CHOPIN TECHNOLOGIES

Use of a dual speed mixing protocol as a rapid wheat screening tool for Alveograph W value estimation

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KPM ANALYTICS

The need:

Fast assessment of wheat quality including W value

Wheat Sample

Lab Analysis

TIME

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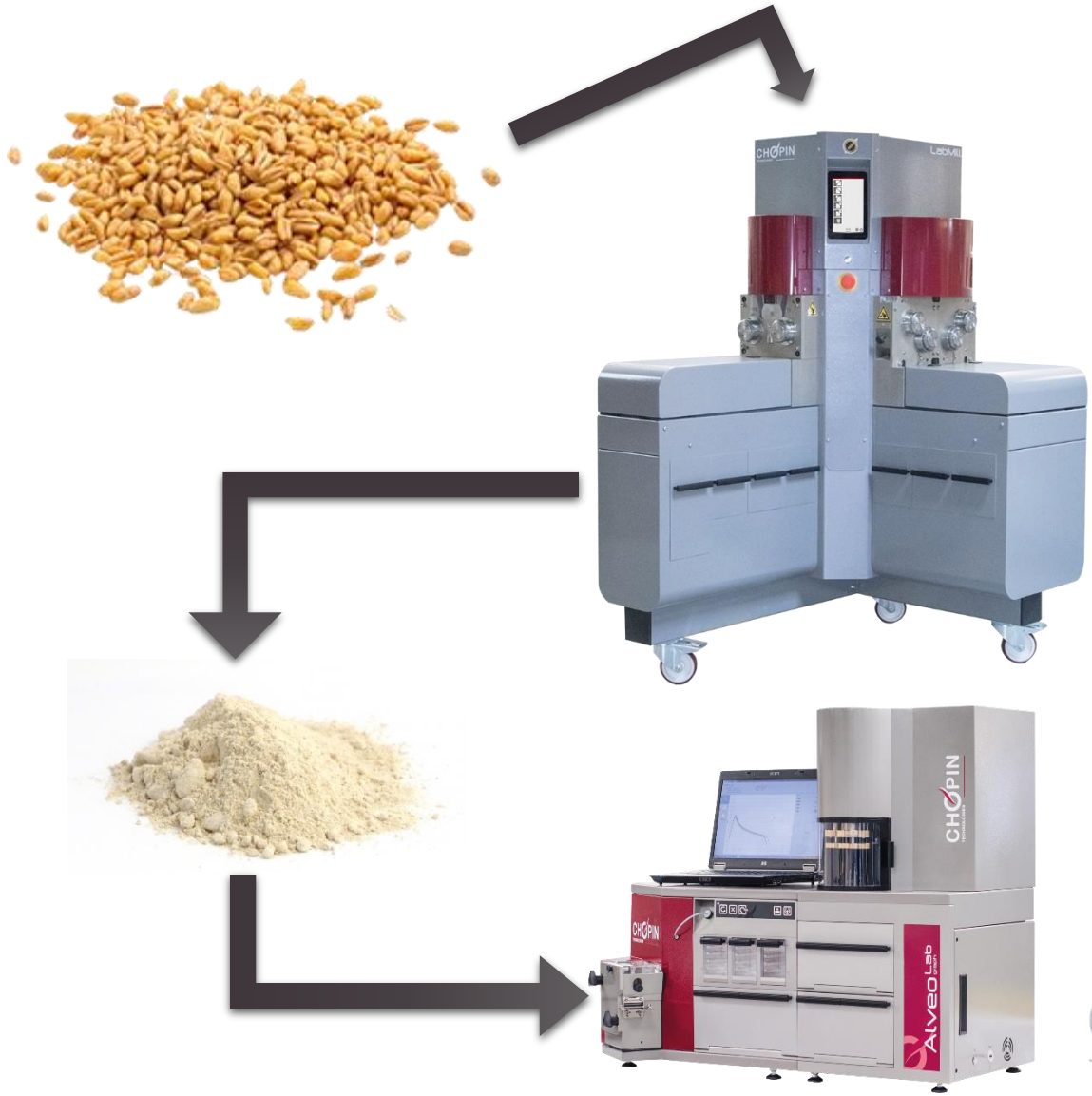
Alveograph Standard Method (ISO 27971:2015)

Standard method

- Wheat moisture –oven- (2,5 h)
- Wheat tempering (24 h)
- Milling (20 min)
- Flour moisture –oven- (2 h)
- Analyze (Alveograph) (30 min)
- W value

Total Analyse Time ≈ 29 h



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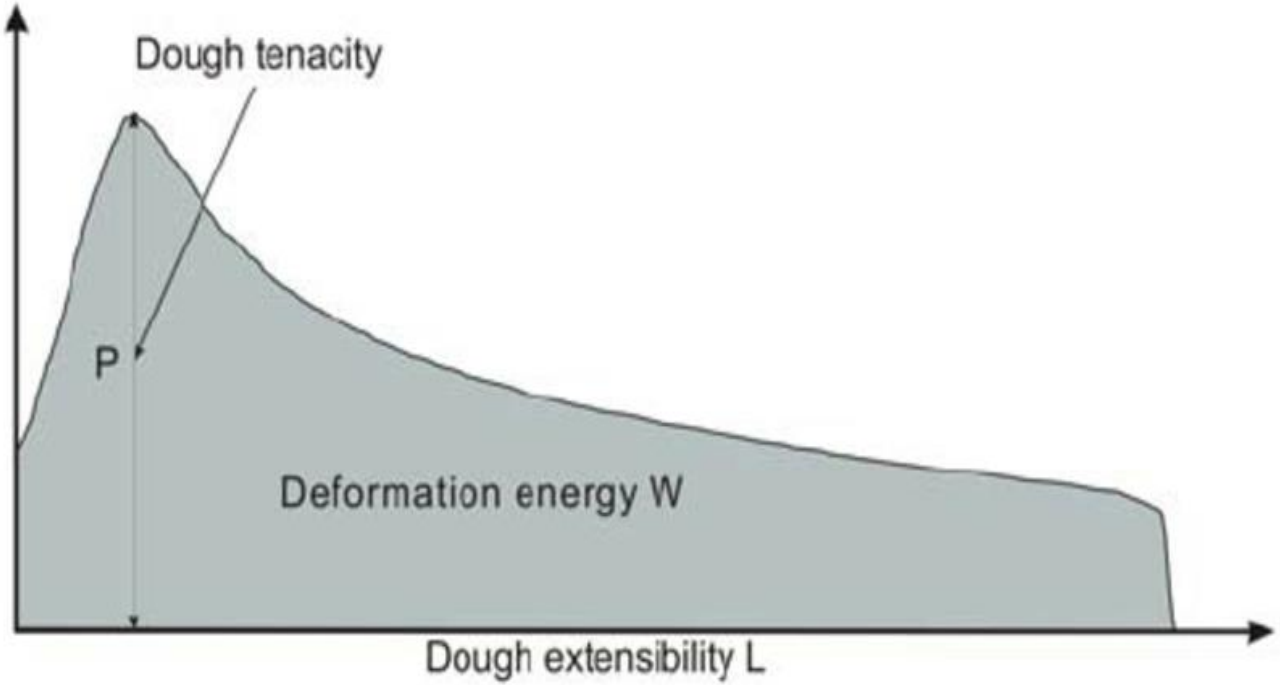
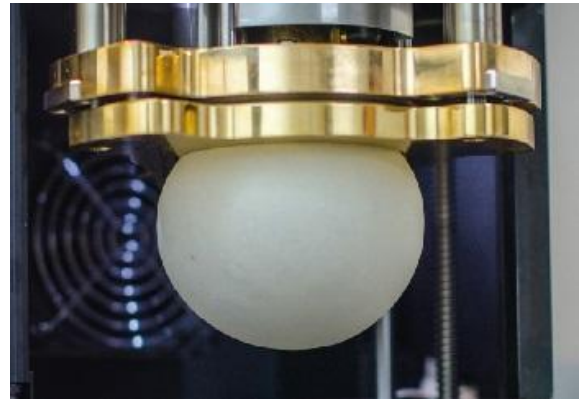
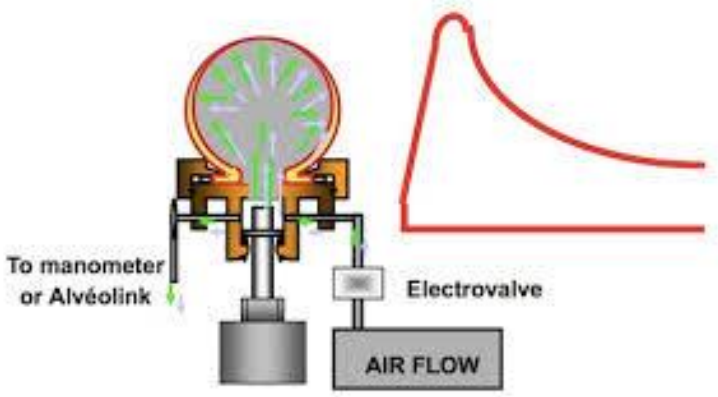
What is W value?







