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Analyse Service GmbH

RFA Ringversuch ATILH, Frankreich - Portlandzement CEM I 52,5 N

Veranstalter des Ringversuchs:	Association Technique de l'industrie des liantshydrauliques (ATILH)
Ringversuchsmaterial:	Portlandzement CEM I 52,5 N
RV geschlossen:	2019 - 12
Literatur:	Interlaboratory testing programme 2018 – final report - (Laborcode 112)

Hauptelemente [MA%]

	CRB	RV	1sRV
SiO_2	21,980	22,140	0,290
Al_2O_3	3,170	3,250	0,110
Fe_2O_3	2,160	2,170	0,070
TiO_2	0,154	0,150	0,010
P_2O5	0,062	0,060	0,010
SO_3	2,425	2,340	0,090
CaO	67,200	67,010	0,430
MgO	0,760	0,760	0,070
K_2O	0,180	0,170	0,030
Na_2O	0,140	0,140	0,030
SrO	0,139	0,130	0,010
MnO	0,113	0,110	0,030
LOI	1,410	1,570	0,090

Legende

CRB: Ergebnisse CRB – **RV:** Ergebnisse Ringversuch -- **1s-RV:** Standardabweichung Ringversuch
Z-Score: Differenz des Messwertes vom Mittelwert des Ringversuchs -- ***** Wert nicht zertifiziert

ATILH

ASSOCIATION TECHNIQUE DE
L'INDUSTRIE DES LIANTS HYDRAULIQUES

Interlaboratory testing Programme

2018

Final report

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Interlaboratory Testing Programme 2018

1. INTRODUCTION

There were **183** laboratories participating this year, of which:

50 were laboratories of the French cement industry, including **4** European pilot laboratories,
20 belonged to various French organizations using cement, including **1** European pilot laboratory,
113 were from other countries, including **12** European pilot laboratories.

A total of **36 countries** took part in this program:

- **ALBANIA**
- **ALGERIA**
- **ARGENTINA**
- **AUSTRALIA**
- **AUSTRIA**
- **BELGIUM**
- **BRAZIL**
- **CHINA**
- **DENMARK**
- **FINLAND**
- **FRANCE**
- **GERMANY**
- **GREECE**
- **ISRAEL**
- **ITALY**
- **JAPAN**
- **JORDAN**
- **LEBANON**
- **LITHUANIA**
- **LUXEMBOURG**
- **MOROCCO**
- **THE NETHERLANDS**
- **NEW-ZEALAND**
- **POLAND**
- **PORTUGAL**
- **ROMANIA**
- **SENEGAL**
- **SINGAPORE**
- **SLOVAKIA**
- **SPAIN**
- **SWEDEN**
- **SWITZERLAND**
- **THE CZECH REPUBLIC**
- **TUNISIA**
- **TURKEY**
- **UNITED STATES**

The cement used in this testing programme was a **CEM I 52,5 N** complying with the European Standard NF EN 197-1.

2. GENERAL CONSIDERATIONS

2.1 Organization.

Four and a half tons of CEM I 52,5 N (as per European standard NF EN 197-1:2012) were homogenized so as to obtain as identical samples as possible, then conditioned in metallic waterproof recipients.

Data submitted by the participants are presented in tables at the end of this report, in the same order as that of the questionnaire. Results are presented identically for each analysis: first a determination of the mean for all methods used put together, then a comparative analysis for each participant, for all methods used, then per method. A mean is also determined for the less popular test methods (< 12 values).

There are three groups of results to be taken into consideration, those of the European pilot laboratories, the European laboratories, and finally those of laboratories outside Europe.

The French cement manufacturers' Central Laboratories, the Materials Laboratory of the City of Paris and European most experience laboratories compose the pilot laboratory group.

2.2 Objectives.

Many types of tests are used, involving one or more laboratories, one or more operators, and implementing different experimental programmes where the test results are submitted to statistical analyses. This is due to the variety of purposes they were designed for: self-regulation, process management, acceptance inspection, round-robin tests,…

ATILH's round-robin tests aim at a better knowledge of cement, of its technology and of what can be expected of it. Our test programmes allow each participant to estimate the position of their results within the same test class. They will also contribute to improvements in resource management, help evaluate the operators' qualifications and check on the quality of the equipment and the validity of the operating procedures. Finally, these tests are part of quality control monitoring.

2.3 Statistical analysis of the results.

A few definitions in statistics:

- **Precision**: closeness of the experimental values obtained throughout a set of experiments done under given conditions.

- **Repeatability**: precision in the case of a single operator in a given laboratory obtaining repeated results testing an identical product with the same material and the same method.

- **Reproducibility**: precision in the case of several operators in different laboratories or in the same laboratory but working at different times, each obtaining individual results testing an identical product with the same method.

2.3.1 General data

The most common approach, supported by the Gauss distribution convergence theorem, is that most distributions found in physic-chemical measures or in industrial practice is noticeably Gaussian.

"Normal" or Laplace-Gauss distribution (***NF X 06-050***) consists solely of two parameters: means m and standard deviation S, respectively $\bar{x}$ and s_R in the statistical tables of this report.

For this type of distribution, we show that :

68 % of the results are between (m - σ) and (m + σ)

95 % of the results are between (m - 2σ) and (m + 2σ)

99,7 % of the results are between (m - 3σ) and (m + 3σ)

For these round-robin tests, P is the probability of the observed value in the test, where, if:

P ≥ 5 %, then the recorded value is considered as correct

2 % < P < 5%, then the recorded value is considered as suspect

P < 2 %, then the recorded value is considered as an outlier

2.3.2 Statistical analysis proper

Every laboratory having given a result for each method used, we are here in the case of reproducibility. Our analysis follows the usual three steps:

a) Elimination of outlier values done on a 98% level through Student's test, minimum and maximum values being determined through the expression:

$$\mathbf{Lm \text{ et } LM = x \pm s.t_{n-1}}$$

Where t_{n-1} is the number of standard deviation separating the mean from the limit, a given value from the STUDENT distribution table, for ***level of significance value*** set at 0,02 and the degree of freedom N = n-1)

b) A reiteration is applied to this level so as to retain only the values attached to the distribution. "Outlier" values are eliminated from the final computations.

