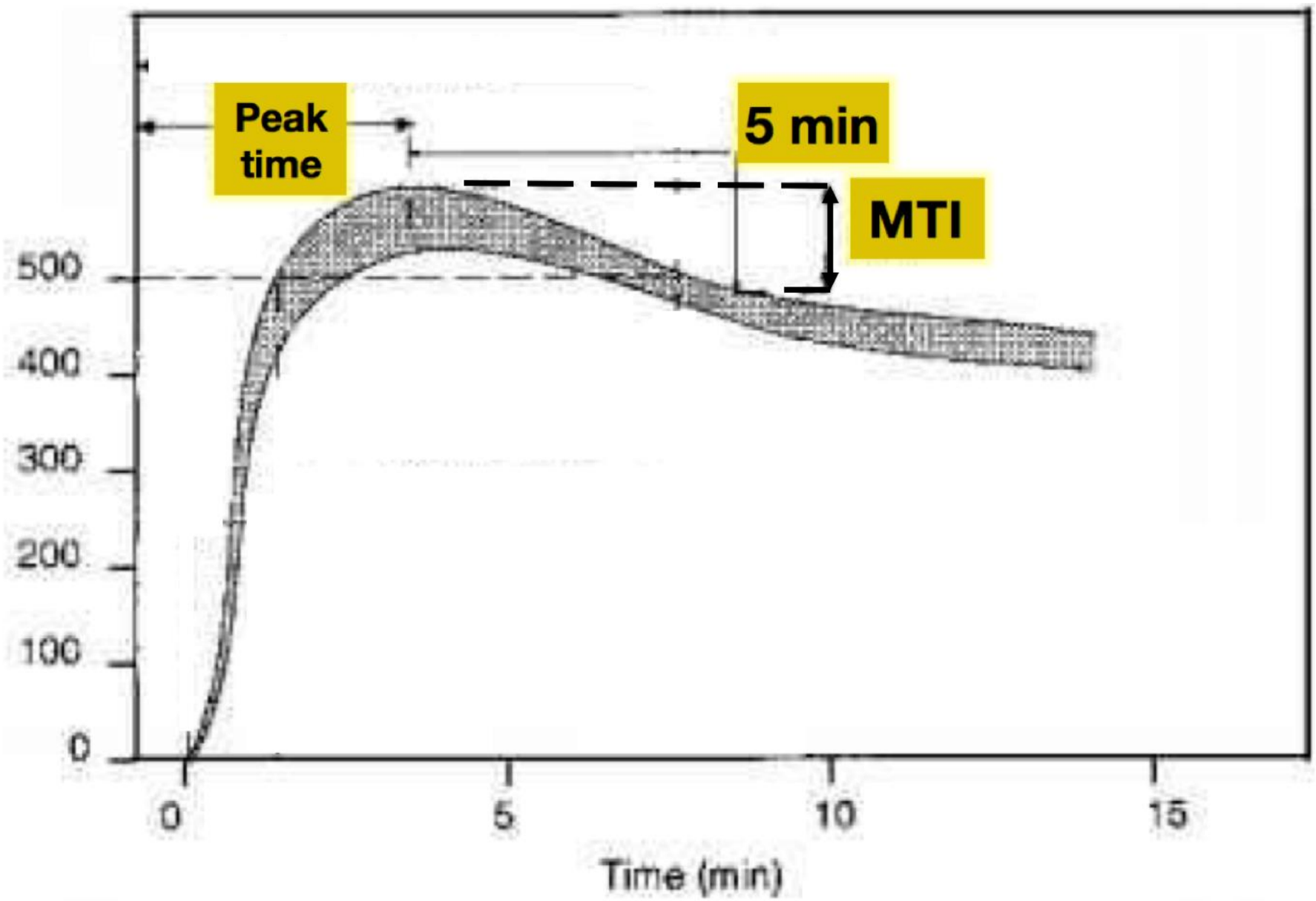
For the numerical characterization of those three phases we have the following readings:

5- ***Farinograph quality index : (FQN)*** *describes the lengths along the timeline from the beginning of water addition until the point where the center of the curve is 30 FE lower than at the development time.*



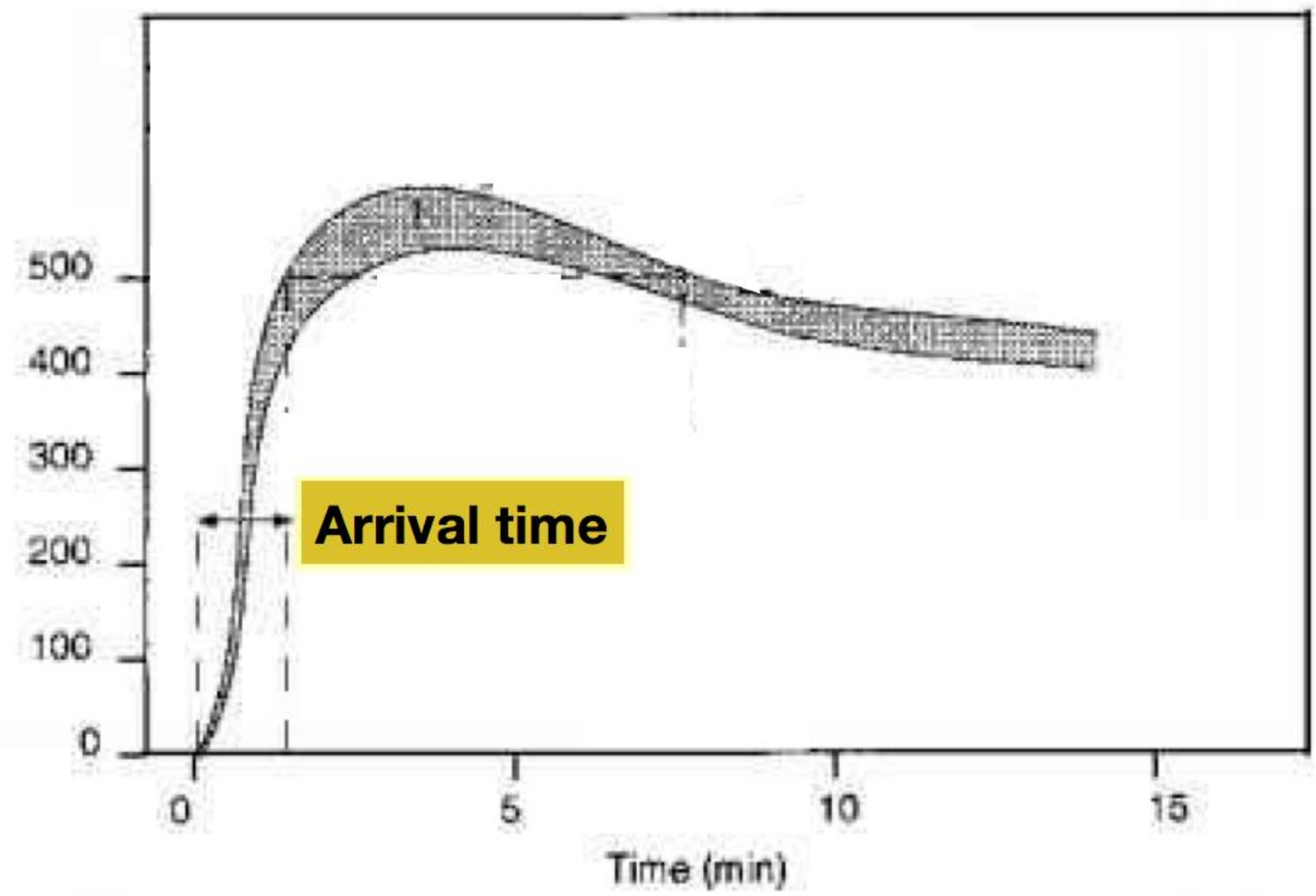
For the numerical characterization of those three phases we have the following readings:

6- ***Mixing tolerance index (MTI)*** *: it is very well known measurement in the united states, defined as the difference in BU between the top of the curve at the peak and the top of the curve measured 5 min after the peak is reached*



For the numerical characterization of those three phases we have the following readings:

7- ***Arrival time:*** *The arrival time is the time required for the top of the curve to reach the 500-BU line after the mixer has been started and the water introduced. This value is a measurement of the rate at which the water is taken up by the flour. Generally, on a given variety of wheat, the arrival time increases as the protein increases.*



According to those AM readings, wheat flours can be classified as :

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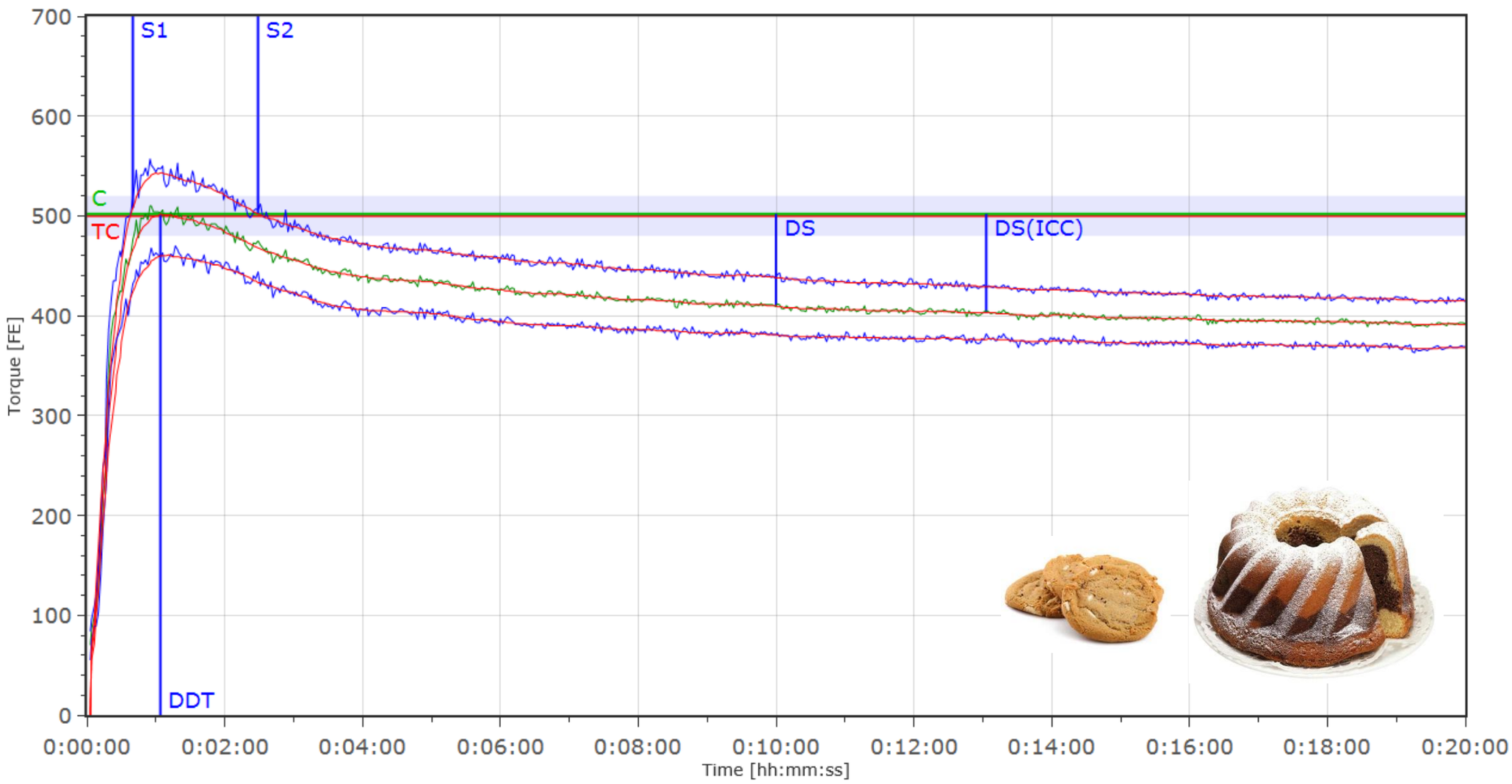
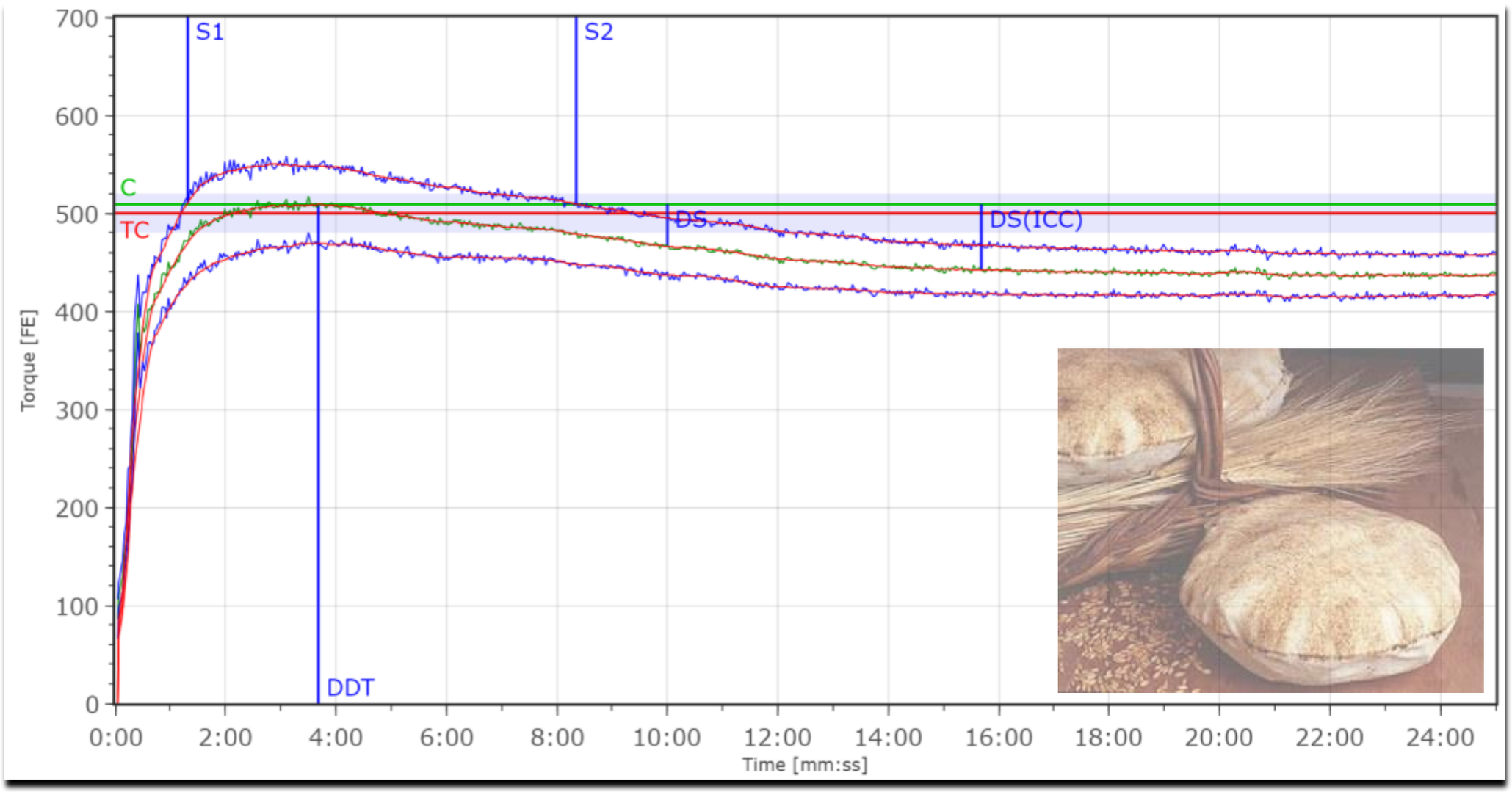
1. ***Weak:*** *These flours are characterized by short development times (less than 2.5 min), low stability (less than 3 min), low water absorption (less than 55%), degree of softness (more than 80), MTI is greater than 100 they usually have low protein content (7.5- 9.0%) and starch damaged (0-10) Farrand.*
Major uses are pastry products, crackers, and soft wheat noodles, in fact many millers blend this flour with very strong wheat flours.