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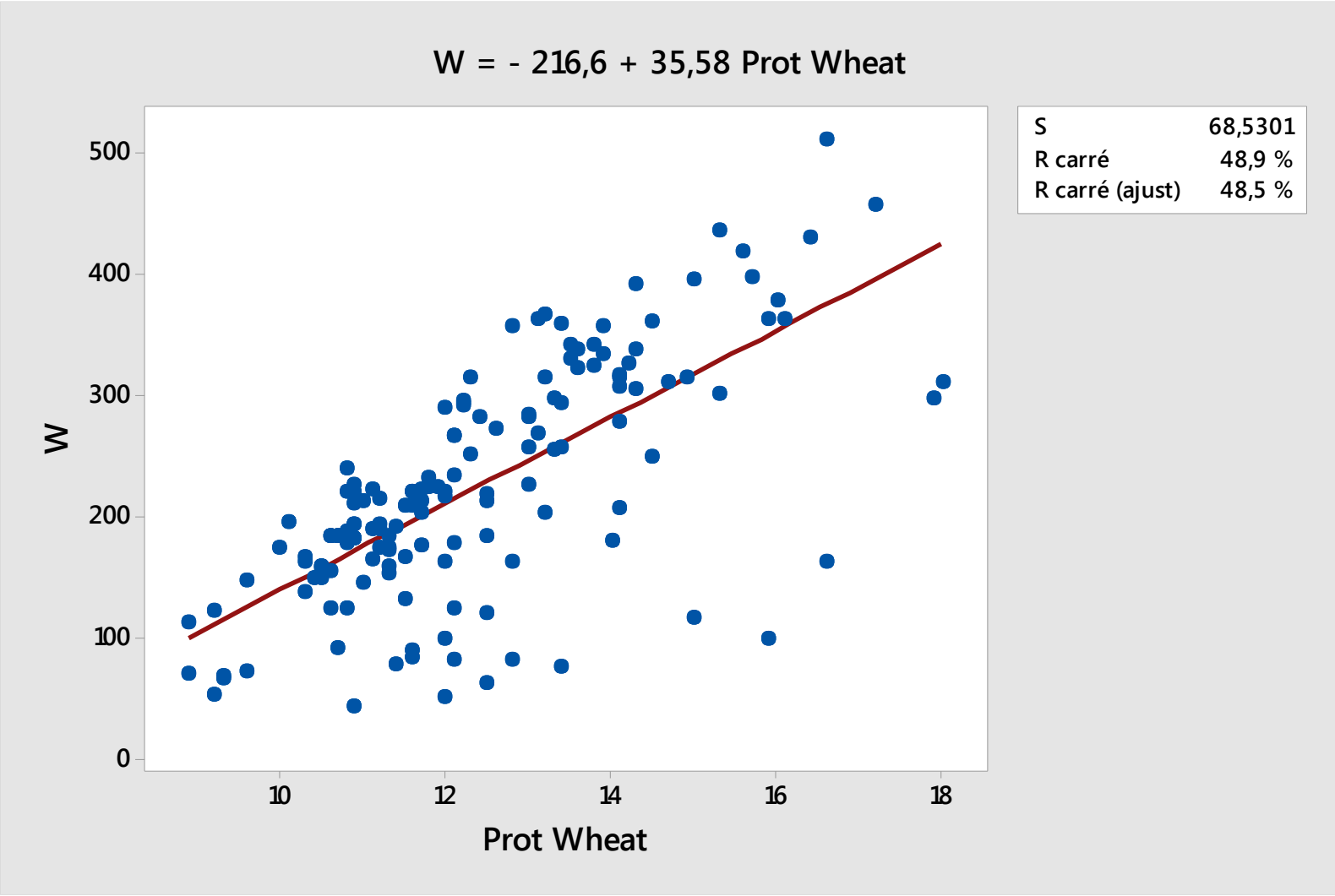
Is protein content enough to predict W value?



Let’s do some thinking…

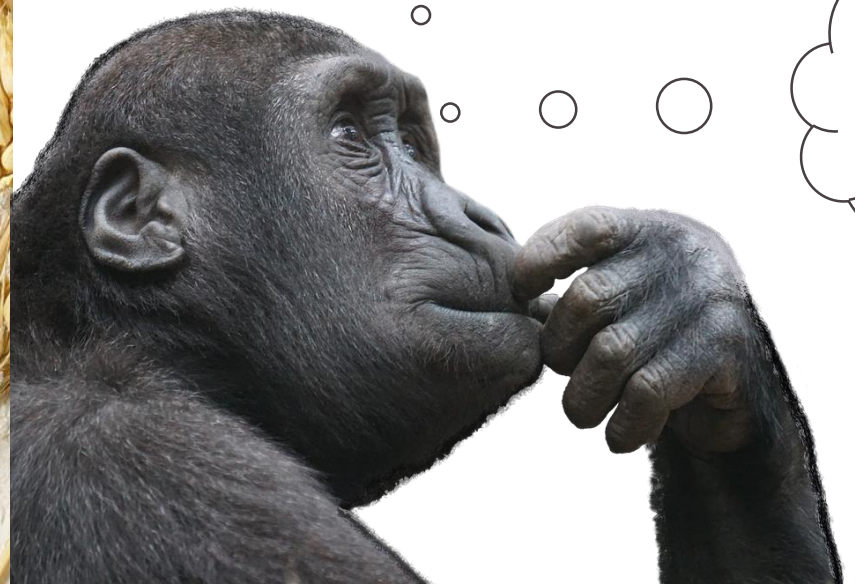
Tempering and milling grain takes time → Use ground wheat

+

Alveograph test only works on White flour → Use dough testing device suitable for ground wheat

+

I want to reduce sample size? → Use a device requiring limited sample size (50 g)



Why not try MIXOLAB mixing curve on ground wheat with a specific protocol ?

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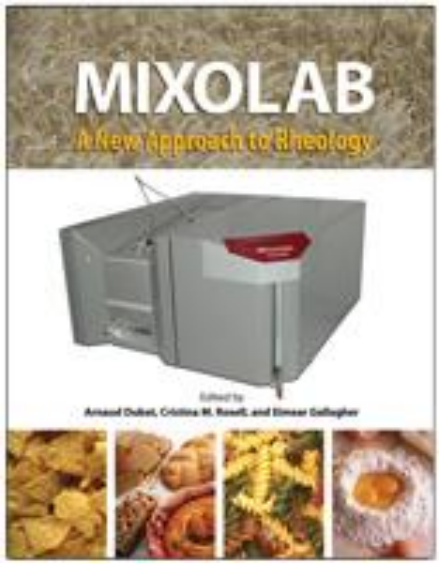
Stressing Gluten Network by changing Mixing Speed has already been succesfully studied

Estimation of Protease Activity by Use of the Mixolab

K. Kahraman and H. Koksel

Hacettepe University, Department of Food Engeneering, Ankara, Turkey



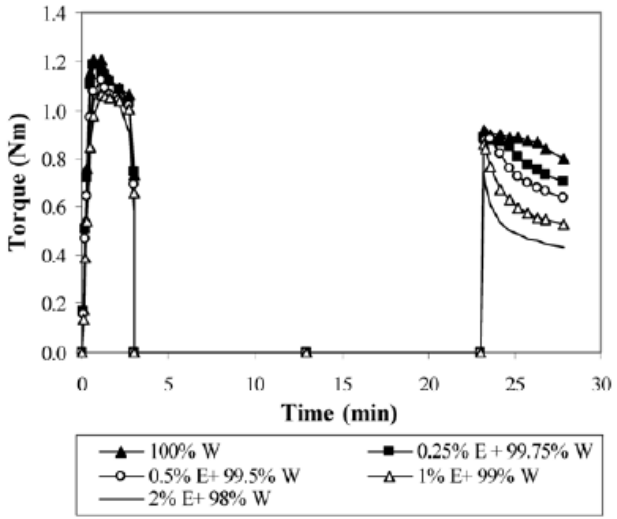


Fig. 8.5. Mixolab graphs of the weak flour (W) samples supplemented with crude suni-bug enzyme extract (E).