c) A classical **reduction of the data**. The various parameters and characteristic that can be computed are divided into two categories:

. ***CENTRAL TREND* PARAMETERS**

* the arithmetic mean x : where $\mathbf{x_i}$ is the observed value and **n** the total population ***(in the sample)***

$$\bar{x} = \frac{\sum_{i=1}^{n} \bar{x_i}}{n}$$

DISPERSION PARAMETERS

☛ experimental variance S^2 estimated from the sample of population **n**, determined by:

$$S^2 = \frac{\sum_{i=1}^{n} (x_i - x)^2}{n-1}$$

☛ experimental standard deviation **S**, estimated from the square root of the variance

$$S = \sqrt{\frac{\sum_{i=1}^{n} (x_i - x)^2}{n-1}}$$

☛ coefficient of variation **V**, used for comparing dispersions :

$$V(\%) = \frac{s \times 100}{|x|}$$

Interpretation of the data:

The "empirical" characteristics above are to be clearly differentiated from the theoretical ones of the "model" to which we will try to link the recorded observations. We have assumed that the "population" that has been studied ***will bear the comparison*** to a statistical law or theoretical model.

The ***level of critical value***, i.e. the degree of probability or degree of confidence targeted is set at 0,05**,** which means a 95% chance that interpretation of results will conform to the hypothesis.

Values outside the range determined by level 95 are considered as suspect but are computed statistically.

The precision of the measure or the maximum probable error to be expected can be determined by the following expression, placed after the mean in the statistical tables, in ± ε :

Where t_{n-1} is a value from the STUDENT table at the selected ***level*** of confidence:

$$\varepsilon = \frac{s}{\sqrt{n}} \cdot t_{n-1}$$

SYMBOLS OF METHODS

CHEMICAL DETERMINATIONS

	Loss on ignition	SiO_2	Al_2O_3	Fe_2O_3	CaO	MgO	Alklies	SO_3	Free lime	Insoluble residue	Cl	TiO_2	P_2O_5	SrO
A	*θ = 1000°c T=20min*	*Atomic Absorption (AAS)*										*Atomic Absorption (AAS)*		
B	*θ < 1000°c T=20min*	*Quinoléine*							*Glycerin Alcohol*					
C	*θ = 1000°c T<20min*	*CH_2-CH_2-O*	*Complexometry*						*Glycol Complexometry*					
D	*θ < 1000°c T>20min*	*Double Insolubilite*												
E	*θ < 1000°c T=20min*	*NH_4Cl*						*Eltra*	*Ethylene Glycol*					
G	*θ = 1000°c T=15min*	*Gelatin*						*Gravimetry*	*Glycol Acidimetry*					
K*	*θ = 950°c T=15min*	*Double Insolubilite*	*Complexometry*				*Flame photometry*	*Gravimetry*		*Gravimetry*	*$AgNO_3$*			
L	*θ = 1000°c T>20min*							*Leco*	*Glycol Conductimetry*					
M		*Plasma (ICP)*										*Plasma(ICP)*		
P	*θ < 1000°c T=20min*	*$HClO_4$*					*Flame photometry*				*Potentiometry*			
T	*Thermo gravimetry*							*Turbidimetry*	*Thermo gravimetry*					
X	*θ < 1000°c T<20min*	*X-ray fluorescence*									*X-ray fluorescence*			

*** CEN reference method**

PHYSICAL DETERMINATIONS

	Specific gravity	Granulometer	Setting time test	Mechanical tests
A	ASTM – NBS standard	Alpine sieving	Automatic apparatus	AFNOR Sand, CEN Standard
B		Other sieving		AFNOR Sand, National Standard
C				National Sand, National Standard
D				National Sand, CEN Standard
G	Atilh standard			
L	Lafarge standard	Laser granulometer		
M			Manual test	

N : ***For the individual case (Physical, Chemical or Mechanical tests) not mentioned method or few results.***

UNITS OF MEASURE

Chemical, Granulometry Mineralogy and normal consistency	Specific gravity	Specific surface	Setting time	Soundness	Skrinkage and Swelling	Heat of hydration	Maximum heat and Age maximum	Maniability fluidity	Mass on demoulding	Compression and Bending strengths
%	g/cm^3	cm^2/g	min	mm	µm/m	J/g	J/g/h and h	s	g	MPa

CEMENT STANDARDS

NF EN 197-1	*Cement*	*Composition, specifications and conformity criteria for common cements*
NF EN 196-1	*Methods of testing cement*	*Determination of strength*
NF EN 196-2	*Methods of testing cement*	*Chemical analysis of cement*
NF EN 196-3	*Methods of testing cement*	*Determination of setting time and soundness*
CEN TR/ 196-4	*Methods of testing cement*	*Quantitative determination of constituents*
NF EN 196-5	*Methods of testing cement*	*Pozzolanicity test for pozzolanic cement*
NF EN 196-6	*Methods of testing cement*	*Determination of fineness*
NF EN 196-7	*Methods of testing cement*	*Methods of taking and preparing samples of cement*
NF P 15-433	*Methods of testing cement*	*Determination of shrinkage and swelling*
NF EN 196-8	*Methods of testing cement*	*Part 8: heat of hydration - solution method*
NF EN 196-9	*Methods of testing cement*	*Part 9: heat of hydration - semi-adiabatic method*
XP P 15-437	*Testing technics*	*Characterization of cements by fluidity measurement under mortar vibration*
NF P 18-452	*Concrete*	*Measuring the flow time of concretes and mortars using a workabilitymeter*
NF X 06-050	*Statistical*	*Statistical application – Study of the normal distribution*