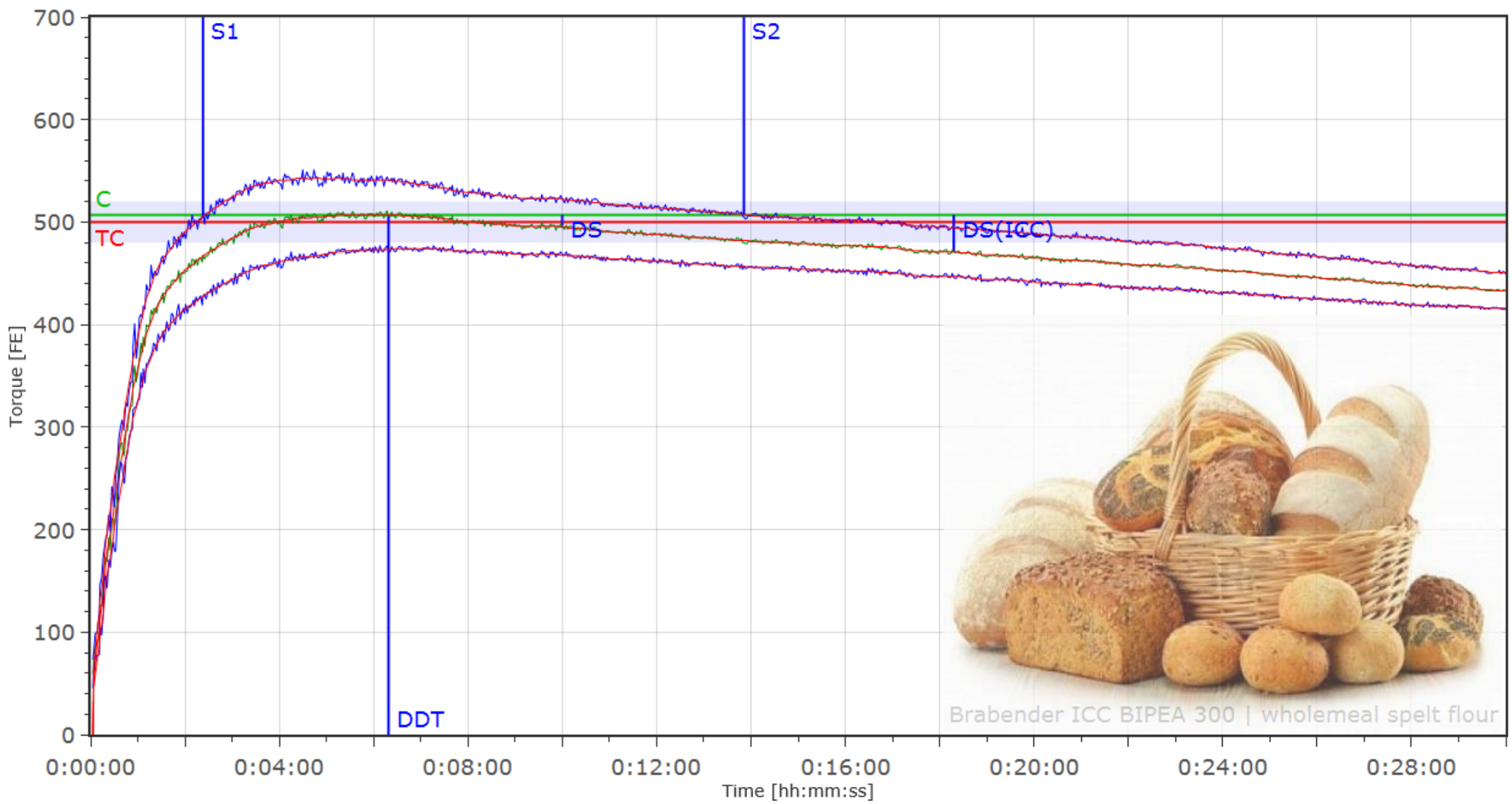
According to those AM readings, wheat flours can be classified as :

2. ***Medium:*** *these flours have dough development times ranging from 2.5 to 4.0 min stability (3-10 min), water absorption (54- 60%), MTI (60- 100 BU), degree of softness is between (70 – 80) usually the starch damaged of those flours ranges from 10-20 farrand.*
Major uses in addition to crackers is chappattis and Arabic Bread.



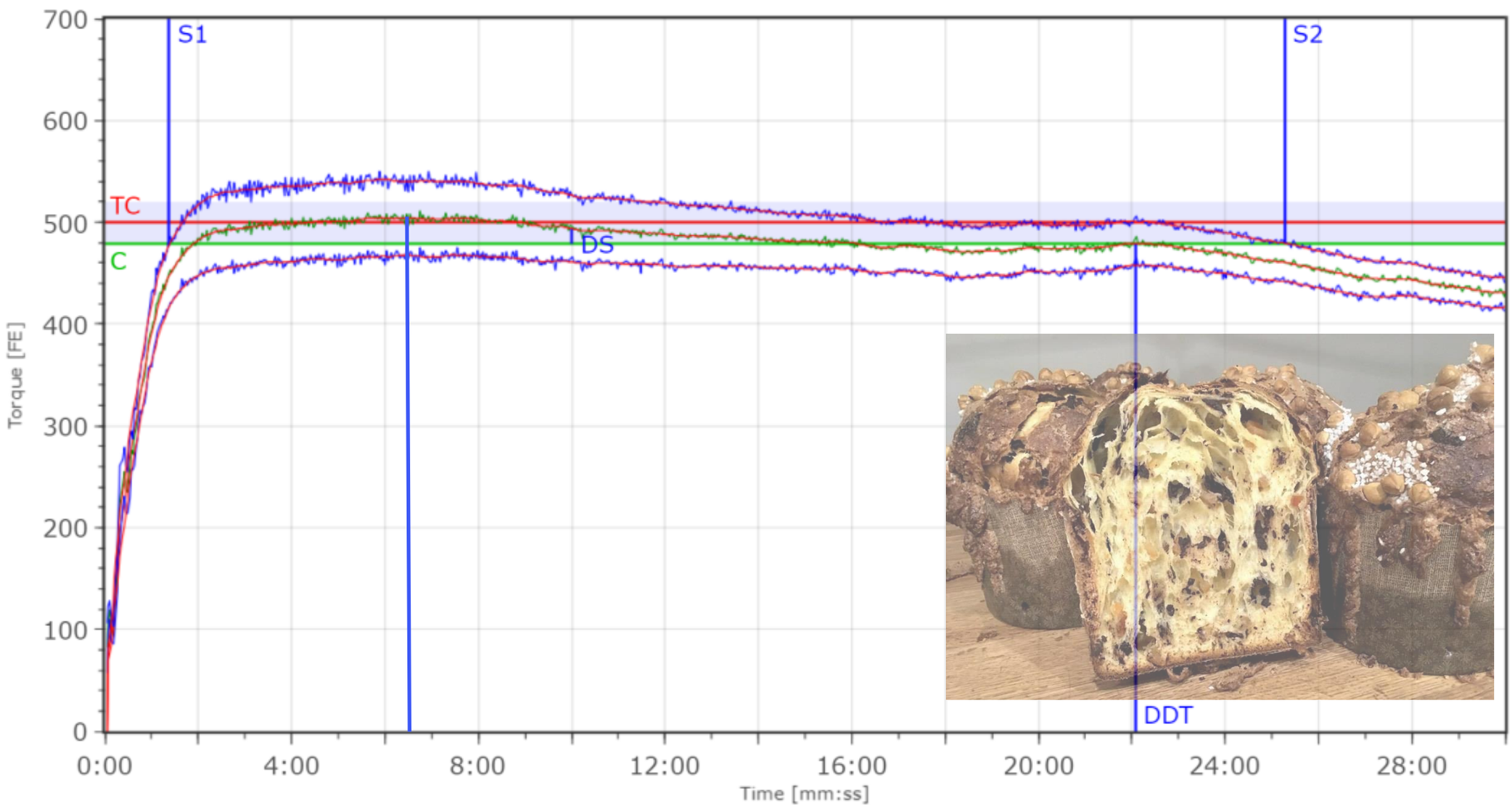
According to those AM readings, wheat flours can be classified as :

3. ***Strong:*** *the farinogram of these flours show long development times (4- 8 min), stability (greater than 10 min), water absorption (greater than 58%), MTI (15-50 BU) and degree of softening is less than 80 BU normaly the starch damaged of those flours ranges (15- 30) Farrand,*
The major uses varites of bread and hard wheat noodles.



According to those AM readings, wheat flours can be classified as :

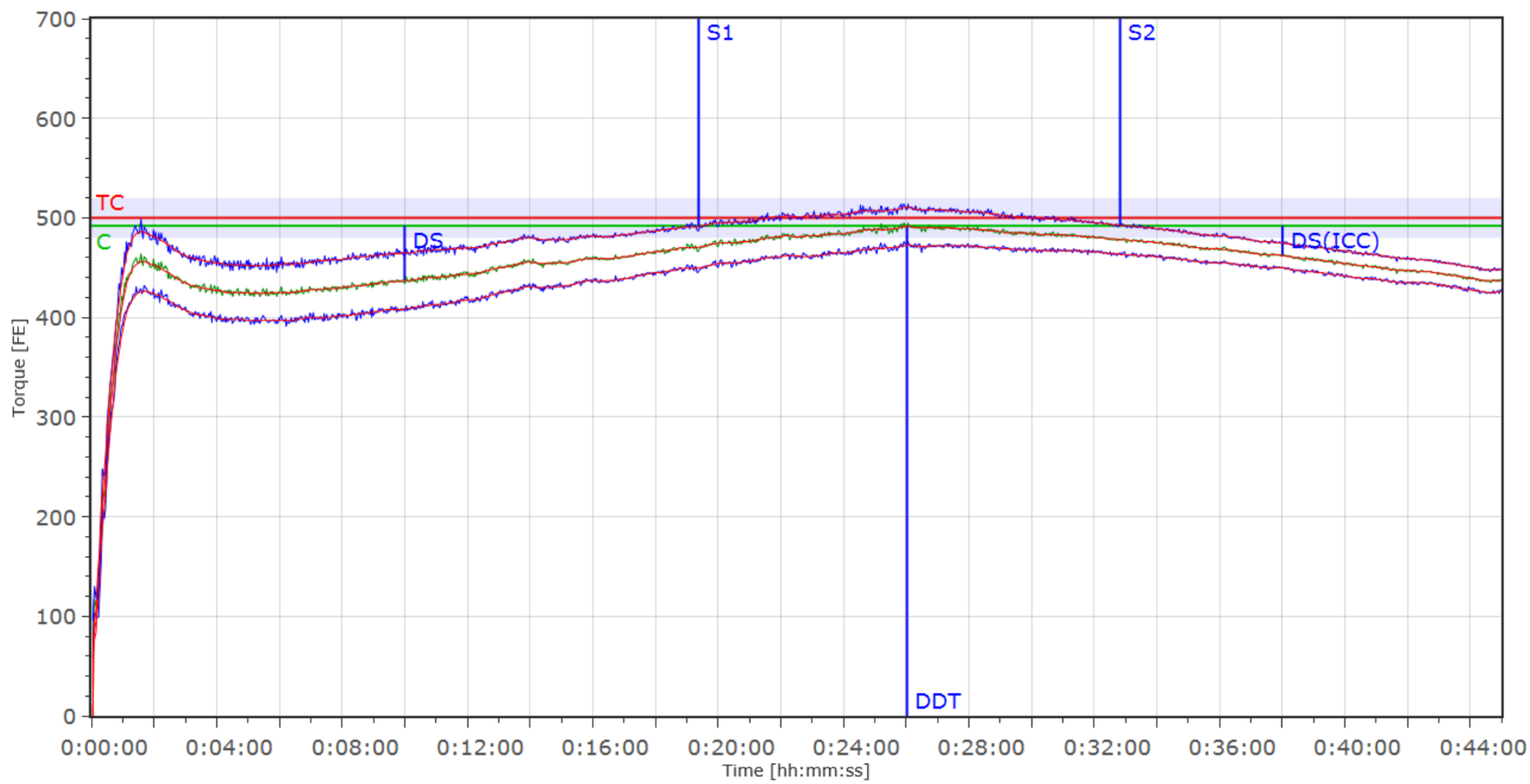
4. ***Very strong:*** *has very long development time (greater than 10 min), very low MTI (less than 10 Bu) and degree of softening less than 50 BU.*
Normally the starch damaged for those flours is greater than 15 farrand.
The major use of this flours is to blend with weaker flours, long fermentation doughs or products like panettone.



Each variety of wheat has its own Farinogram, and this Farinogram also changes from location to location, Weather and soil conditions during growth of the plant are two of many main factors that affect the shape of the curve.