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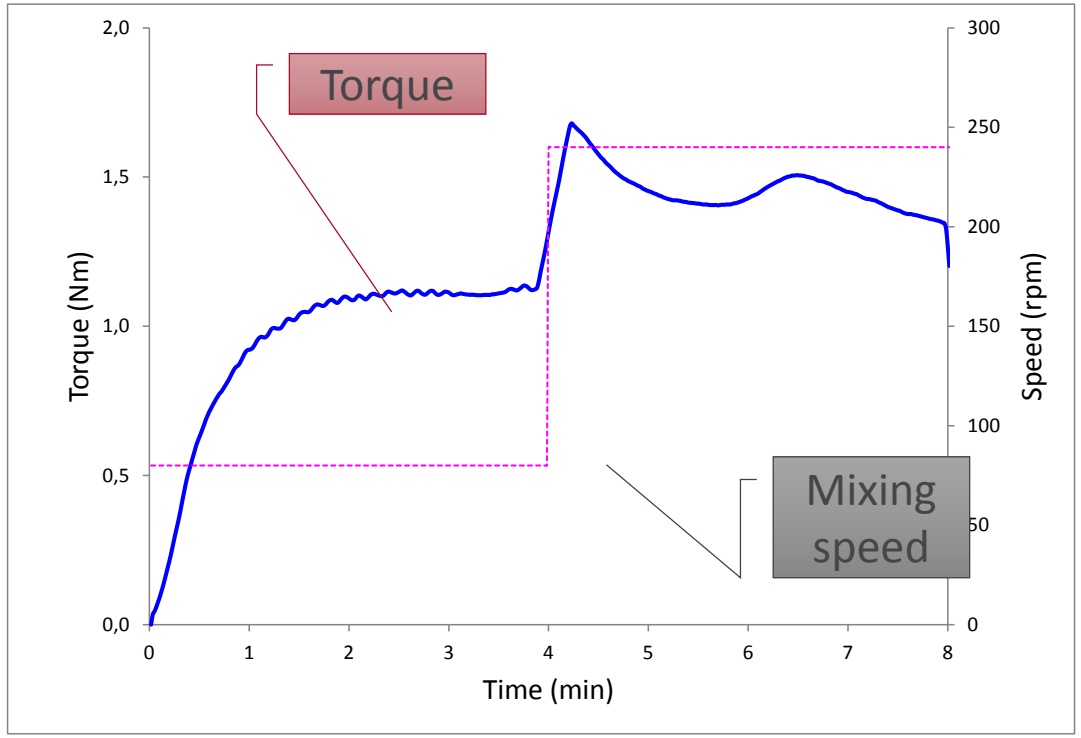
Design of a new protocol

We know that :

- Dough consistency during the first minute at constant hydration relates to dough strength.
- We need to have a moderate mixing speed at the beginning to form the dough by mixing flour and water.
- Increasing mixing speed creates a reactive « bouncing » of the torque curve, postulate is that the bounce will be higher on stronger doughs. For the stronger doughs complete dough development will be achieved during the second stage at higher mixing speed.



Protocol	Wixo
Hydration	60% b14
Dough Weight	75 g
Water T°C	30°C
Mixer T°C	30°C
Mixing speed 1	80 rpm
Time 1	4 min
Mixing speed 2	240 rpm
Time 2	4 min
Total Analisys Time	8 min

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Context

A procedure on grinded wheat, combining the Grinder-CHOPIN, the Infraneo and the Mixolab has been imagined to meet this challenge ...

Standard method

- Wheat moisture –oven- (2,5 h)
- Wheat tempering (24 h)
- Milling (20 min)
- Flour moisture –oven- (2 h)
- Analyse (Alveograph) (30 min)
- W value

Total Analysis Time ≈ 29 h

Alternative method

- Wheat grinding (1 min)
- H2O% whole meal– Infraneo (1 min)
- Mixolab test (specific protocol = 8 minutes)
- W estimation (Via mathematical model)

Total Analysis Time ≈ 10 min

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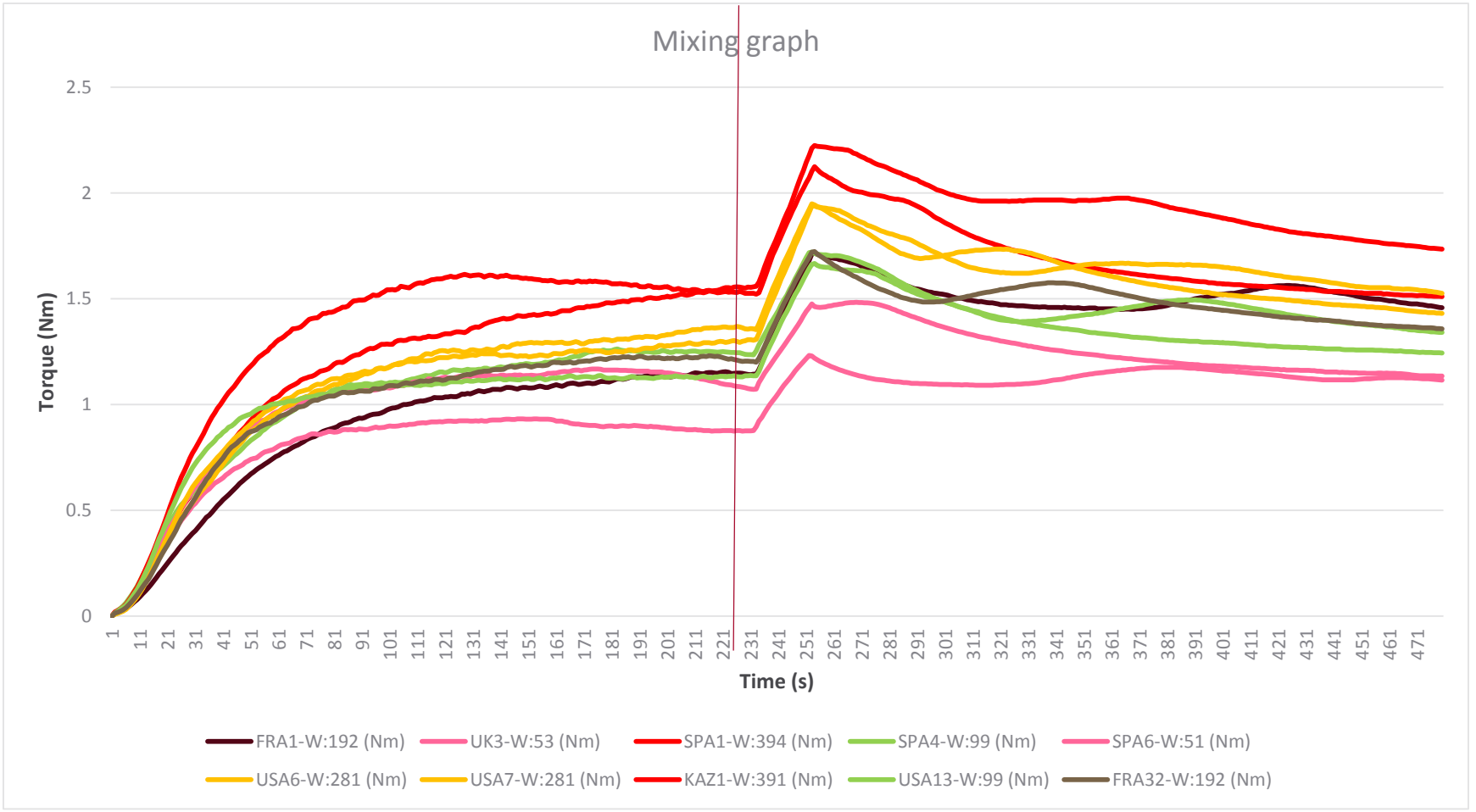
Experiment:
Is the protocol responding as planned?