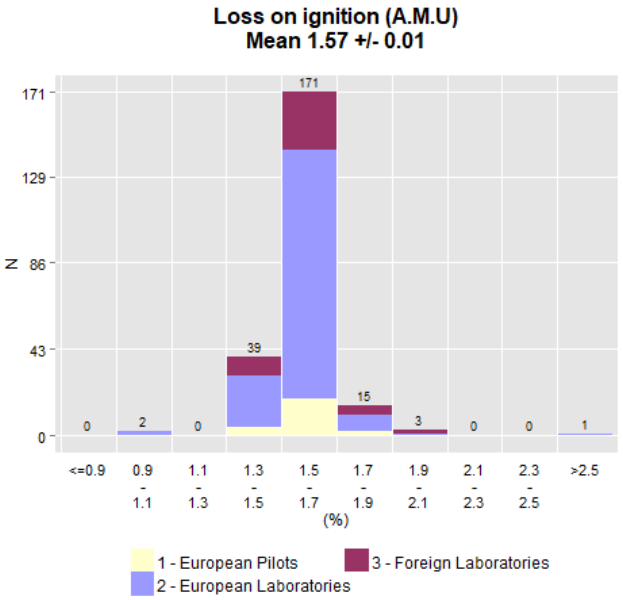
SYMBOLS BY STATISTICS

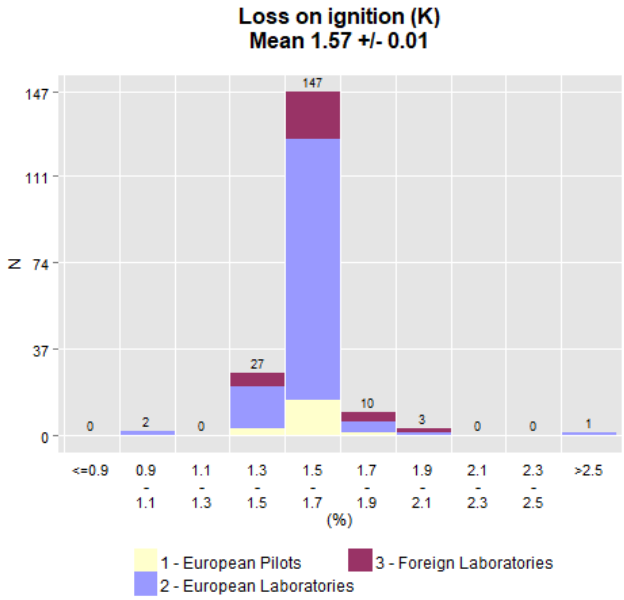
A.M.U.	*All methods used*
Nb	*Number of test per laboratory* or number of laboratory
$\bar{x}$	*Arithmetic mean*
ε	*Precision of a measure of the mean (5%)*
S_R	*Standard of deviation of reproductibility*
CV	*Coefficient of variation (V%=S/x)*
Lm 95%	*Lower confidence limits after elimination of outliers*
LM 95%	*Upper confidence limits after elimination of outliers*

3. Table results of the test campaign 2018 - All people and all methods used

Parameter	Nb Labo	Nb Results	Mean (%)	S_R (%)	*CV* (%)	Lm95%	LM95%
Loss on ignition	169	222	**1.57**	0.09	5.8	**1.39**	**1.75**
SiO2	148	204	**22.14**	0.29	1.3	**21.57**	**22.70**
Al2O3	150	201	**3.25**	0.11	3.4	**3.03**	**3.46**
Fe2O3	150	210	**2.17**	0.07	3.1	**2.04**	**2.30**
CaO	148	204	**67.01**	0.43	0.6	**66.16**	**67.86**
MgO	149	205	**0.76**	0.07	8.7	**0.63**	**0.89**
MnO	80	103	**0.11**	0.03	24.6	**0.06**	**0.16**
SO3	159	276	**2.34**	0.09	3.8	**2.17**	**2.52**
Free lime	130	144	**0.56**	0.17	29.9	**0.23**	**0.89**
Insoluble residue	139	179	**0.44**	0.19	43.4	**0.06**	**0.82**
Na2O	144	196	**0.14**	0.03	19.2	**0.09**	**0.19**
K2O	151	208	**0.17**	0.03	15.3	**0.12**	**0.23**
TiO2	105	131	**0.15**	0.01	8.0	**0.13**	**0.18**
Chloride	145	185	**0.04**	0.01	18.9	**0.02**	**0.05**
P2O5	114	147	**0.06**	0.01	17.1	**0.04**	**0.08**
SrO	63	84	**0.13**	0.01	5.8	**0.12**	**0.15**
CO_2	49	49	**1.15**	0.12	10.6	**0.91**	**1.40**
S^{--}	47	47	**0.01**	0.01	101.0	**-0.01**	**0.02**
Cr^{6+}	100	100	**0.000150**	0.000110	73.2	**-0.000068**	**0.000368**
Specific Gravity	160	196	**3.14**	0.02	0.6	**3.10**	**3.18**
Specific surface	163	168	**3687**	149	4.0	**3394**	**3981**
Corrected surface	156	161	**3684**	136	3.7	**3415**	**3953**
Normal consistency	157	203	**27.8**	0.6	2.1	**26.6**	**28.9**
Initial setting time	161	226	**156**	16	10.3	**124**	**188**
Soundness	139	172	**0.52**	0.44	84.3	**-0.35**	**1.38**
Workability	4	5	**3.7**	0.5	12.6	**2.4**	**5.0**
Fluidity	1	1	**5.1**	-	-	**-**	**-**
Granulométrie 2.5µm	73	73	**10.3**	2.7	26.3	**4.9**	**15.7**
Granulométrie 12.5µm	74	74	**47.8**	3.5	7.3	**40.9**	**54.8**
Granulométrie 31.5µm	77	81	**85.5**	3.7	4.3	**78.1**	**92.9**
Granulométrie 80µm	107	124	**99.7**	0.3	0.3	**99.0**	**100.3**
Shrinkage 3d	21	21	**174**	41	23.5	**89**	**259**
Shrinkage 7d	28	28	**346**	53	15.3	**238**	**455**
Shrinkage 14d	26	26	**482**	61	12.6	**357**	**606**
Shrinkage 28d	29	29	**639**	70	11.0	**495**	**783**
Swelling 3d	15	15	**34**	21	61.2	**-11**	**80**
Swelling 7d	13	13	**47**	21	44.3	**2**	**91**
Swelling 14d	14	14	**58**	31	53.4	**-9**	**124**
Swelling 28d	16	16	**63**	41	65.3	**-25**	**152**
Heat of hydration 41h	40	40	**312**	19	6.2	**273**	**351**
Heat of hydration 3d	33	33	**322**	27	8.3	**267**	**376**
Heat of hydration 5d	30	30	**331**	30	9.0	**271**	**392**
Heat of hydration 7d	15	15	**343**	22	6.5	**295**	**391**
Maximum heat exhaust rate	14	23	**42.9**	3.0	6.9	**36.8**	**49.1**
Age maximum rate	13	23	**7.2**	0.5	6.5	**6.2**	**8.2**
Clinker	36	41	**94.5**	1.4	1.5	**91.6**	**97.4**
Set regulator	35	42	**3.7**	0.3	7.8	**3.1**	**4.3**
Constituent 1	28	32	**2.4**	0.3	12.6	**1.8**	**3.1**
C3S Mineralogy	46	46	**70.9**	2.9	4.1	**65.1**	**76.7**
C2S Mineralogy	48	48	**13.2**	3.9	29.8	**5.3**	**21.1**
C3A Mineralogy	49	49	**3.4**	1.1	34.0	**1.1**	**5.7**
C4AF Mineralogy	48	48	**6.4**	0.7	10.3	**5.1**	**7.7**
Free Lime Mineralogy	28	28	**0.5**	0.2	44.9	**0.0**	**1.0**
SO4Ca Mineralogy	24	24	**2.5**	1.2	48.1	**0.0**	**4.9**
Mean of weight of samples at demoulding	149	149	**585.4**	5.9	1.0	**573.8**	**597.0**
Bending 1 day	71	71	**4.8**	0.4	8.2	**4.0**	**5.6**
Bending 2 days	76	76	**6.1**	0.4	7.0	**5.3**	**7.0**
Bending 7 days	77	77	**8.0**	0.6	7.1	**6.9**	**9.1**
Bending 28 days	77	77	**9.2**	0.6	6.4	**8.0**	**10.4**
Compression 1 day	196	217	**23.3**	1.3	5.4	**20.8**	**25.8**
Compression 2 days	219	246	**35.3**	1.4	4.1	**32.5**	**38.1**
Compression 7 days	220	247	**51.6**	2.1	4.2	**47.4**	**55.8**
Compression 28 days	218	244	**67.6**	2.5	3.7	**62.7**	**72.5**