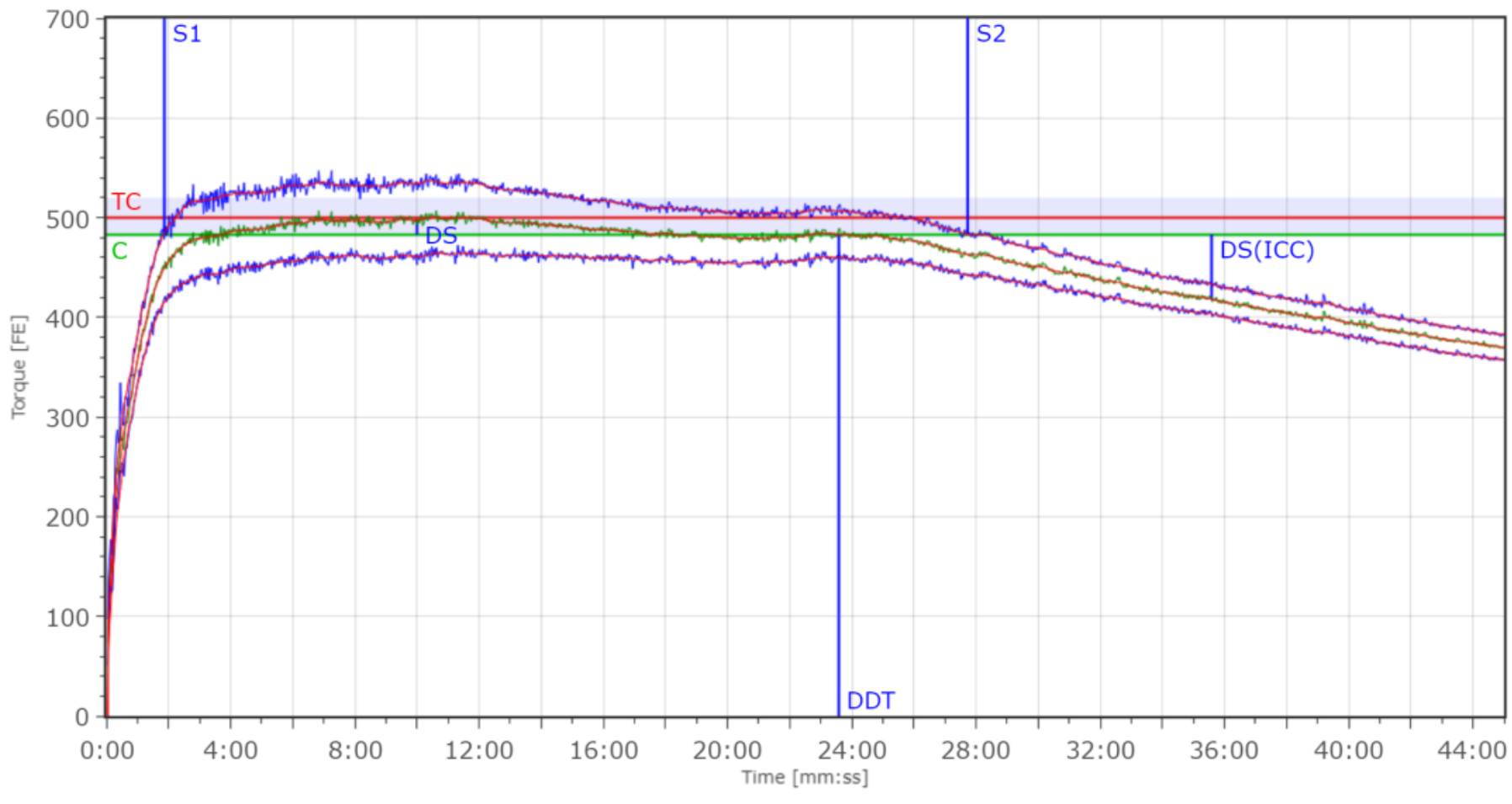
Chinese Wheat

Point	Value	Unit
T	45:00	mm:ss
DT	28.1	°C
DDT	26:02	mm:ss
C	492	FE
WZ	61.8	%
WAC	61.6	%
WAM	61.6	%
S	13:27	mm:ss
DS	55	FE
DS(ICC)	30	FE
FQN	380	mm



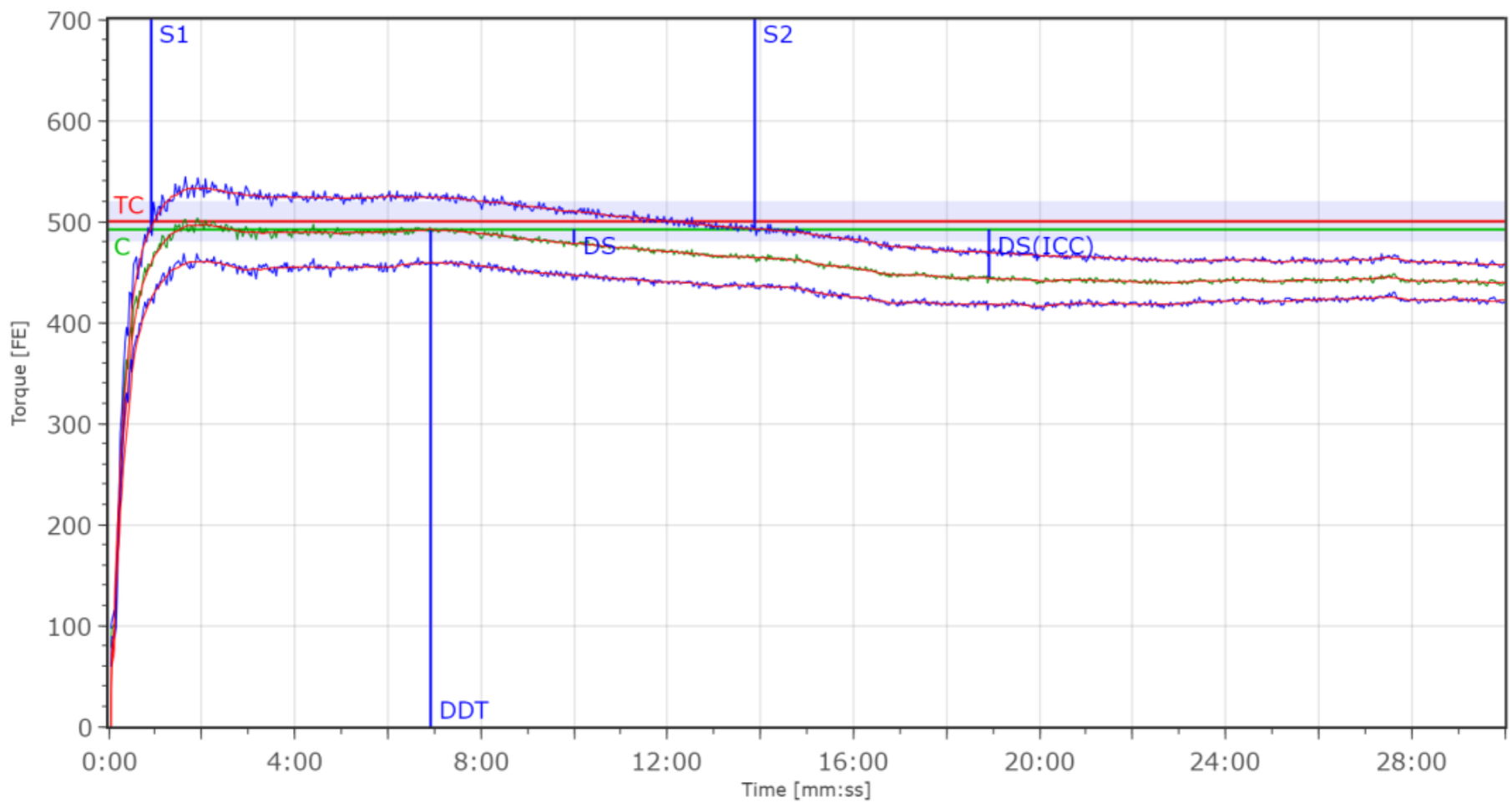
Canadian Wheat

Point	Value	Unit
T	45:00	mm:ss
DT	28.1	°C
DDT	23:35	mm:ss
C	483	FE
WZ	63.2	%
WAC	62.8	%
WAM	62.5	%
S	25:52	mm:ss
DS	15	FE
DS(ICC)	65	FE
FQN	295	mm



French Wheat

Point	Value	Unit
T	30:00	mm:ss
DT	28.7	°C
DDT	6:55	mm:ss
C	492	FE
WZ	55.9	%
WAC	55.7	%
WAM	55.7	%
S	12:58	mm:ss
DS	14	FE
DS(ICC)	48	FE
FQN	146	mm



American Wheat

	Hard Red Winter[1]		Hard Red Spring		Northern Durum[2]		Desert Durum®		Soft White		Soft Red Winter	
	2018	5-Year Avg	2018	5-Year Avg	2018	5-Year Avg	2018	5-Year Avg	2018	5-Year Avg	2018	5-Year Avg
Test Weight (lb/bu)	60.9	60.1	62.2	61.7	61.4	60.4	62.8	62.7	61.7	60.5	57.9	58.2
(kg/hl)	80.2	79.1	81.7	81.1	79.9	78.6	81.8	81.6	81.1	79.6	76.2	76.6
Grade	1 HRW	1 HRW	1 DNS	1 NS	1 HAD	1 HAD	1 HAD	1 HAD	1 SW	1 SW	3 SRW	2 SRW
Dockage (%)	0.5	0.6	0.5	0.6	0.7	0.8	0.3	0.5	0.5	0.5	0.4	0.5
Wheat Moisture (%)	10.9	11.2	11.8	12.2	11.2	11.7	6.7	6.8	8.6	9.2	12.8	13.0
Wheat Protein (%) [3]	12.4	12.4	14.5	14.0	14.5	13.6	13.4	13.6	9.3	10.3	9.9	9.7
Wheat Ash (%) [3]	1.49	1.53	1.58	1.50	1.54	1.57	1.70	1.71	1.36	1.35	1.45	1.47
1000 Kernel Weight (g)	30.7	29.8	31.1	31.1	41.2	39.9	46.3	49.2	35.7	34.4	29.9	32.6
Wheat Falling Number (sec)	374	393	403	374	425	374	615	557	315	341	322	304
Flour/Semolina Extraction (%)	75.1	75.7	67.8	68.2	69.3	66.3	71.0	63.7	72.5	74.5	68.0	70.0
Flour/Semolina Ash (%)[3]	0.44	0.59	0.52	0.51	0.73	0.69	0.80	n/a	0.42	0.46	0.47	0.44
Wet Gluten (%)	28.1	28.5	35.3	34.2	37.4	33.8	32.3	33.7	23.2	24.9	23.6	21.6
Farinograph:												
Peak Time (min)	5.2	5.0	7.7	7.1	n/a	n/a	n/a	n/a	2.7	2.5	1.2	1.3
Stability (min)	12.2	8.3	10.8	10.8	n/a	n/a	n/a	n/a	2.9	2.7	1.8	2.5
Absorption (%)	58.4	59.9	64.1	62.9	n/a	n/a	n/a	n/a	52.2	53.6	51.9	52.9

Physical Factors influence the Farinogram:
there are two main factors

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1- ***Mixing bowl*** *:*
The size and the Physical conditions of the bowl have a big influence on the Farinogram of the flour sample, that is the resistance of dough for mixing contributes of main two factors; one is from the mixing blades and the second is the adhesive to the bowl walls. (Fig 2) shows the Farinogram for the same flour differs from the two bowls and from a new bowl to a defected one.