10 wheat covering W values from 50 to 395



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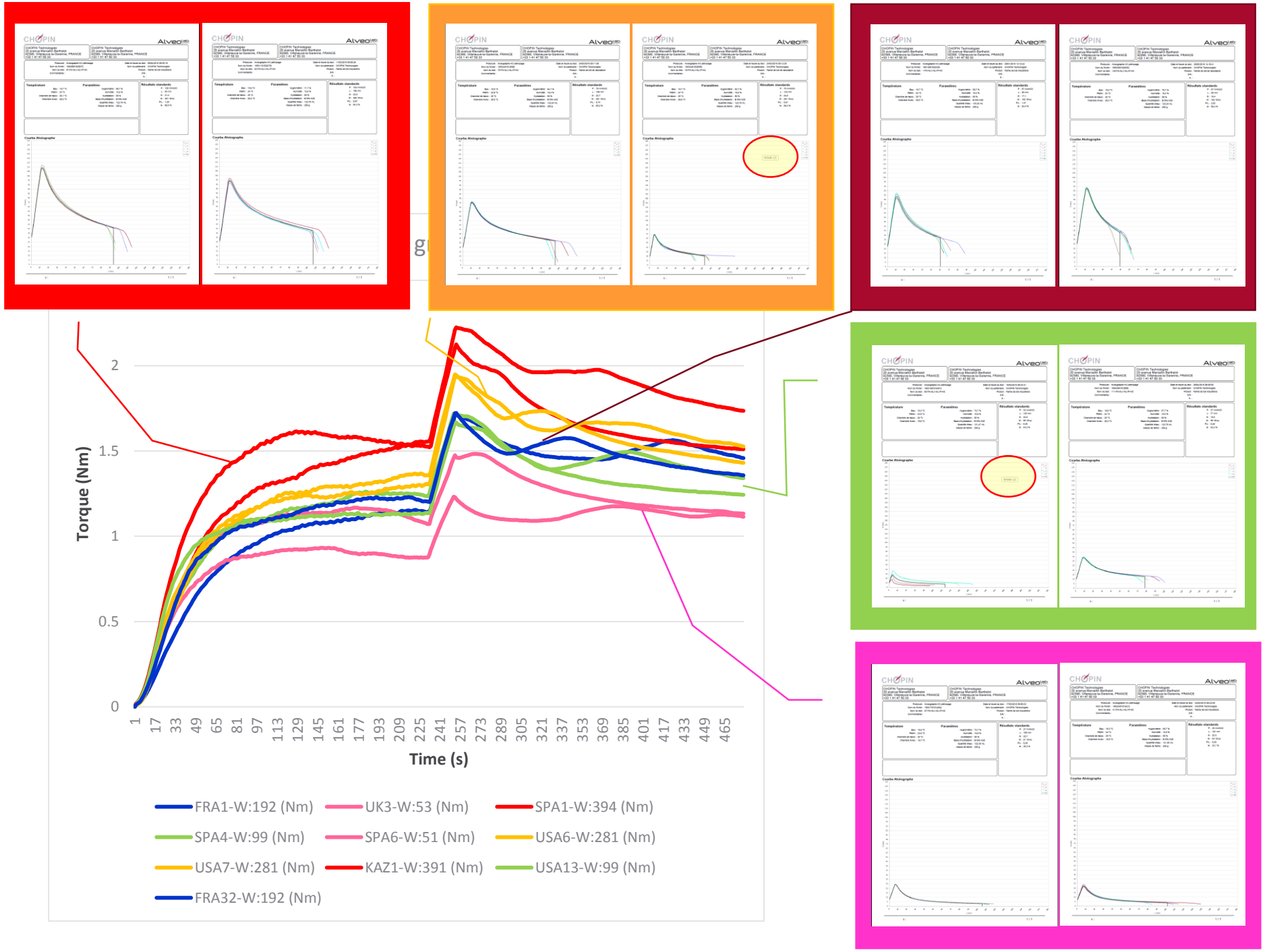
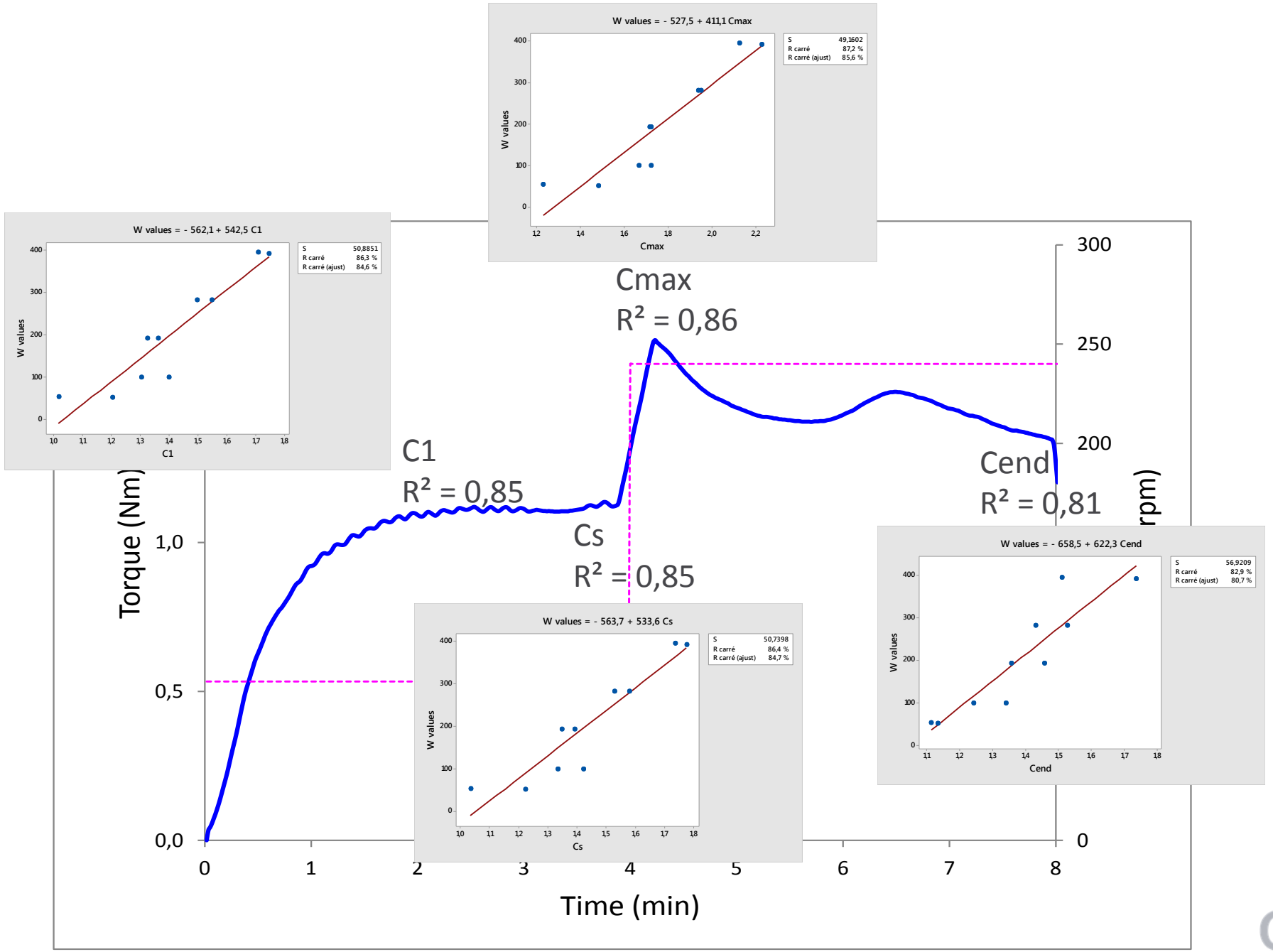

Torque (Nm)
0
0.5
1
1.5
2
1
17
33
49
65
81
97
113
129
145
161
177
193
209
225
241
257
273
289
305
321
337
353
369
385
401
417
433
449
465
Time (s)
FRA1-W:192 (Nm)
UK3-W:53 (Nm)
SPA1-W:394 (Nm)
SPA4-W:99 (Nm)
SPA6-W:51 (Nm)
USA6-W:281 (Nm)
USA7-W:281 (Nm)
KAZ1-W:391 (Nm)
USA13-W:99 (Nm)
FRA32-W:192 (Nm)


W values = - 527,5 + 411,1 Cmax
S 49,1602
R carré 87,2 %
R carré (ajust) 85,6 %
W values
Cmax
W values = - 562,1 + 542,5 C1
S 50,8851
R carré 86,3 %
R carré (ajust) 84,6 %
W values
C1
Cmax
R² = 0,86
C1
R² = 0,85
Cs
R² = 0,85
Cend
R² = 0,81
Torque (Nm)
Time (min)
rpm)
0,0
0,5
1,0
0
1
2
3
4
5
6
7
8
0
200
250
300
W values = - 563,7 + 533,6 Cs
S 50,7398
R carré 86,4 %
R carré (ajust) 84,7 %
W values
Cs
W values = - 658,5 + 622,3 Cend
S 56,9209
R carré 82,9 %
R carré (ajust) 80,7 %
W values
Cend