4. Chemical Analysis





Loss on ignition - By population Group & Method

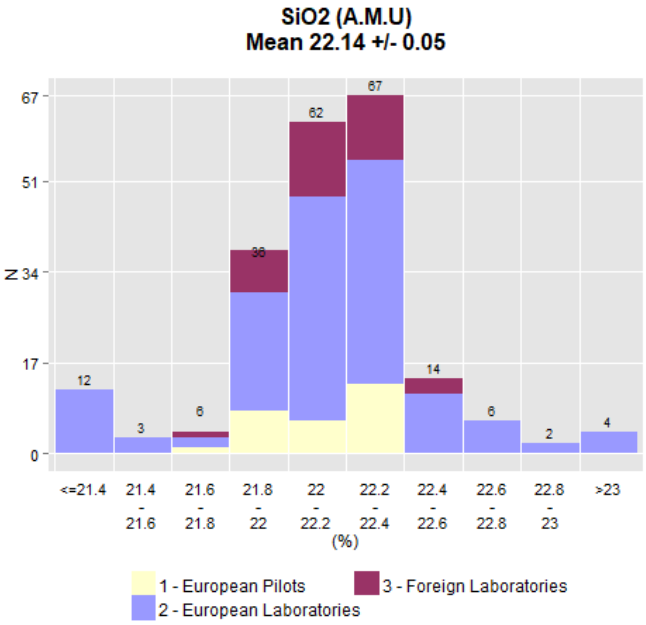
Population	Method	Number of Results	$\bar{x}$	ε	S_R	CV (%)	Lm95%	LM95%
1 – European pilots	A.M.U	23	**1.56**	0.03	0.06	4.1	**1.42**	**1.69**
2 – European laboratories	A.M.U	156	**1.57**	0.01	0.09	5.9	**1.38**	**1.75**
3 – Foreign laboratories	A.M.U	42	**1.57**	0.03	0.09	5.5	**1.40**	**1.75**

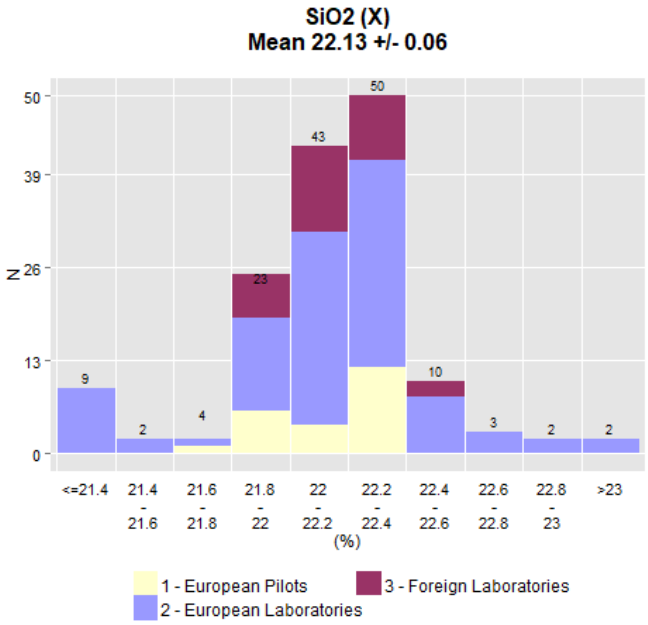
Population	Method	Number of Results	$\bar{x}$	ε	S_R	CV (%)	Lm95%	LM95%
1 – European pilots	K	18	**1.54**	0.02	0.05	3.0	**1.45**	**1.64**
1 – European pilots	N	3	**1.64**	0.29	0.12	7.2	**1.13**	**2.15**
2 – European laboratories	D	10	**1.55**	0.08	0.12	7.6	**1.28**	**1.81**
2 – European laboratories	K	133	**1.57**	0.01	0.09	5.4	**1.40**	**1.74**
2 – European laboratories	N	12	**1.56**	0.08	0.13	8.4	**1.27**	**1.84**
3 – Foreign laboratories	D	3	**1.54**	0.19	0.08	4.9	**1.21**	**1.86**
3 – Foreign laboratories	K	30	**1.58**	0.03	0.09	5.8	**1.39**	**1.77**
3 – Foreign laboratories	N	9	**1.56**	0.05	0.07	4.4	**1.40**	**1.72**

Loss on Ignition - Eliminated Outliers
Confidence Level = 2%

N°Labo	Population	Method	Value
8	1 – European pilots	K	**1.71**
37	2 – European laboratories	K	**0.99**
59	2 – European laboratories	K	**1.99**
87	2 – European laboratories	K	**1.90**
134	2 – European laboratories	K	**2.57**
219	3 – Foreign laboratories	K	**1.95**
226	3 – Foreign laboratories	K	**2.01**
232	3 – Foreign laboratories	N	**1.90**

- Whatever the population and whatever the method used, the results of the mean are very homogeneous. The mean A.M.U is 1,57 %. (see general summary table at the beginning of the report).