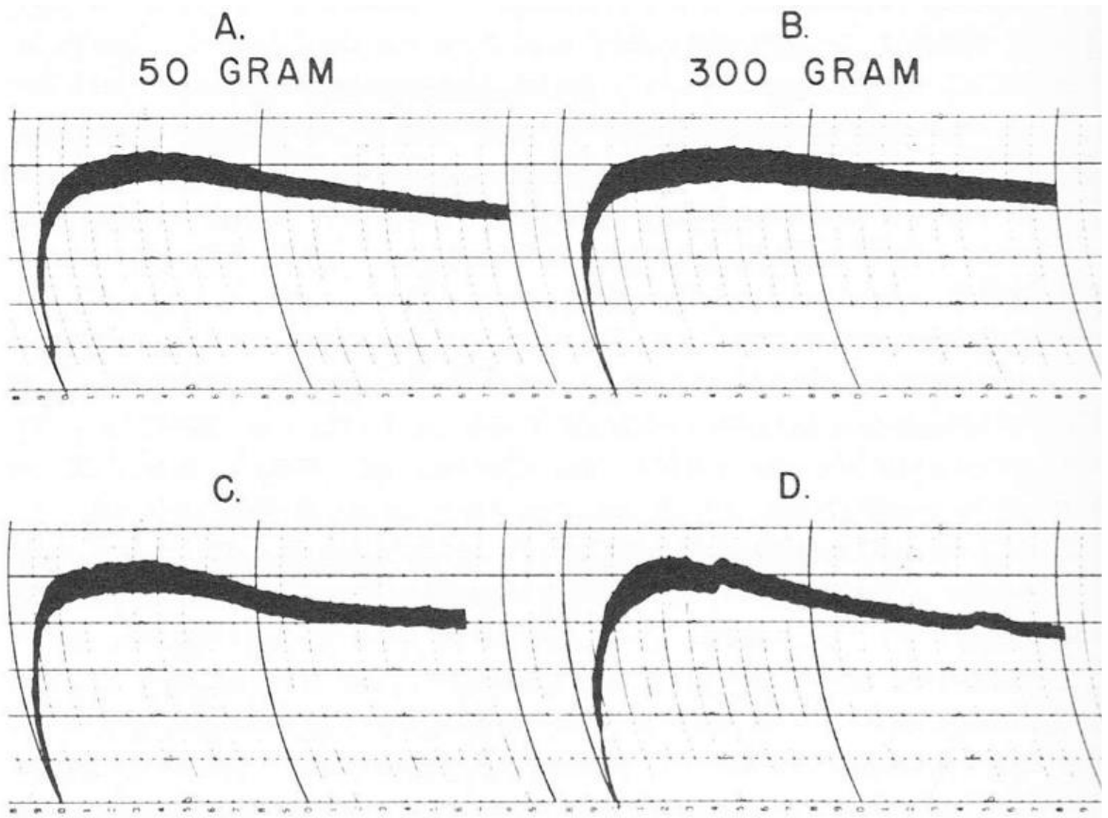
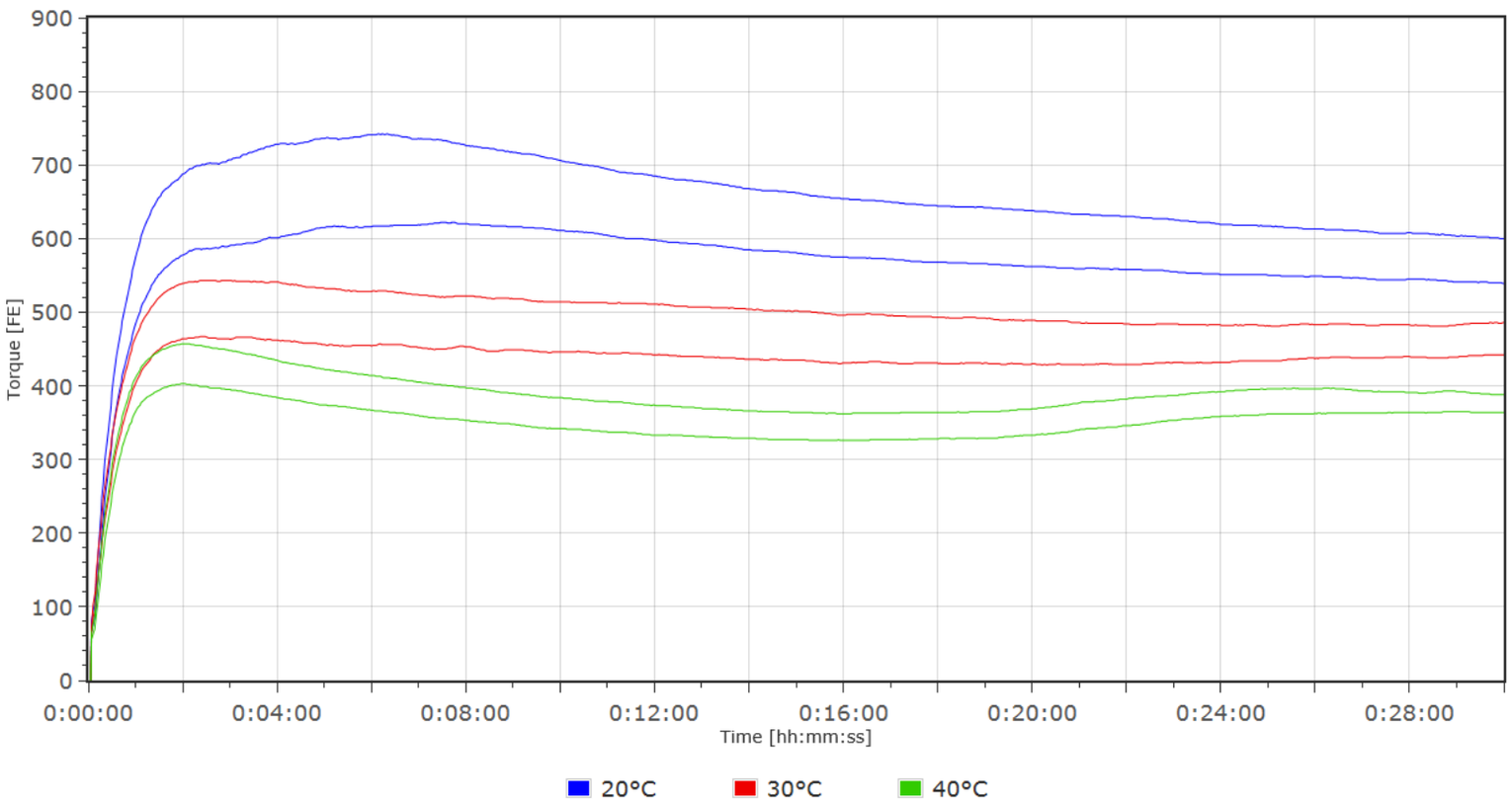


Fig. 2. Farinograms made: with a 50-g mixer (**A**) and a 300-g mixer (**B**); in a greatly used bowl (**C**); and in a bowl with a physical defect (**D**).

Physical Factors influence the Farinogram: there are two main factors

2- ***Temperature*** *:*

By making tests on many samples we found out that the bowl temperature has a big influence on the curve.



	ID	T	DT	DDT	C	WZ	WAC	WAM	S	DS	DS(ICC)	FQN
	20°C	30:00	21.4	6:10	680	59.9	64.4	64.4	10:34	21	74	110
	30°C	30:00	28.5	2:27	505	59.9	60.0	60.0	12:18	25	36	123
	40°C	30:00	39.9	1:59	430	59.9	58.2	58.2	3:08	67	82	48
	Mean Value	30:00	29.9	03:32	538	59.9	60.9	60.9	08:40	38	64	94
	Standard Dev.	00:00	7.6	01:52	105	0.0	2.6	2.6	03:59	21	20	33

New applications of the farinograph:

New applications of the farinograph:

***1- Baking tests**:*

baking test is now a main procedure to control the improvers to the flour, and Farinograph mixer is ideal for those tests.

Tips on how to use the Farinograph in Baking tests

a) *Determination of the water absorption*
b) *Kneading the dough in the Farinograph (1min with 63rpm + 4min with 180rpm)*
Recipe:

- *300 g flour*
- *15 g yeast*
- *4.5 g salt*
- *3 g sugar*
- *3 g vegetable fat*

Parameter:

- *Dough temperature : 26 °C ± 1 °C*
- *Dough rest: 32 °C ± 1 °C & 80 % ± 5 %*
- *Dough resting time : 20-22 °C 20min*

c) *Moulding @ dough resting: 20-22°C for 10min*
d) *Weighing and dividing : 50 g each X 9 pieces*
e) *Shaping of the dough pieces*
f) *Rising process : 25 min inside fermentation chamber (Extensograph Chamber)*
g) *Further rising process: Drying the surface of the dough pieces at room temperature by moving air for 2 min*
h) *Baking : 240°C for 20 min*
i) *Volume and physical test measurement*

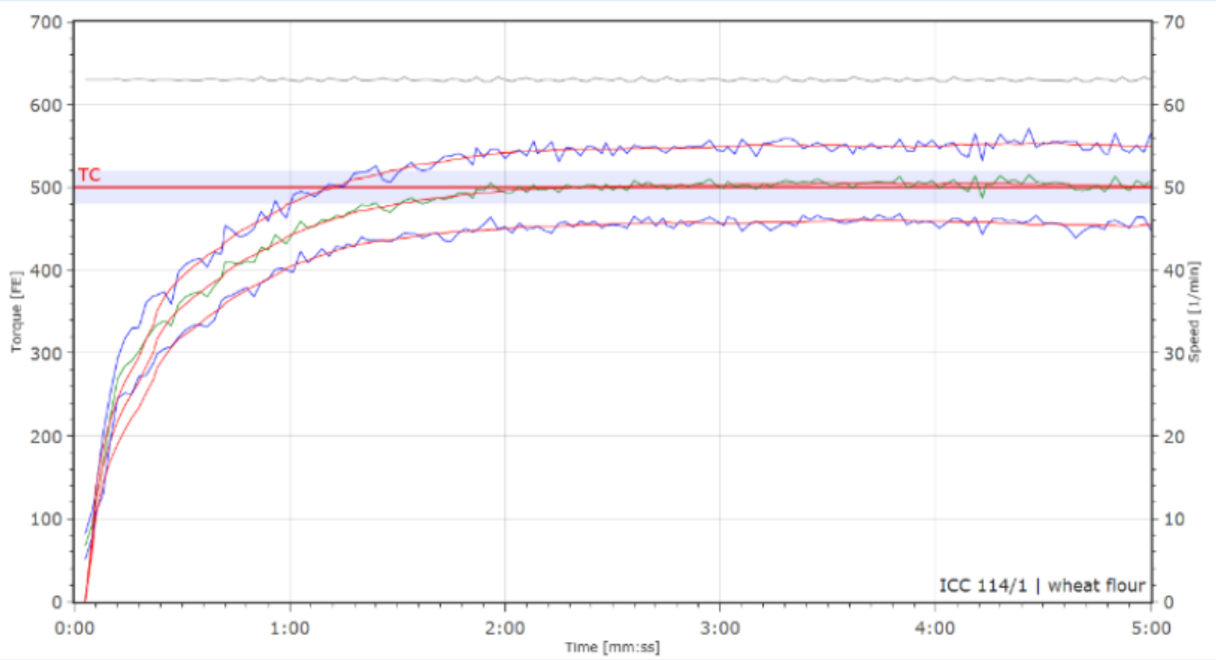
Sample preparation for Extensograph

ICC Standard No. 114/1 and AACCI Method 54-10 are both used for determination of the rheological properties of wheat flour dough for evaluation in the Brabender Extensograph. The recorded load-extension curve gives information about the quality of flour and its response to improving agents.

The analyzed dough must be prepared under given guidelines at the Farinograph. For both methods first you have to determine the Extensograph water absorption (which is usually 2% lower than the Farinograph water absorption because of the addition of salt) and after that, generating a dough which has a consistency of 500FU at the end of the kneading process. What differs from AACCI to ICC measuring method is the speed profile, which is used for manufacturing the dough. Both speed profiles are already included in the Farinograph-TS measuring methods and can be selected easily.

Speed profile ICC 114/1:

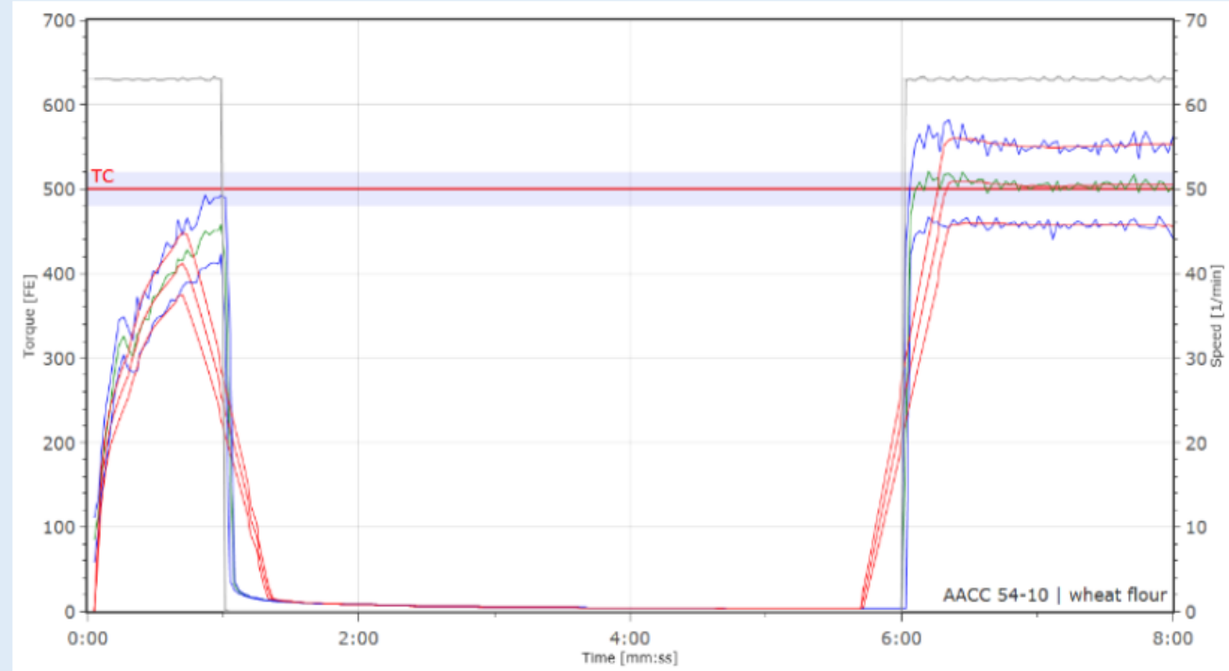
Premixing	1min	63rpm
Mixing	5min	63rpm



Point	Value	Unit
T	5:00	mm:ss
DT	28.1	°C
EC	502	FE
WZ	59.0	%
WAE	59.1	%

Speed profile AACCI 54-10

Premixing	1min	63rpm
Mixing	1min	63rpm
	5min	0rpm
	2min	63rpm



Point	Value	Unit
T	8:00	mm:ss
DT	28.0	°C
EC	505	FE
WZ	58.9	%
WAE	59.0	%

New applications of the farinograph:

2- Bug Damage :

Many asks us about a method to find out the bug damage in the wheat by Farinograph and here is an important method.
Parameter:

Speed: 63 rpm

Dough/Mixing bowl temperature: 40°C

Stop mixing at max consistency point and keep dough to rest for some time .