Seems responding as expected, let's try it on a greater scale…

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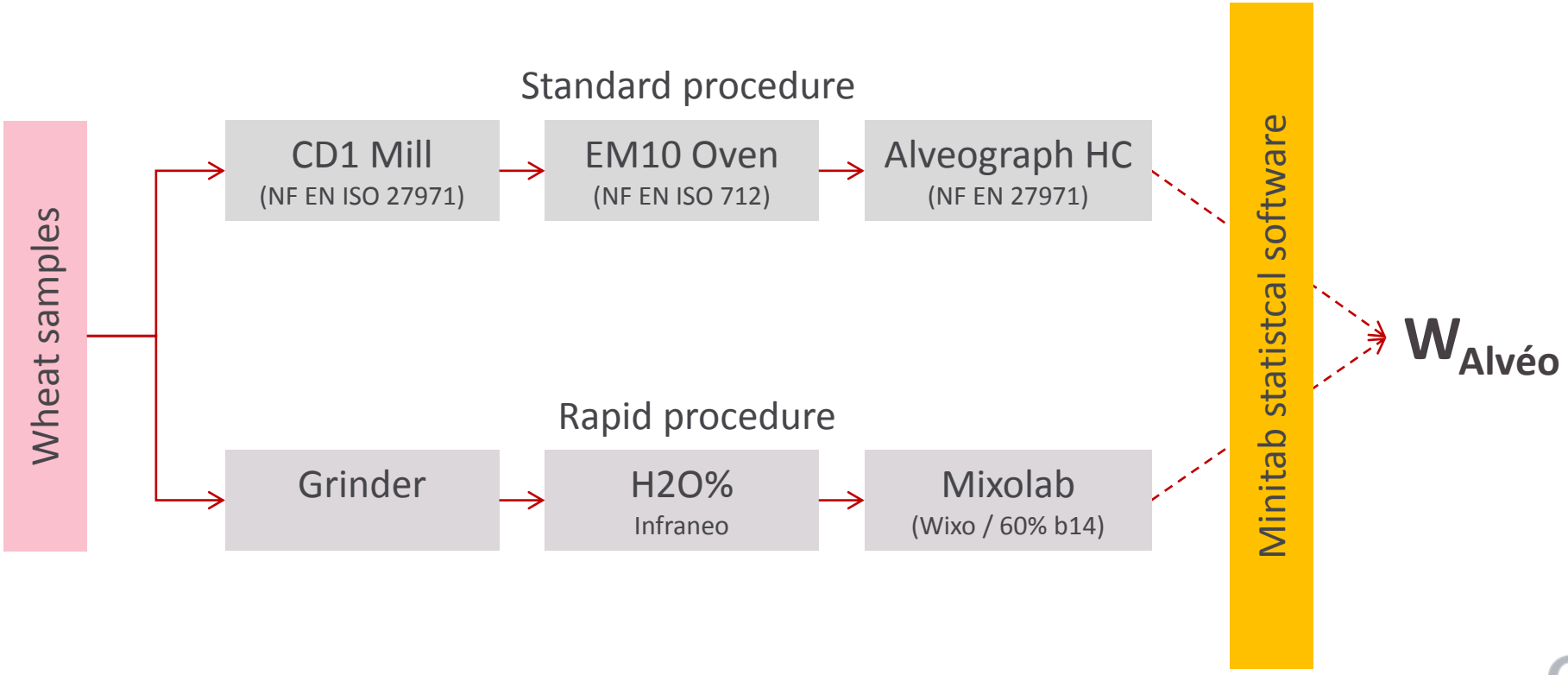
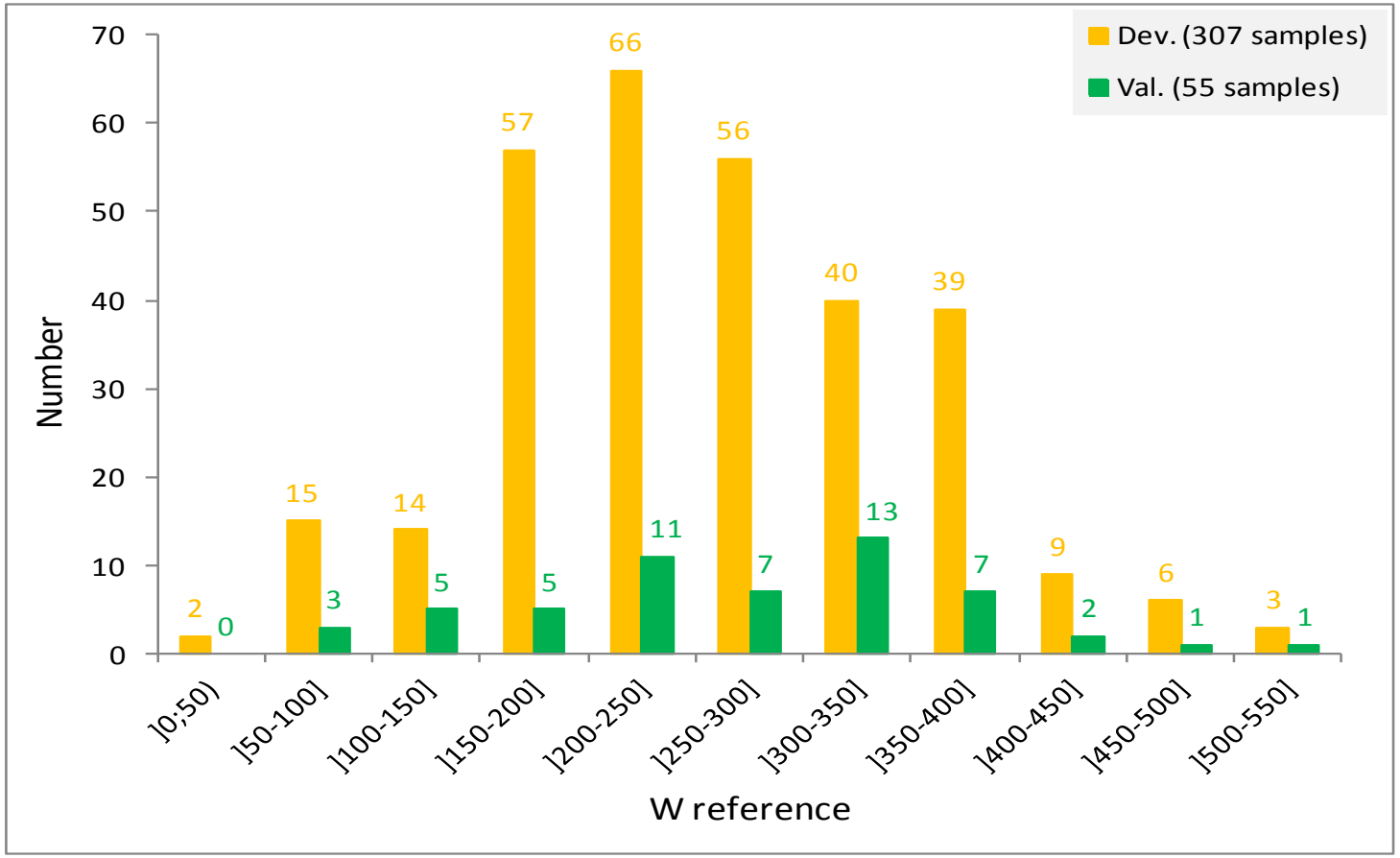
Validation plan

The aim of the study is to analyse simustaneously the same wheat samples according to the standard procedure and according to the rapid procedure and to compare statistically the $W_{estimated}$ Vs the $W_{reference}$.