SiO_2 - By population Group & Method

Population	Method	Number of Results	$\bar{x}$	ε	S_R	CV (%)	Lm95%	LM95%
1 – European pilots	A.M.U	28	**22.11**	0.07	0.18	0.8	**21.75**	**22.47**
2 – European laboratories	A.M.U	137	**22.15**	0.06	0.33	1.5	**21.50**	**22.79**
3 – Foreign laboratories	A.M.U	38	**22.13**	0.06	0.19	0.8	**21.76**	**22.51**

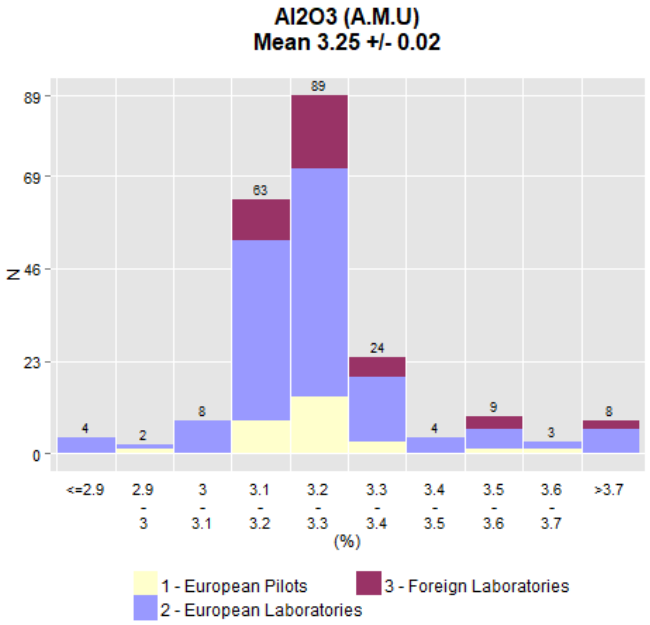
Population	Method	Number of Results	$\bar{x}$	ε	S_R	CV (%)	Lm95%	LM95%
1 - European pilots	K	5	**22.01**	0.23	0.18	0.8	**21.50**	**22.52**
1 - European pilots	X	23	**22.13**	0.07	0.17	0.8	**21.78**	**22.48**
2 – European laboratories	K	36	**22.18**	0.08	0.23	1.0	**21.72**	**22.63**
2 – European laboratories	X	92	**22.13**	0.07	0.36	1.6	**21.42**	**22.84**
2 – European laboratories	M	7	**22.19**	0.35	0.38	1.7	**21.27**	**23.12**
3 – Foreign laboratories	X	29	**22.14**	0.07	0.18	0.8	**21.78**	**22.50**
3 – Foreign laboratories	K	4	**22.13**	0.34	0.21	1.0	**21.45**	**22.80**

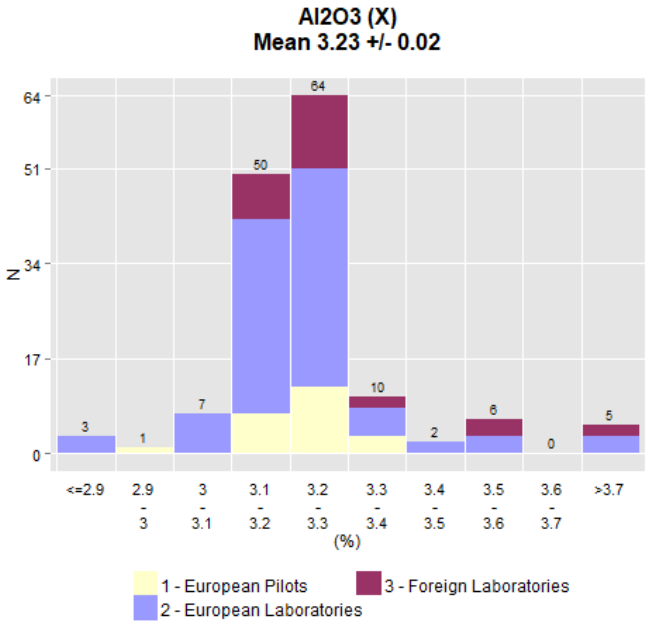
SiO_2 - Eliminated Outliers
Confidence Level = 2%

N°Lab	Population	Method	Value
27	2 – European laboratories	X	**20.54**
59	2 – European laboratories	X	**23.16**
71	2 – European laboratories	N	**24.54**
85	2 – European laboratories	M	**20.02**
114	2 – European laboratories	K	**23.46**
128	2 – European laboratories	X	**20.88**
139	2 – European laboratories	K	**20.72**
139	2 – European laboratories	K	**20.81**

- The overall mean for all methods used is 22,14 % (see general summary table at the beginning of the report).

- Overall, the results are very satisfactory for all three populations AMU and by methods.