Test time approx. 25-30 min. depending on gluten quality (dough development time)

***Procedure**:*

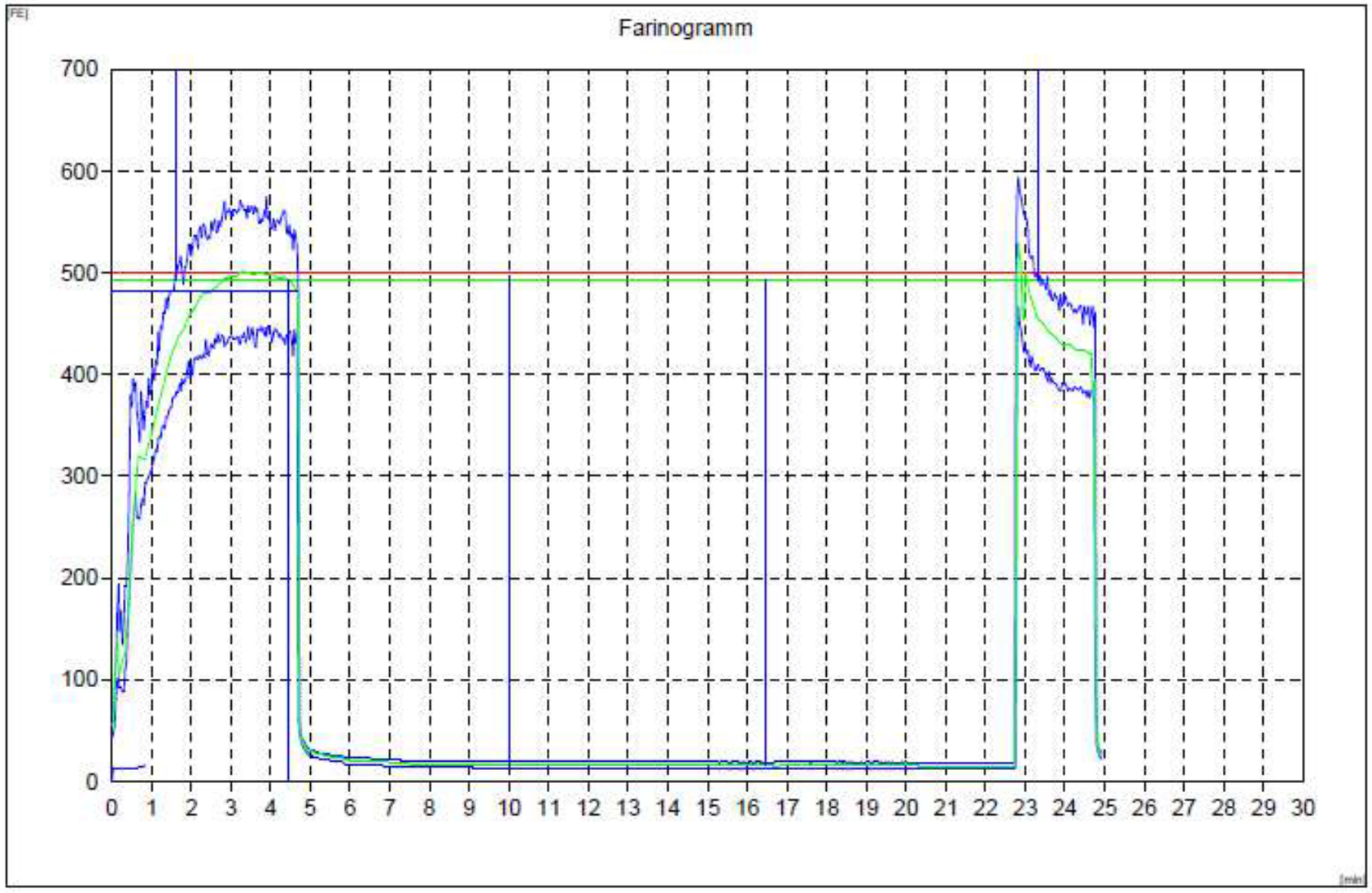
- *Mixing the dough until the dough is developed.*
- *Short after that stop mixing and wait – 23 min resting time.*
- *During resting time the enzymatic process of the turtle bug damage the proteinase.*
- *Start of the mixing again is 23 min. later.*

Evaluation:

The consistence of the dough is similar to the one before

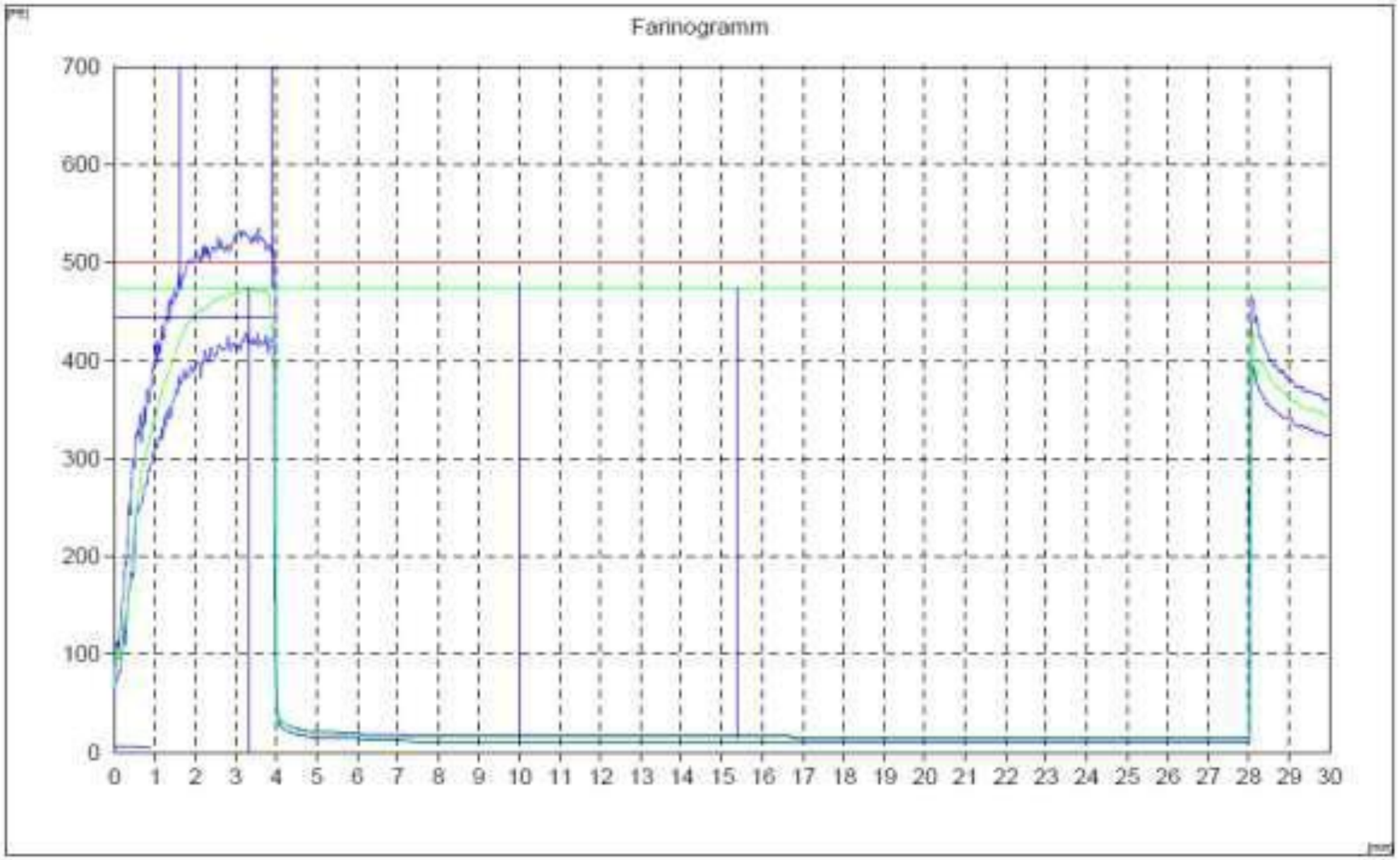
resting time: ***no damage***

No turtle bug damage



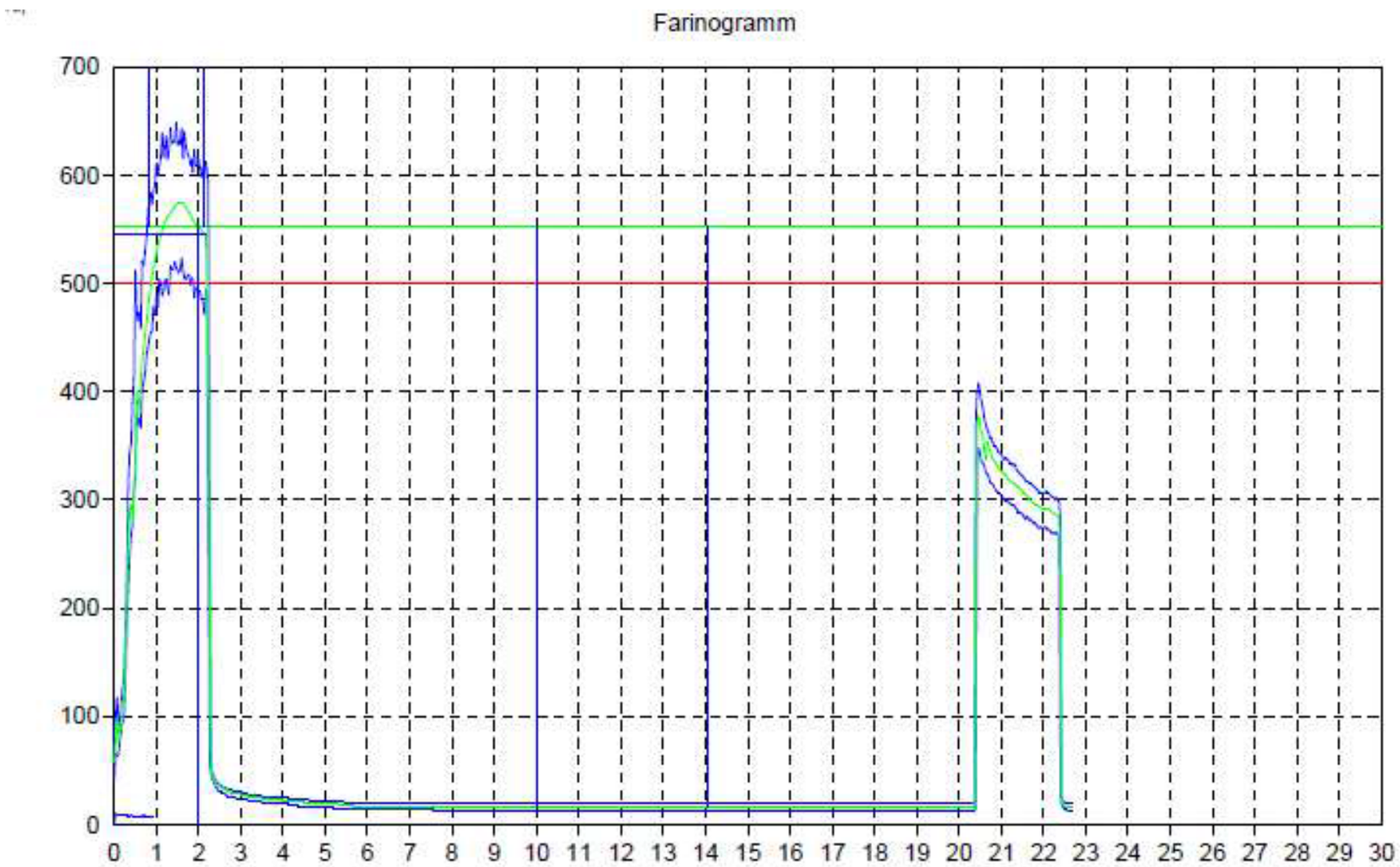
A little bit lower to the one before resting time: ***low damage***

Low turtle bug damage



Much lower to the one before mixing: ***high damage***

High turtle bug damage



New applications of the farinograph:

*3- **Online dough testing***

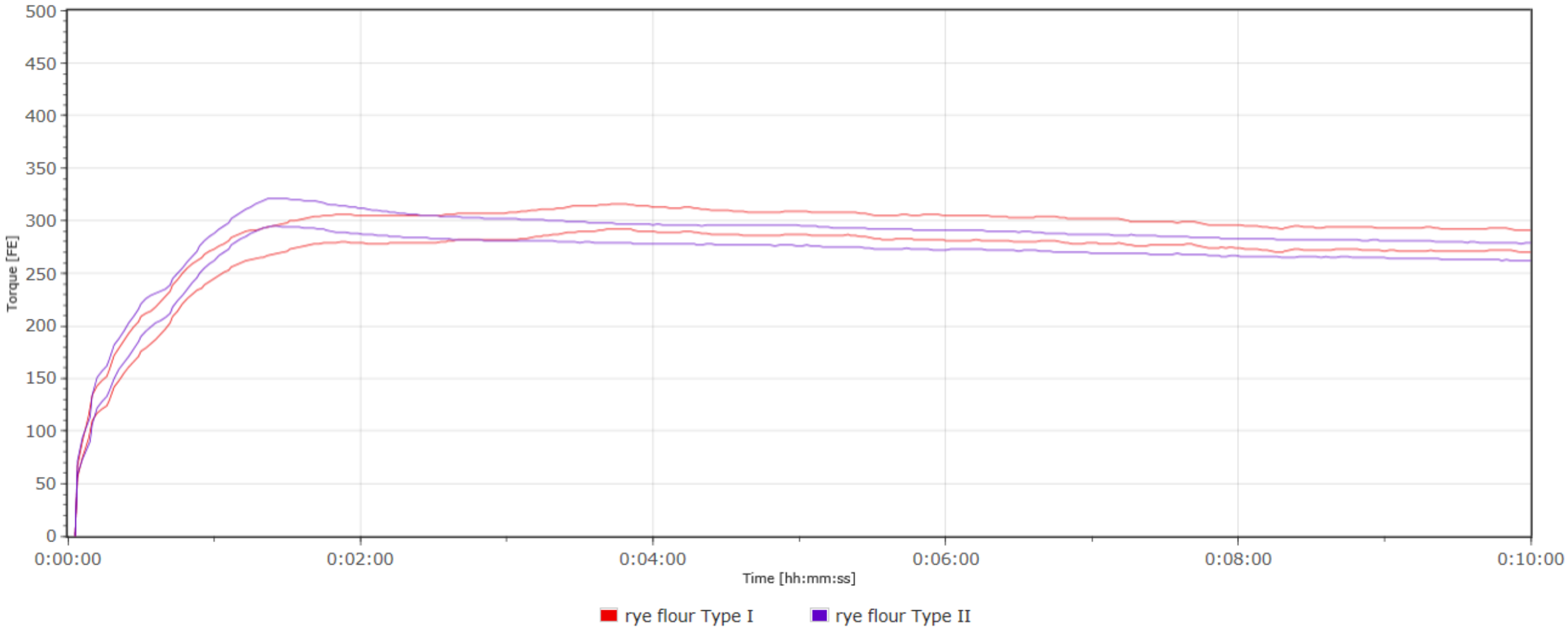
With the Farinograph-TS it is possible to determine the ideal mixing time and mixing speed for every processing step. To check the consistency of a dough during processing, 480g from the production line should be taken and measured in the Farinograph-TS. Depending on the baking product, the ideal dough properties will be different and must be found out by experimentation.