Model development



	Sets:	
	Dev.	Val.
N éch.	307	55
Min	38	64
Max	545	501
Range	507	437

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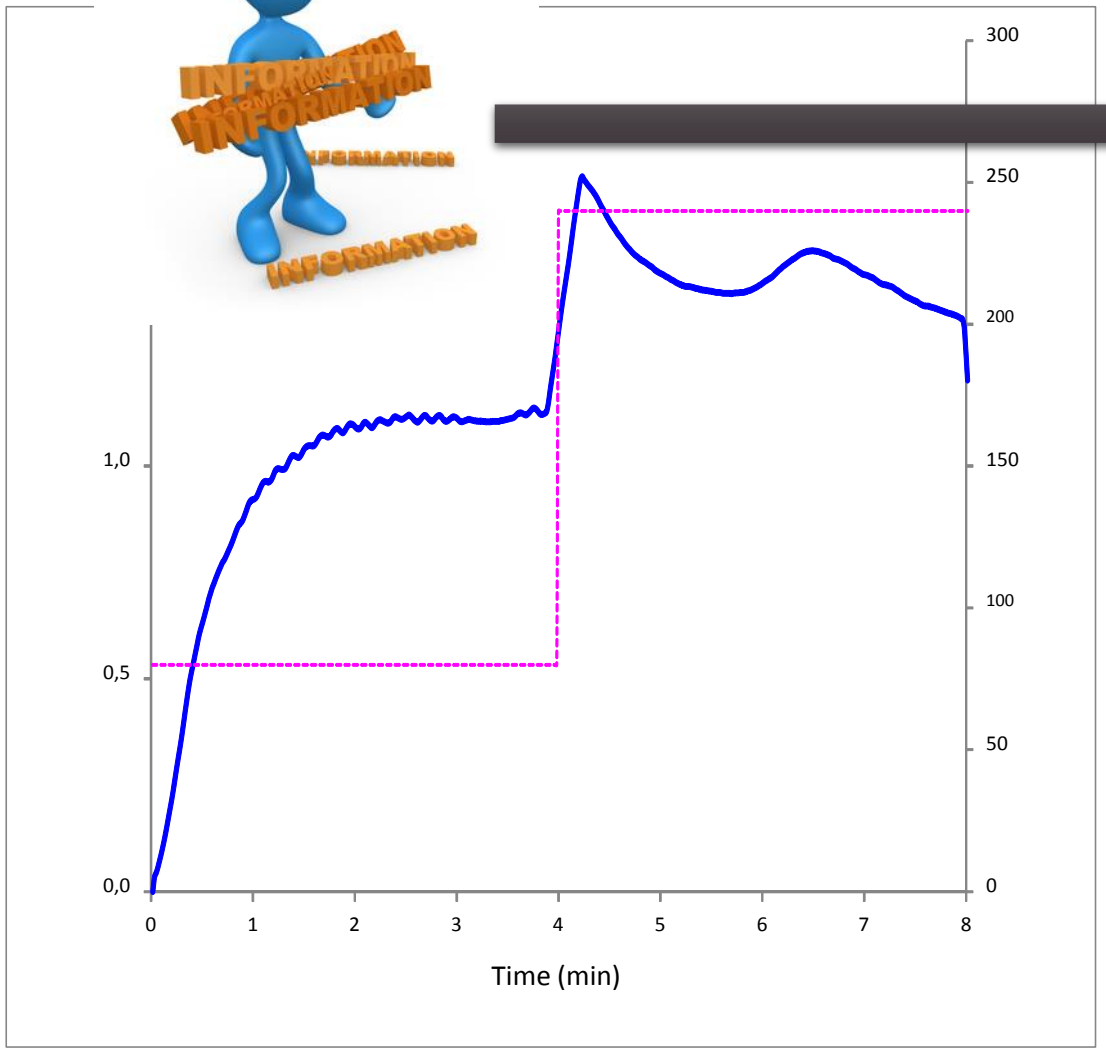
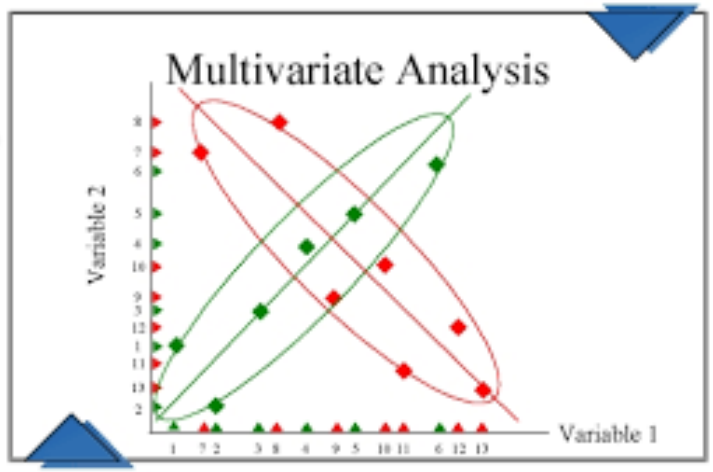
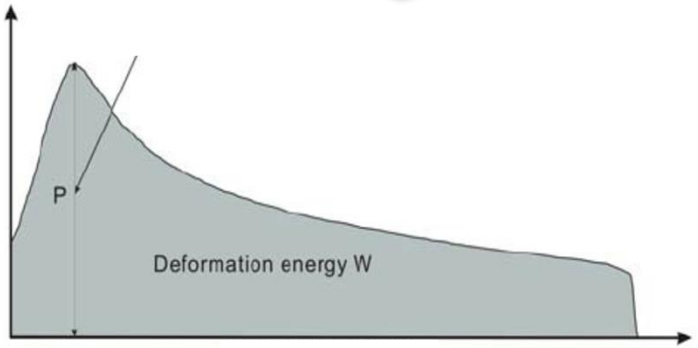
From the curve to the W value





Westimated



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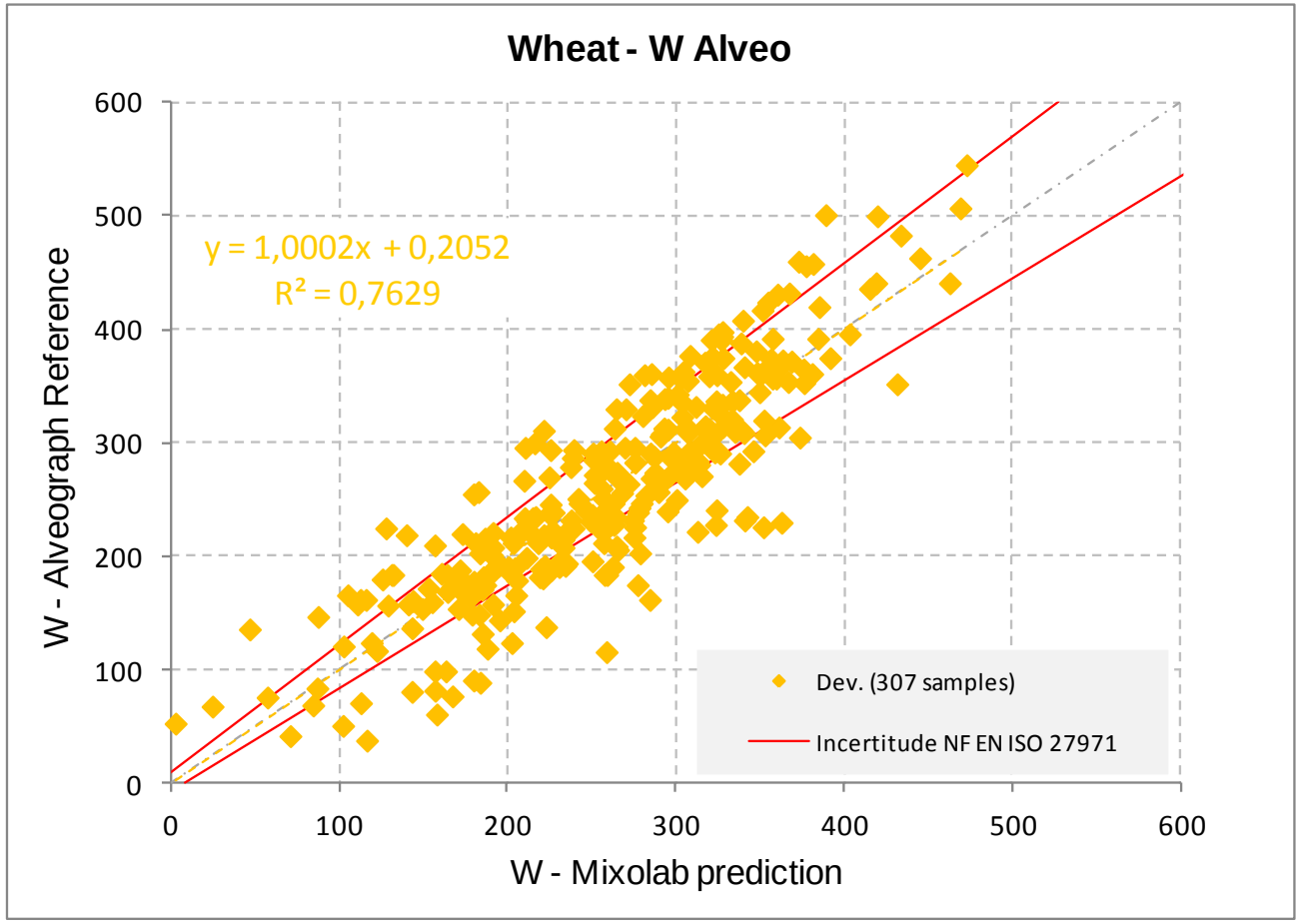
Model Development - Performances