Al_2O_3 - By population Group & Method

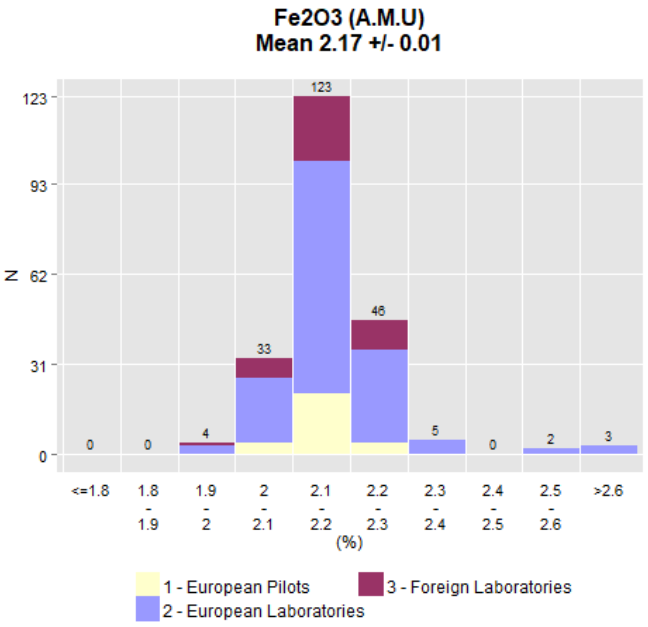
Population	Method	Number of Results	$\bar{x}$	Ɛ	S_R	CV (%)	Lm95%	LM95%
1 – European pilots	A.M.U	26	**3.25**	0.03	0.08	2.5	**3.08**	**3.42**
2 – European laboratories	A.M.U	138	**3.24**	0.02	0.11	3.5	**3.01**	**3.46**
3 – Foreign laboratories	A.M.U	36	**3.27**	0.04	0.11	3.2	**3.05**	**3.48**

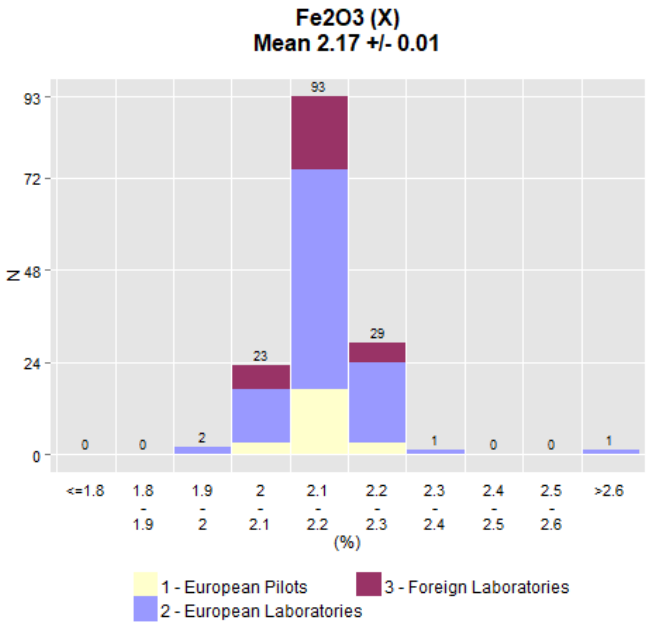
Population	Method	Number of Results	$\bar{x}$	Ɛ	S_R	CV (%)	Lm95%	LM95%
1 - European pilots	X	22	**3.23**	0.03	0.06	1.8	**3.11**	**3.36**
1 - European pilots	K	4	**3.32**	0.25	0.16	4.7	**2.82**	**3.81**
2 - European laboratories	X	91	**3.22**	0.02	0.09	2.9	**3.03**	**3.41**
2 - European laboratories	K	34	**3.29**	0.04	0.13	3.8	**3.03**	**3.55**
2 - European laboratories	M	9	**3.20**	0.05	0.07	2.2	**3.04**	**3.37**
3- Foreign laboratories	K	4	**3.27**	0.09	0.06	1.8	**3.08**	**3.45**
3- Foreign laboratories	X	26	**3.26**	0.05	0.12	3.6	**3.02**	**3.51**

Al_2O_3 - Eliminated Outliers
Confidence Level = 2%

N°Lab	Population	Method	Value
2a	1 - European pilots	K	**3.63**
13	1 - European pilots	X	**2.96**
21	2 - European laboratories	X	**3.96**
21	2 - European laboratories	X	**3.99**
75	2 - European laboratories	M	**3.91**
108	2 - European laboratories	K	**3.82**
117	2 - European laboratories	K	**3.76**
134	2 - European laboratories	X	**3.72**
138	2 - European laboratories	K	**2.63**
138	2 - European laboratories	X	**2.63**
138	2 - European laboratories	X	**2.77**
219	3- Foreign laboratories	X	**4.00**
223	3- Foreign laboratories	X	**3.88**

- The overall mean for all methods used is 3,25 % for 201 tests (see general summary table at the beginning of the report).
- The results of the mean obtained are very satisfactory whatever the method or the populations.





Fe_2O_3 - By population Group & Method

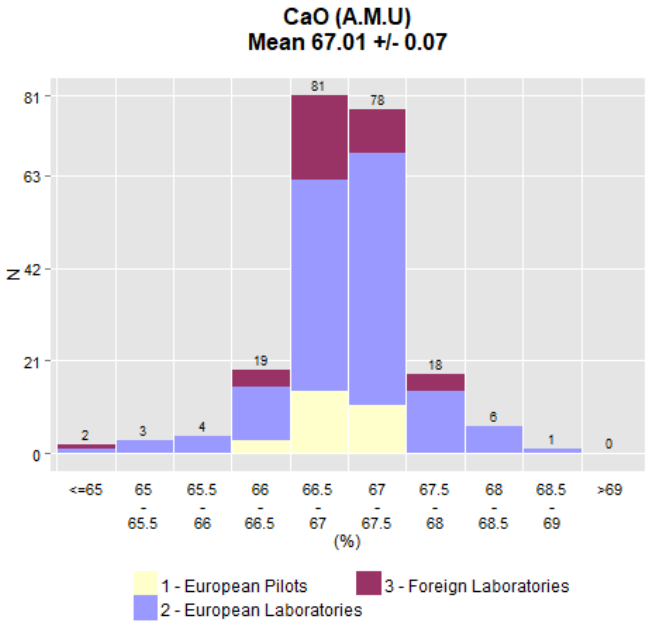
Population	Method	Number of Results	$\bar{x}$	ε	S_R	CV (%)	Lm95%	LM95%
1 – European pilots	A.M.U	29	**2.16**	0.02	0.04	2.0	**2.07**	**2.25**
2 – European laboratories	A.M.U	141	**2.17**	0.01	0.07	3.3	**2.03**	**2.31**
3 – Foreign laboratories	A.M.U	39	**2.18**	0.02	0.07	3.1	**2.04**	**2.32**