New applications of the farinograph:

*4- **Rye Method***

Unlike wheat flour, rye flour contains a special type of starch called pentosane. In contact with water, this class of polysaccharides forms a gel which provides much viscosity to bread mass. Because of the different dough properties, it makes sense, to adjust the Farinograph- TS test parameters related to target consistency and amount of test material. There are different approaches for the comparison of rye fours. The following method has been developed by use of the Farinograph-TS and 300g mixer see next table

Parameter	Setting
Temperature	30°C
Sample weight	250g
Time	10 min (+1minPremixing)
Farinogram Units	300FE
Rotational Speed	63rpm

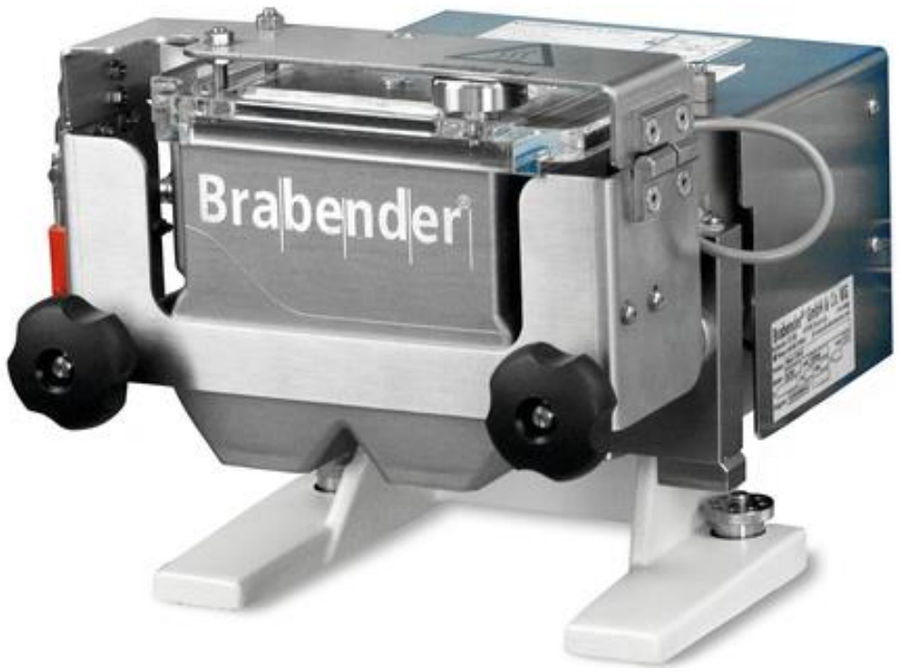


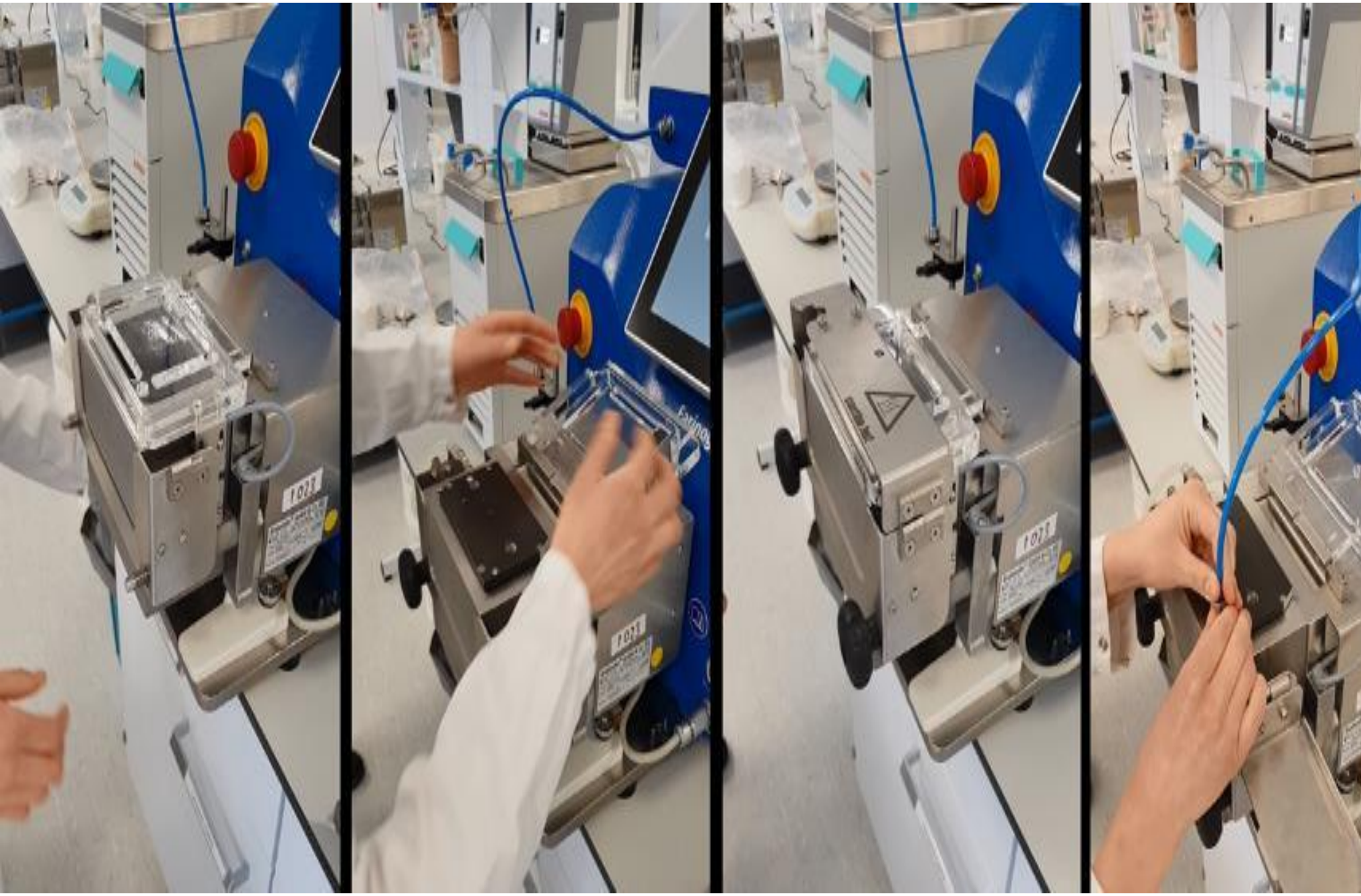
ID	T	DT	DDT	C	WZ	WAC	WAM	S	DS	DS(ICC)	FQN
rye flour Type I	10:00	28.2	3:47	304	62.9	63.0	63.0	4:40	26	62	104
rye flour Type II	10:00	28.4	1:24	308	60.6	60.8	60.8	1:03	37	62	69
Mean Value	00:10:00	28.3	00:02:36	306	61.8	61.9	61.9	00:02:51	32	62	86
Standard Dev.	00:00:00	0.1	00:01:11	2	1.2	1.1	1.1	00:01:49	6	0	18

New applications of the farinograph:

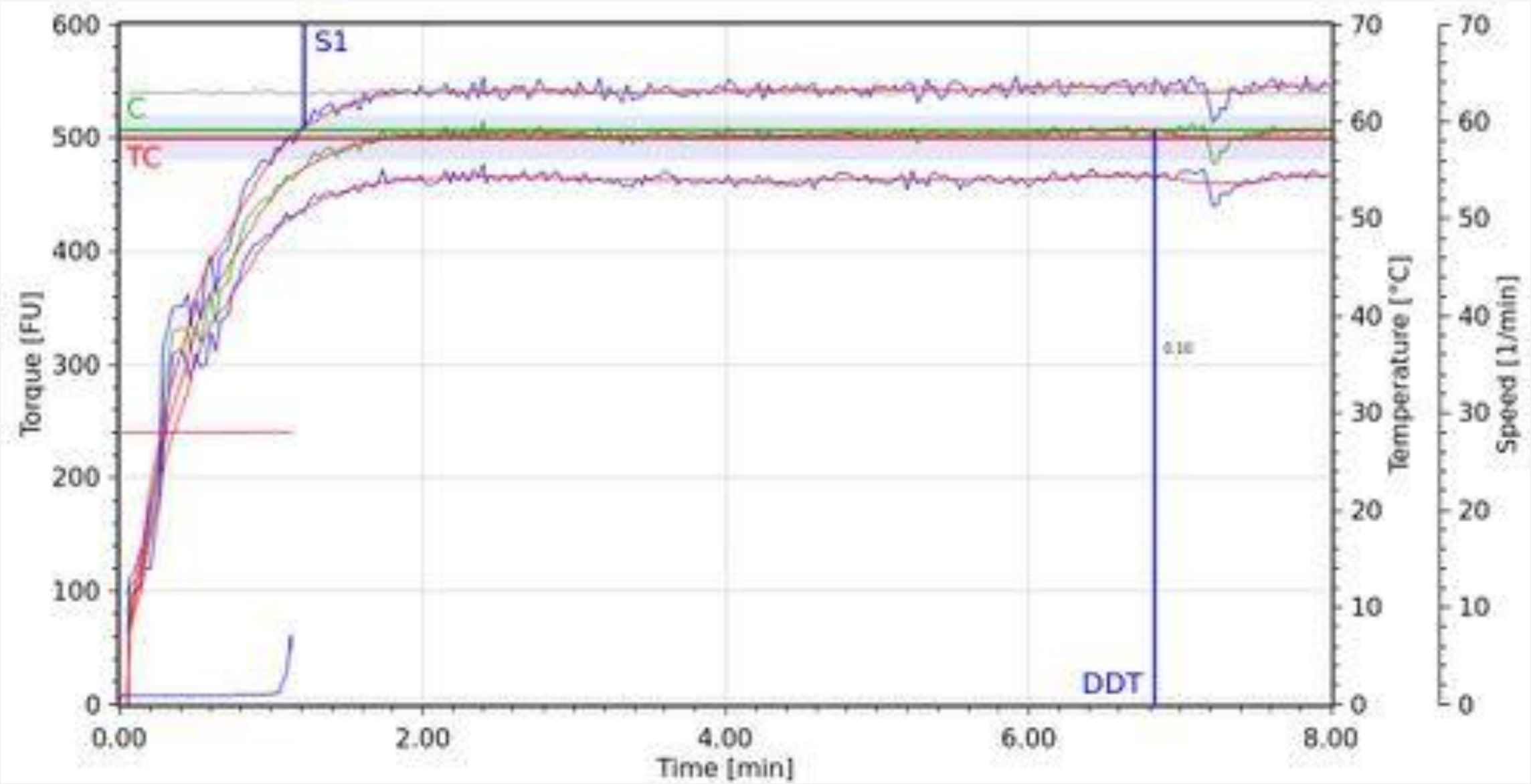
5- Gluten free Masses

Analysis of powders with no dough developing properties can be difficult sometimes. Particularly for the measuring of gluten free material like corn or rice a special approach on the Farinograph-TS is required. For dough development of non-elastic masses it is necessary to limit the kneading space above the mixing blades by adjusting the block and clamp device that is placed above of the mixer blades. This ensures a better mixture of test material and water can be ensured as well as the mixer cannot be opened accidentally by the swelling dough.
Because of the strongly varying dough properties from different raw material, it is necessary to find out the ideal test parameters by trial. Especially measuring time, target consistency and sample weight must be adjusted.