	Wmixo-ABCDc1 -3-0
r^2	0,76
% IN	57,7 (177/307)
|Delta| average	**36,0**
|Delta| médian	29,6

% IN ➔ Delta < Uncertainty ISO 27971

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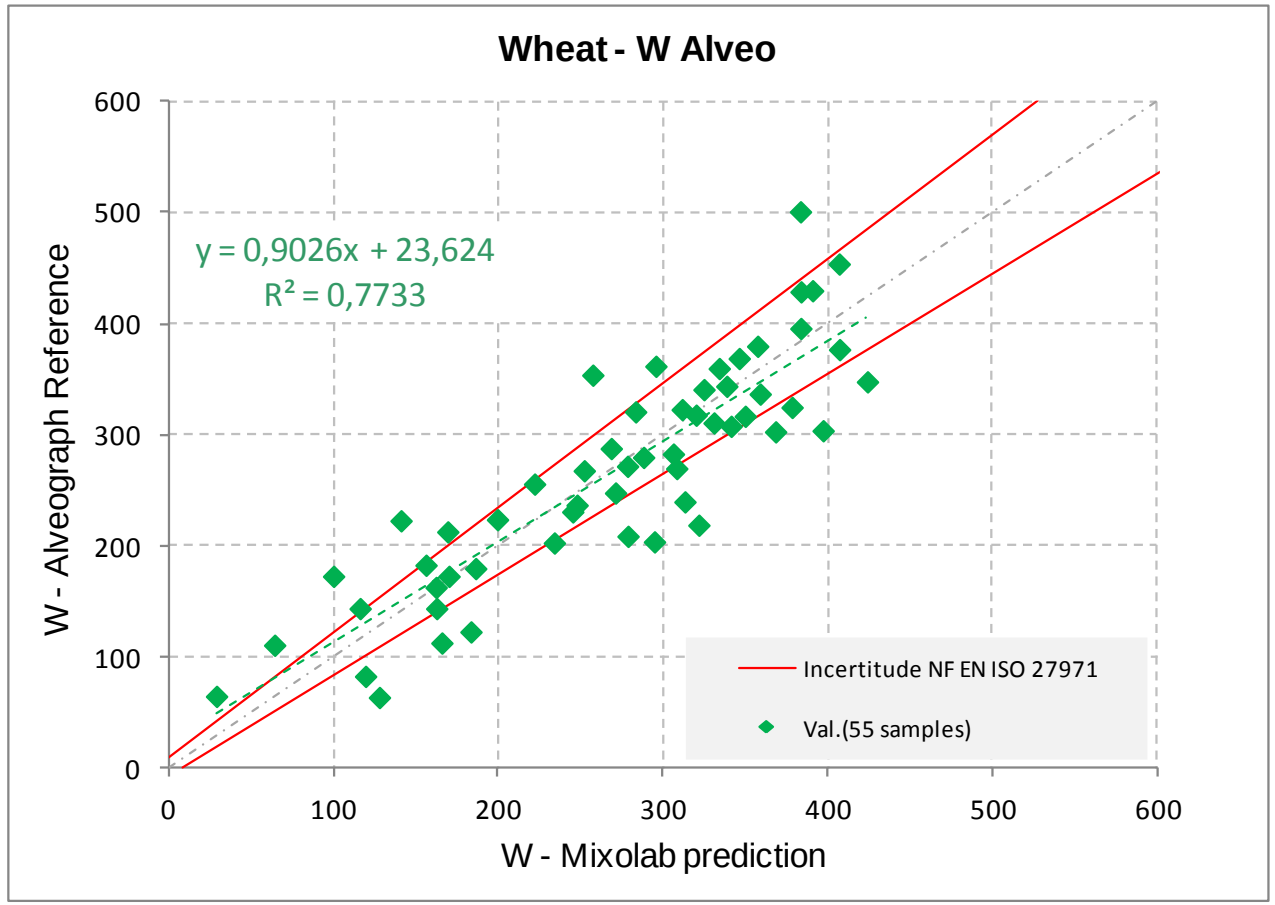
Model Validation - Performances



	Wmixo-ABCDc1 -3-0
r^2	0,77
% IN	58,2 (32/55)
|Delta| average	39,2
|Delta| médian	32,7