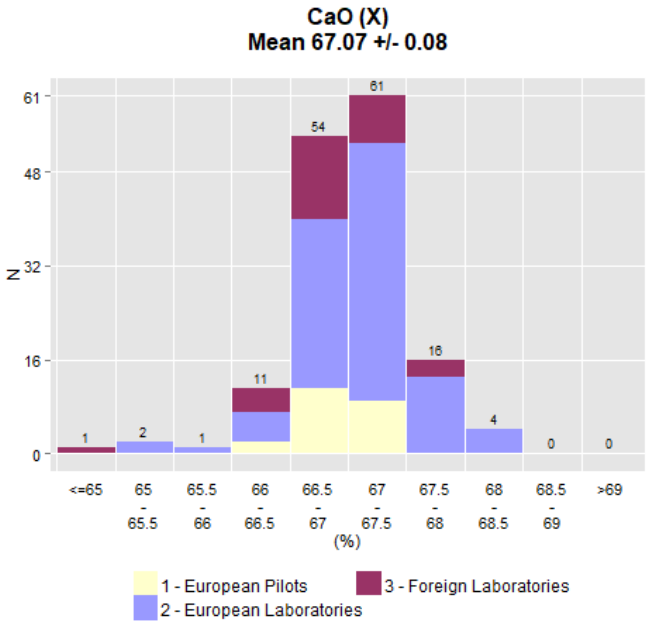
Population	Method	Number of Results	$\bar{x}$	ε	S_R	CV (%)	Lm95%	LM95%
1 - European pilots	K	5	**2.15**	0.09	0.07	3.2	**1.96**	**2.34**
1 - European pilots	X	23	**2.17**	0.02	0.04	1.8	**2.09**	**2.25**
2 - European laboratories	K	35	**2.18**	0.03	0.08	3.8	**2.01**	**2.35**
2 - European laboratories	M	9	**2.19**	0.07	0.09	4.0	**1.99**	**2.39**
2 - European laboratories	X	94	**2.17**	0.01	0.06	2.8	**2.05**	**2.29**
3- Foreign laboratories	K	3	**2.12**	0.18	0.07	3.4	**1.81**	**2.43**
3- Foreign laboratories	X	30	**2.17**	0.02	0.06	2.7	**2.05**	**2.29**

Fe_2O_3 - Eliminated Outliers
Confidence Level = 2%

N°Lab	Population	Method	Value
75	2 - European laboratories	M	**2.70**
103	2 - European laboratories	X	**3.17**
103	2 - European laboratories	M	**3.15**
106	2 - European laboratories	K	**2.51**
113	2 - European laboratories	K	**2.51**
201	3- Foreign laboratories	K	**1.94**

- The overall mean for all methods used is 2,17 % for 210 tests (see general summary table at the beginning of the report).
- The results of the mean obtained are very satisfactory whatever the method or the populations.





CaO - By population Group & Method

Population	Method	Number of Results	$\bar{x}$	ε	S_R	CV (%)	Lm95%	LM95%
1 – European pilots	A.M.U	28	**66.94**	0.12	0.30	0.5	**66.32**	**67.56**
2 – European laboratories	A.M.U	138	**67.04**	0.08	0.45	0.7	**66.15**	**67.94**
3 – Foreign laboratories	A.M.U	37	**66.94**	0.13	0.40	0.6	**66.12**	**67.75**

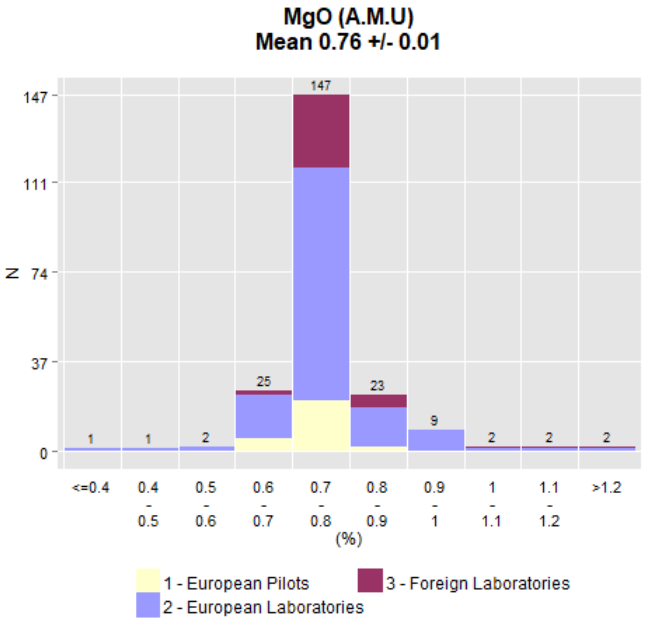
Population	Method	Number of Results	$\bar{x}$	ε	S_R	CV (%)	Lm95%	LM95%
1 - European pilots	K	6	**66.89**	0.30	0.28	0.4	**66.16**	**67.62**
1 - European pilots	X	22	**66.95**	0.14	0.31	0.5	**66.30**	**67.60**
2 - European laboratories	K	33	**66.78**	0.15	0.43	0.6	**65.90**	**67.65**
2 - European laboratories	X	94	**67.15**	0.08	0.40	0.6	**66.36**	**67.94**
2 - European laboratories	M	9	**66.94**	0.54	0.71	1.1	**65.30**	**68.57**
3- Foreign laboratories	X	29	**66.92**	0.17	0.43	0.6	**66.03**	**67.81**
3- Foreign laboratories	K	3	**66.98**	0.31	0.13	0.2	**66.44**	**67.53**