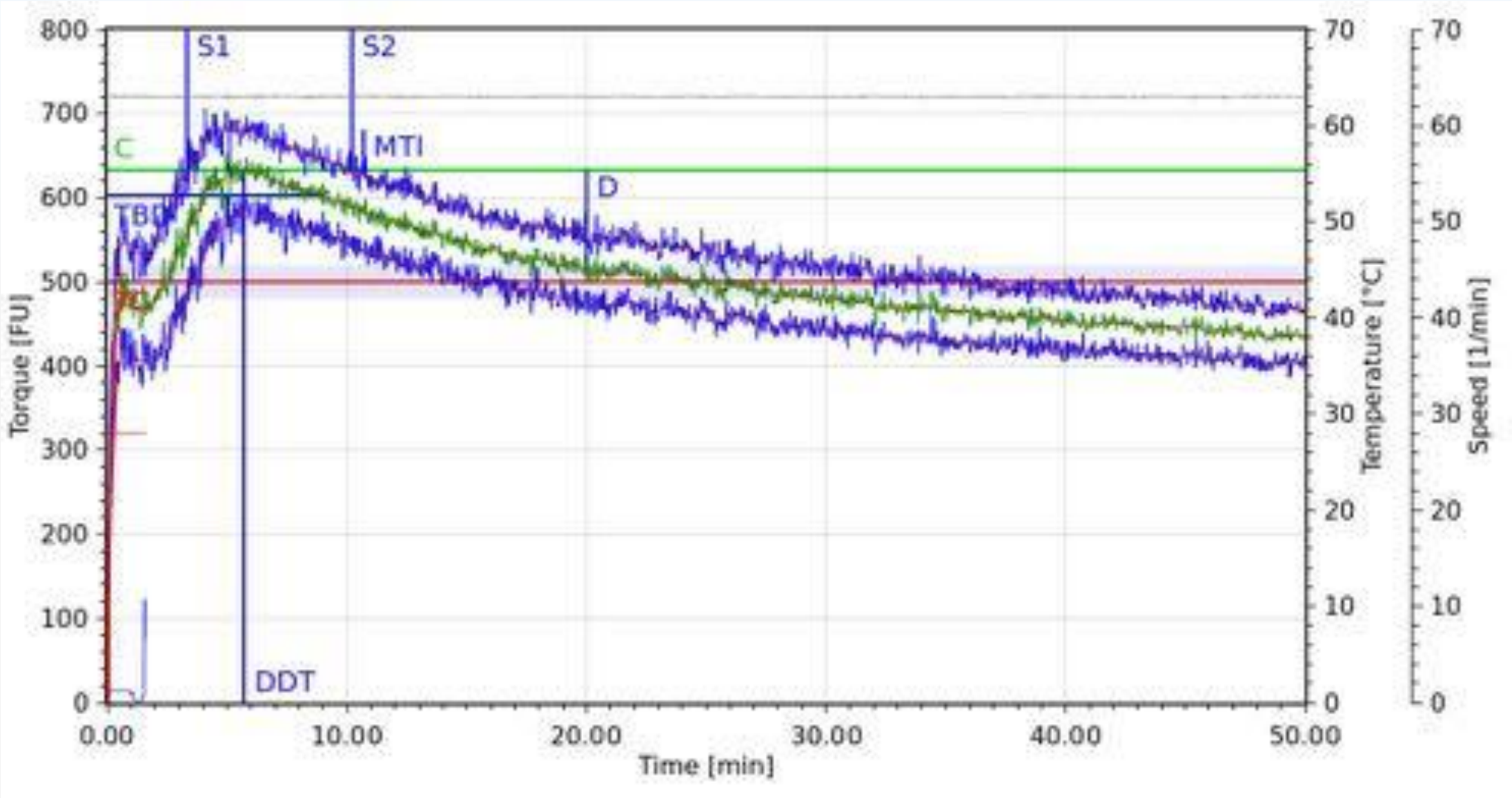




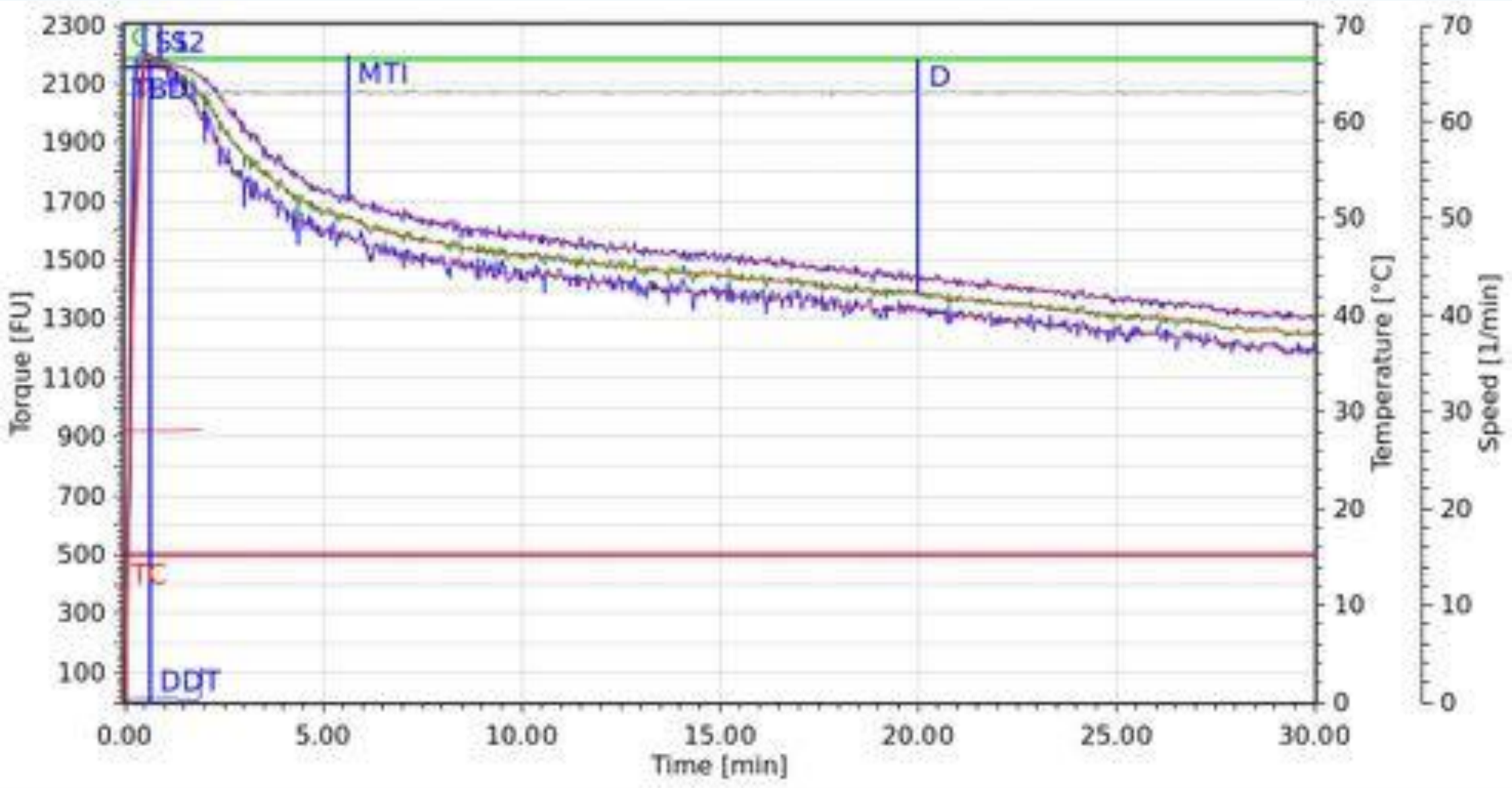
Wheat


S1
C
TC
DDT
Torque [FU]
Temperature [°C]
Speed [1/min]
Time [min]
0
100
200
300
400
500
600
0.00
2.00
4.00
6.00
8.00
10
20
30
40
50
60
70

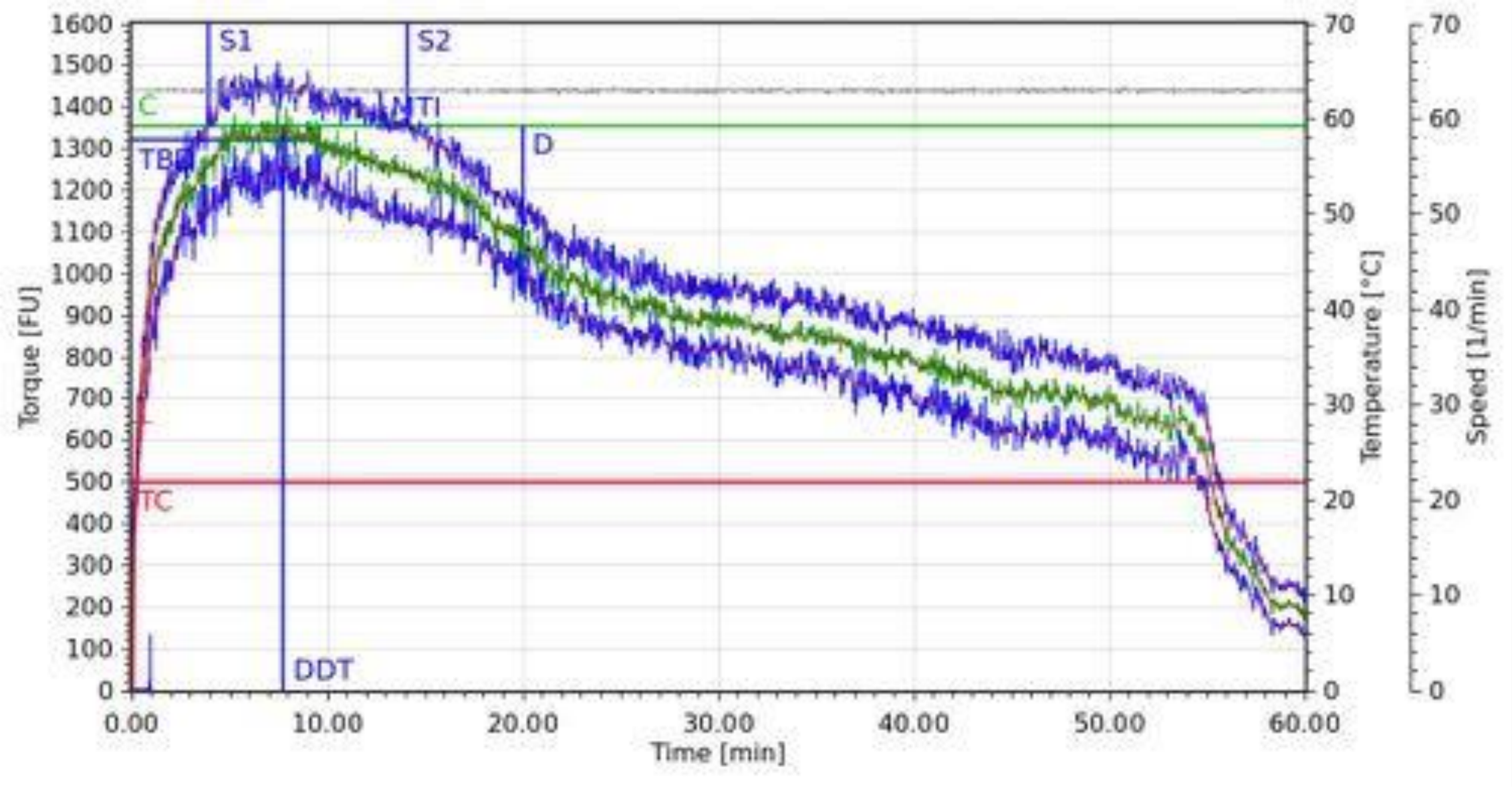
Sorghum


S1
S2
MTI
C
D
TBD
DDT
Torque [FU]
Temperature [°C]
Speed [1/min]
Time [min]
800
700
600
500
400
300
200
100
0
70
60
50
40
30
20
10
0.00
10.00
20.00
30.00
40.00
50.00

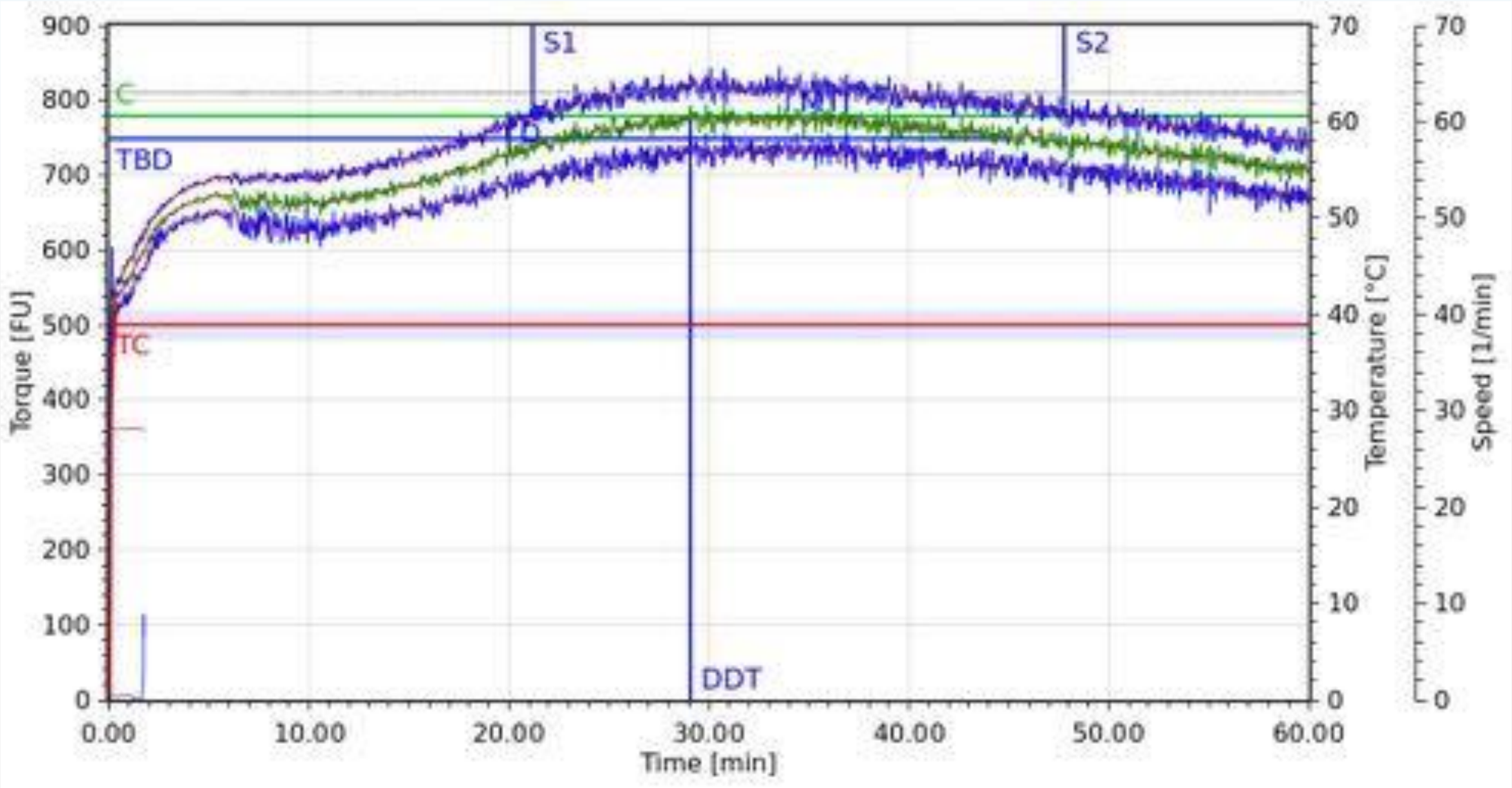
Quinoa


2300
2100
1900
1700
1500
1300
1100
900
700
500
300
100
Torque [FU]
70
60
50
40
30
20
10
0
Temperature [°C]
Speed [1/min]
0.00
5.00
10.00
15.00
20.00
25.00
30.00
Time [min]
SS2
MTI
D
TC
DDT

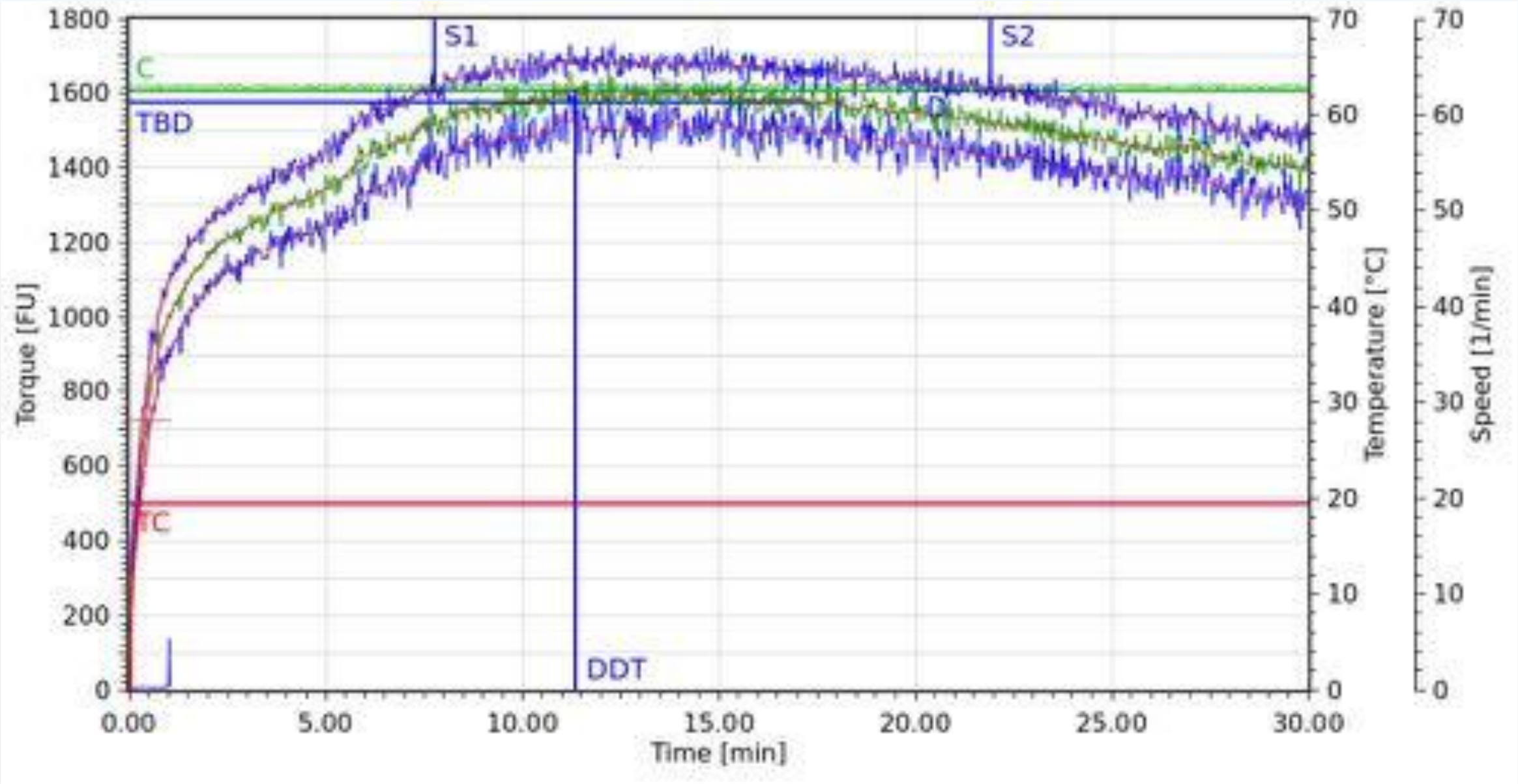
Rice


S1
S2
C
TI
TB
D
TC
DDT
Torque [FU]
Temperature [°C]
Speed [1/min]
Time [min]
0.00
10.00
20.00
30.00
40.00
50.00
60.00