% IN ➔ Delta < incertitude ISO 27971

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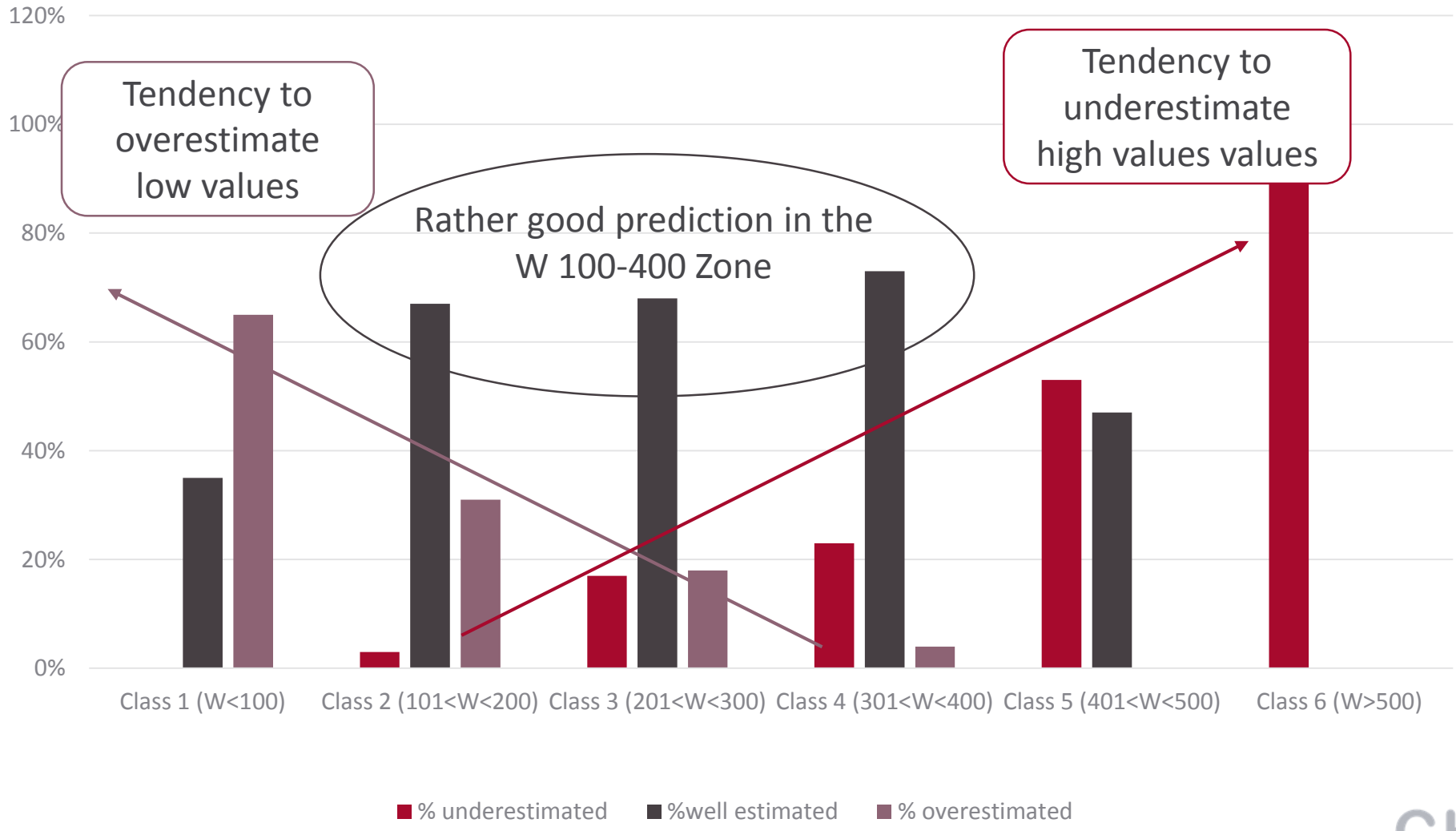
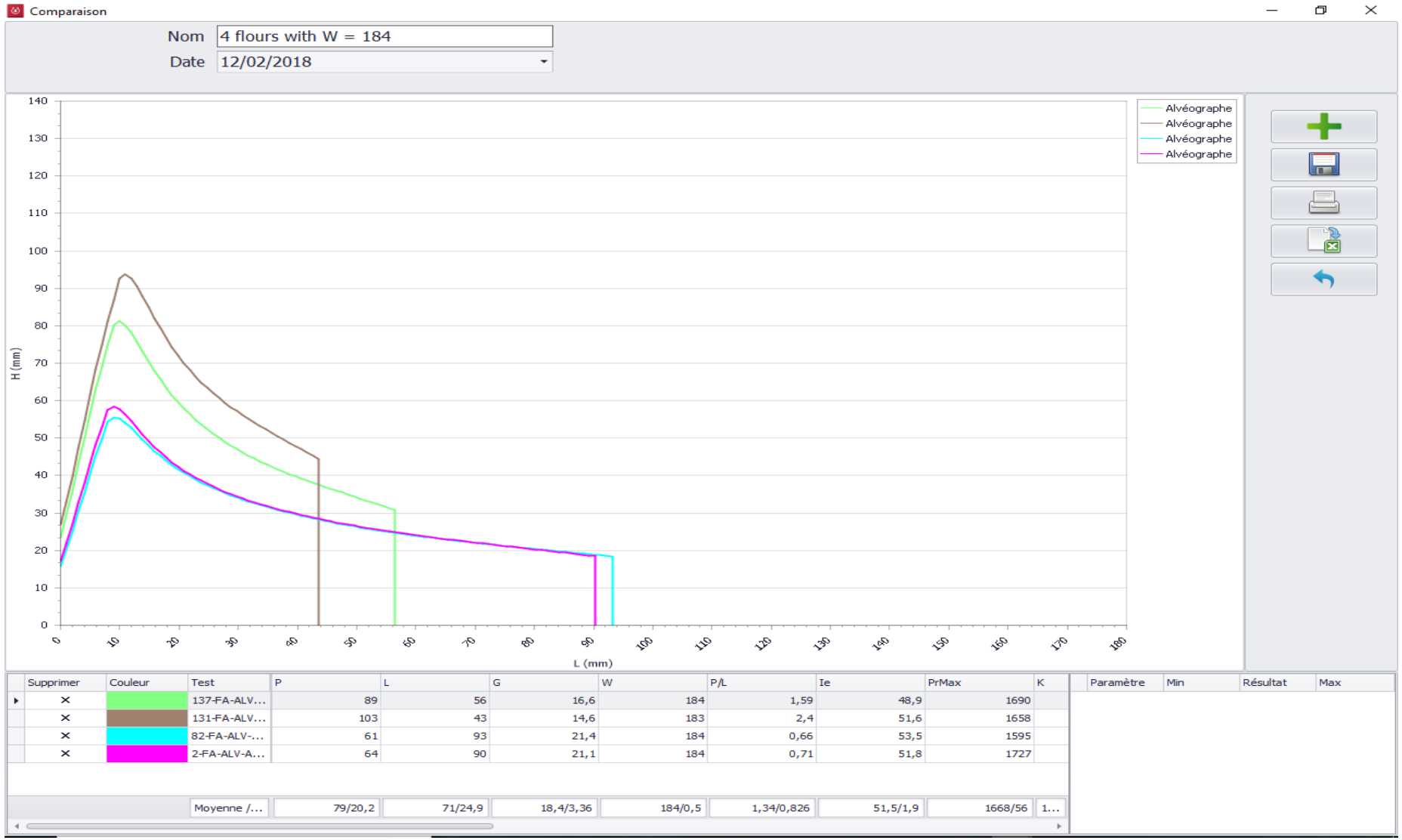
What Does this mean?



Limits of just looking at W value



Conclusion

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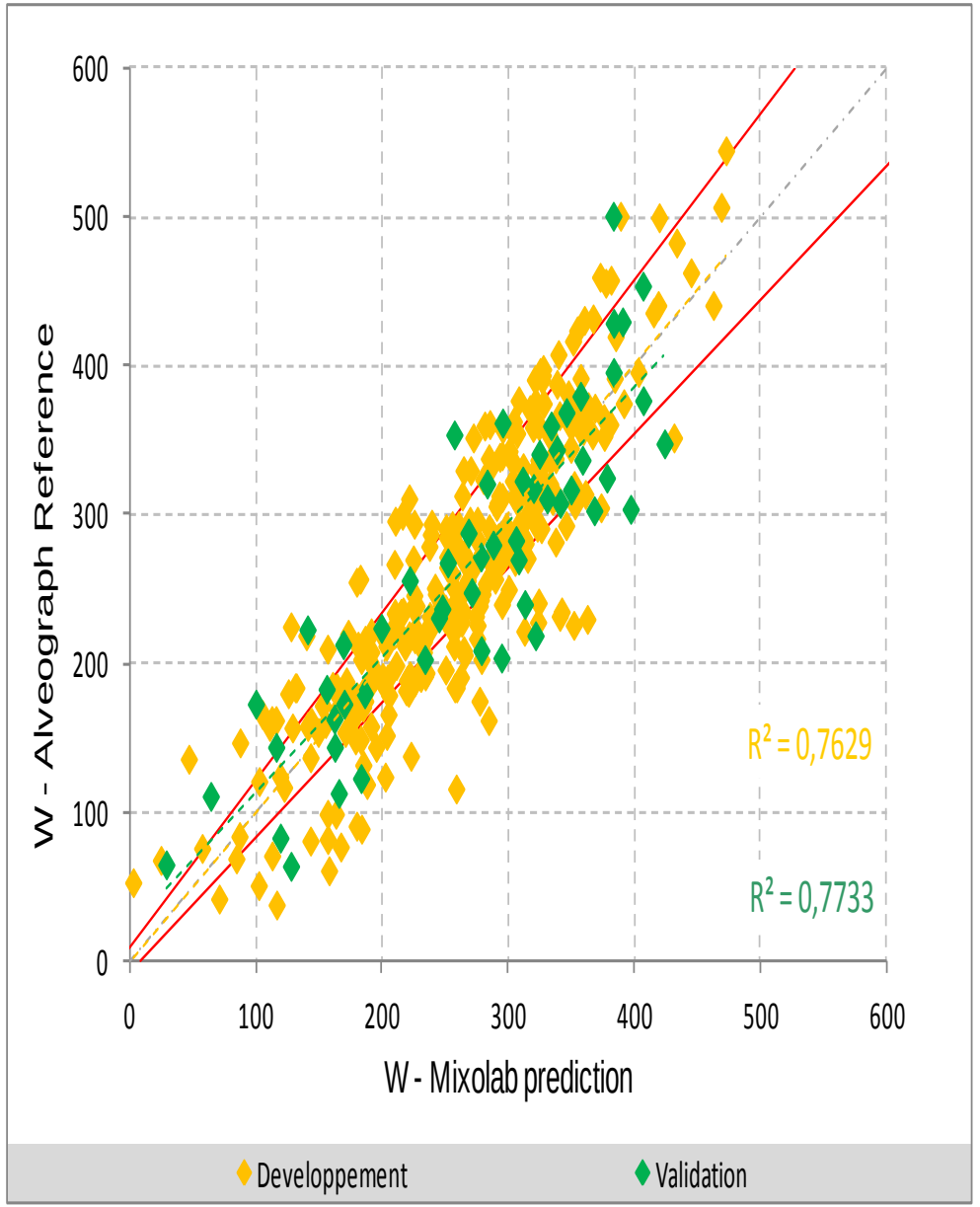
Main Findings

- This first approach shows that it is **possible to predict the Alveograph W value from a rapid mixing curve obtained from a whole meal sample of wheat.**
  - **A rapid mixing protocole** combining 4 min mixing at 80 rpm followed by 4 min mixing at 240 rpm was developped.
  - Multivariate analysis of the curve provides a formula **able to predict W value**.
  - When compared to actual W value, the model makes it possible **to correctly classify 2/3 of the samples**.
- This makes the method **very promising for fast wheat screening** based on rheological analysis, particularly in the area of 100 to 400 W.



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Acknowledgement

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