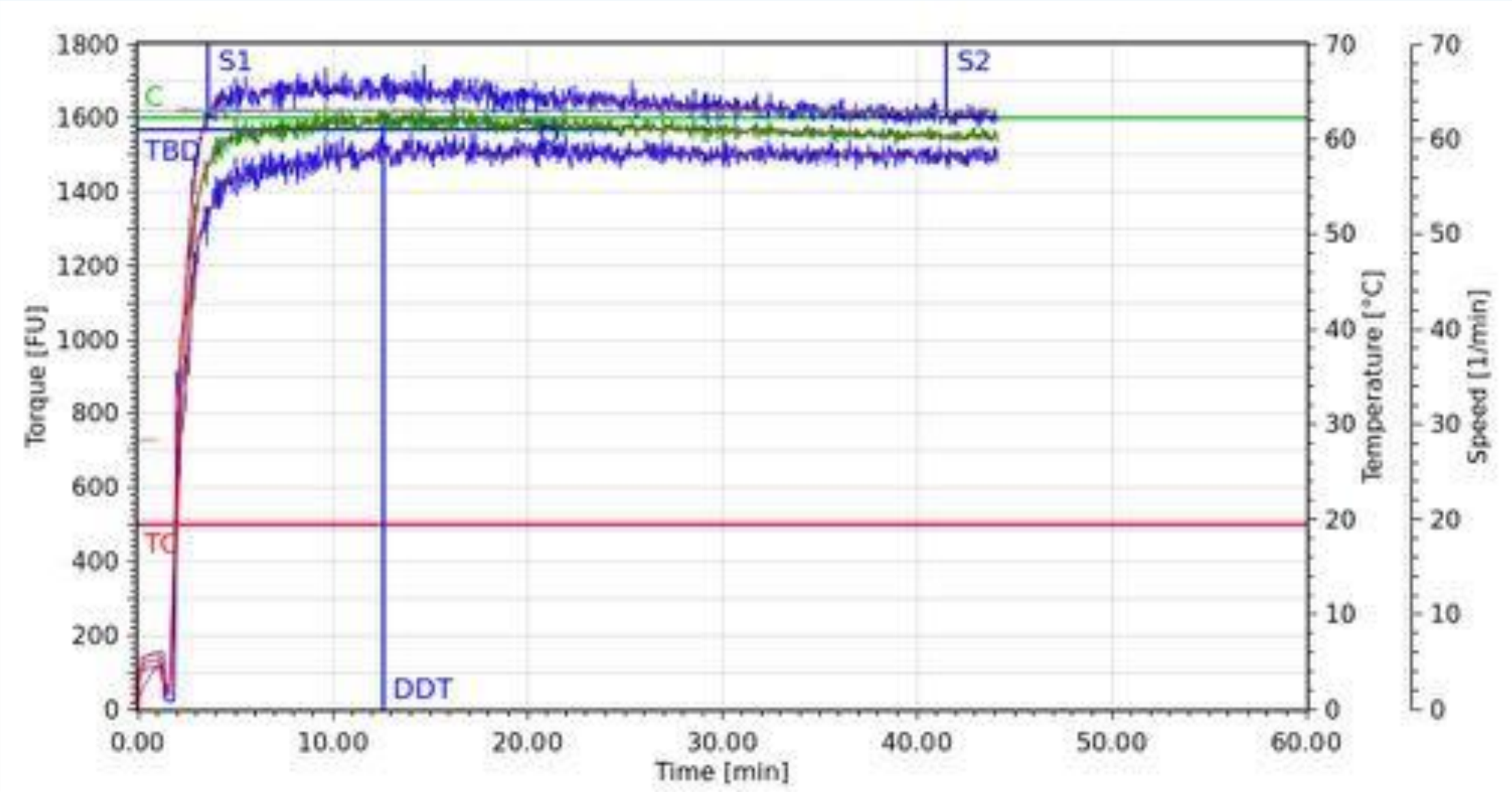
Buckwheat


S1
S2
C
TBD
TC
DDT
Torque [FU]
Temperature [°C]
Speed [1/min]
Time [min]
0
100
200
300
400
500
600
700
800
900
0.00
10.00
20.00
30.00
40.00
50.00
60.00
10
20
30
40
50
60
70

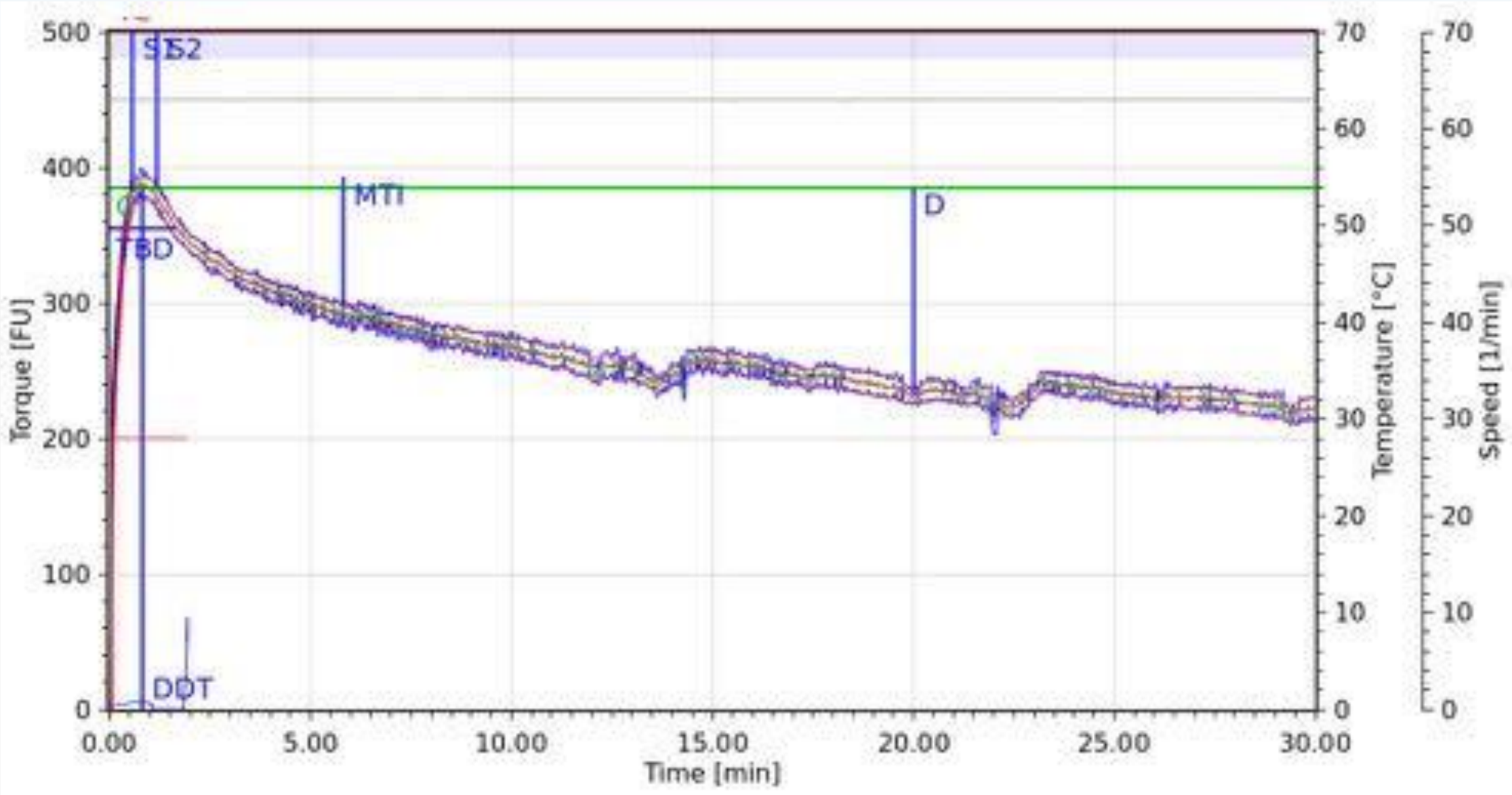
Brown Rice


S1
S2
C
TBD
TC
DDT
Torque [FU]
Temperature [°C]
Speed [1/min]
Time [min]
1800
1600
1400
1200
1000
800
600
400
200
0
70
60
50
40
30
20
10
0
0.00
5.00
10.00
15.00
20.00
25.00
30.00

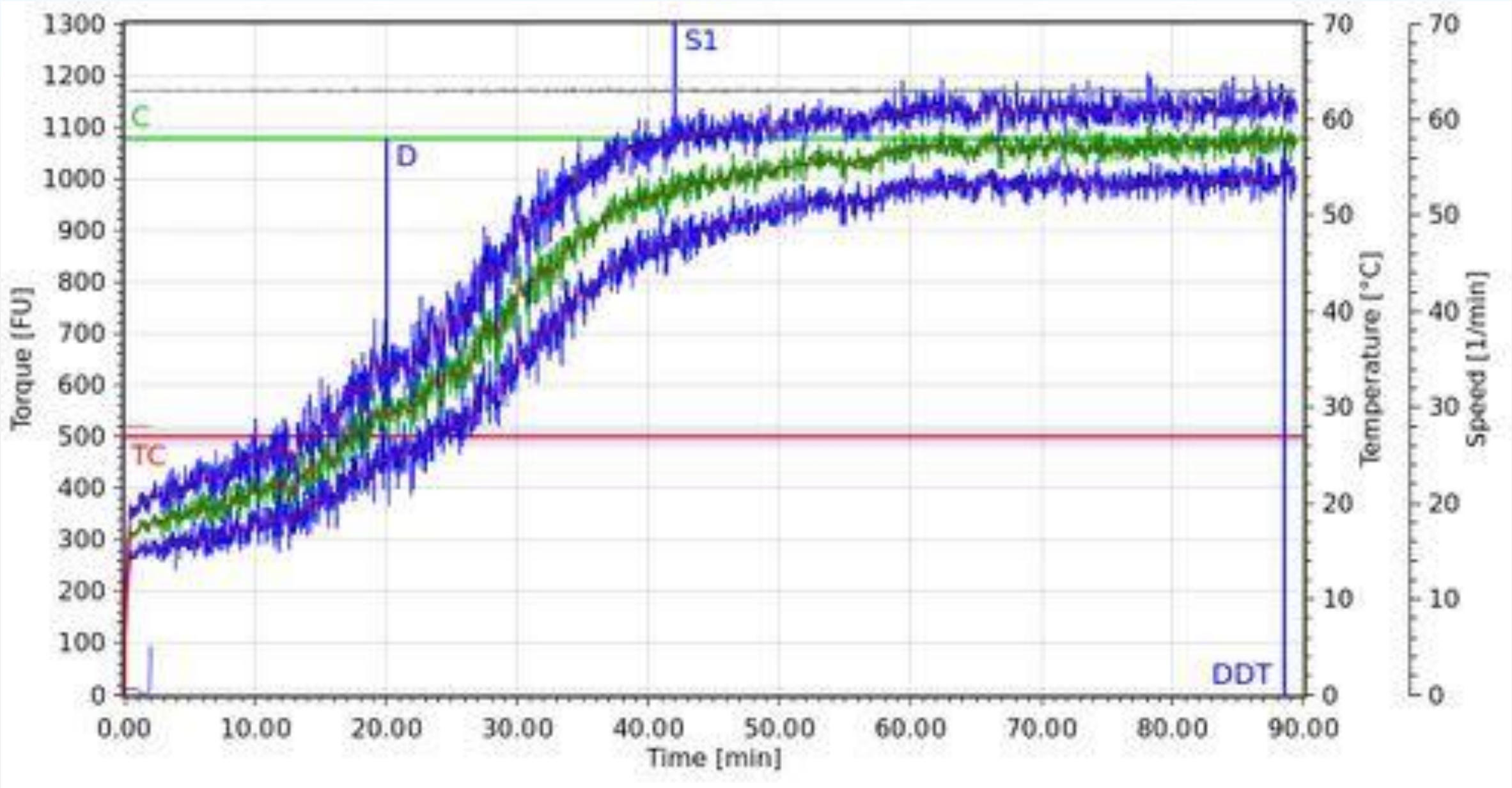
SOY


S1
S2
C
TBD
TC
DDT
Torque [FU]
Temperature [°C]
Speed [1/min]
Time [min]
0
200
400
600
800
1000
1200
1400
1600
1800
0.00
10.00
20.00
30.00
40.00
50.00
60.00
10
20
30
40
50
60
70

Chickpea


500
400
300
200
100
0
Torque [FU]
S
S2
MTI
D
TBD
DDT
0.00
5.00
10.00
15.00
20.00
25.00
30.00
Time [min]
70
60
50
40
30
20
10
0
Temperature [°C]
Speed [1/min]

Corn


S1
C
D
TC
DDT
Torque [FU]
Temperature [°C]
Speed [1/min] pads
Time [min]
1300
1200
1100
1000
900
800
700
600
500
400
300
200
100
0
70
60
50
40
30
20
10
0
0.00
10.00
20.00
30.00
40.00
50.00
60.00
70.00
80.00
90.00

Thank you for your attention

This is a very small spot on this great device

Hope it was useful for you