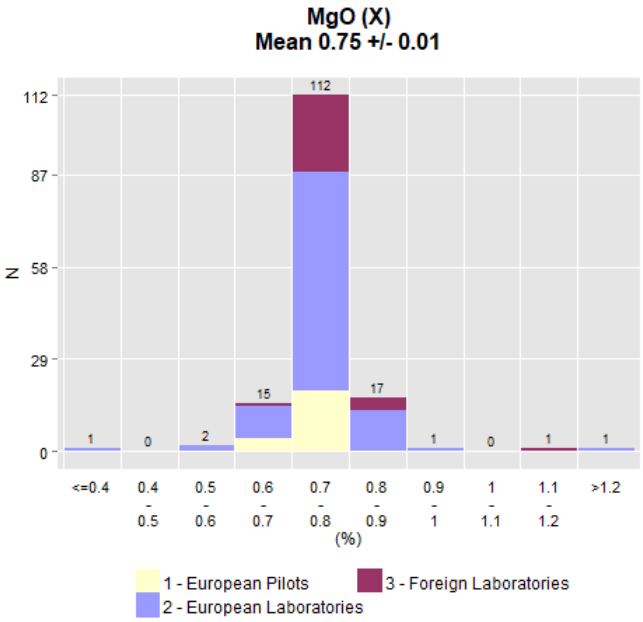
CaO - Eliminated Outliers
Confidence Level = 2%

N°Lab	Population	Method	Value
27	1 – European pilots	X	**65.95**
28	1 – European pilots	X	**68.33**
65	1 – European pilots	X	**65.50**
71	1 – European pilots	N	**65.26**
85	2 - European laboratories	M	**64.40**
117	2 - European laboratories	K	**68.40**
121	2 - European laboratories	K	**68.99**
138	2 - European laboratories	X	**65.18**
223	3- Foreign laboratories	X	**64.63**

- The overall mean for all methods used is 67,01 % for 204 tests (see general summary table at the beginning of the report).

- Please note a lower mean CEN (K) for the and a upper mean X-ray fluorescence analysis for the European laboratories when compared with the other populations, (66,78 % and 67,15 % compared to 66,89 % and 66,95 % for the pilots European laboratories and 66,98 % and 66,92 % for the cement laboratories outside Europe).





MgO - By population Group & Method

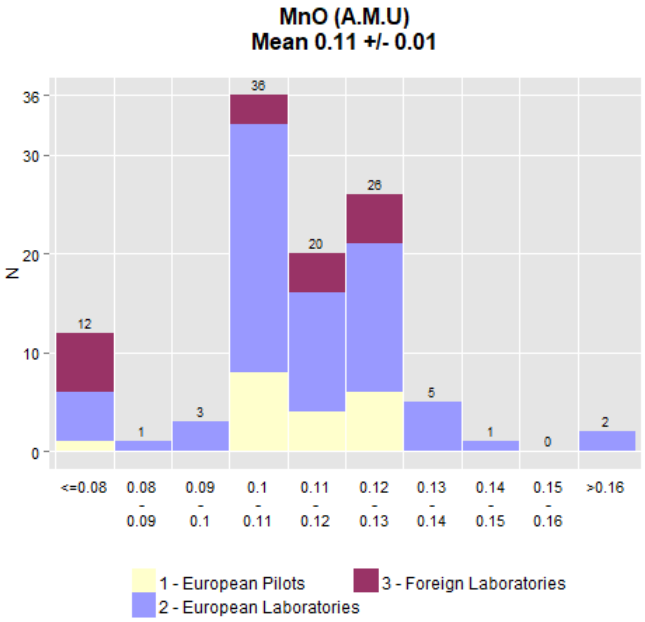
Population	Method	Number of Results	$\bar{x}$	Ɛ	S_R	CV (%)	Lm95%	LM95%
1 – European pilots	A.M.U	27	**0.74**	0.01	0.04	4.7	**0.67**	**0.81**
2 – European laboratories	A.M.U	140	**0.76**	0.01	0.07	9.8	**0.61**	**0.91**
3 – Foreign laboratories	A.M.U	37	**0.76**	0.02	0.05	6.1	**0.66**	**0.85**

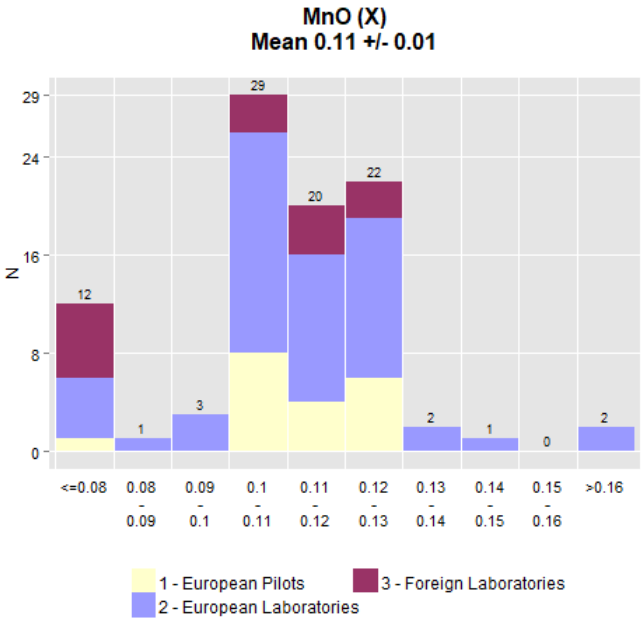
Population	Method	Number of Results	$\bar{x}$	Ɛ	S_R	CV (%)	Lm95%	LM95%
1 - European pilots	K	4	**0.76**	0.07	0.05	6.2	**0.61**	**0.90**
1 - European pilots	X	23	**0.74**	0.01	0.03	4.5	**0.67**	**0.81**
2 - European laboratories	K	32	**0.79**	0.04	0.11	13.8	**0.57**	**1.01**
2 - European laboratories	M	10	**0.77**	0.04	0.05	7.0	**0.65**	**0.89**
2 - European laboratories	X	94	**0.75**	0.01	0.06	7.9	**0.63**	**0.87**
3- Foreign laboratories	X	29	**0.76**	0.02	0.04	5.9	**0.66**	**0.85**
3- Foreign laboratories	M	4	**0.73**	0.11	0.07	9.3	**0.51**	**0.95**

MgO - Eliminated Outliers
Confidence Level = 2%

N°Lab	Population	Method	Value
13	1 - European pilots	K	**0.89**
117	2 - European laboratories	K	**0.43**
128	2 - European laboratories	X	**0.11**
130	2 - European laboratories	K	**1.09**
137	2 - European laboratories	X	**1.52**
138	2 - European laboratories	K	**1.12**
200	3- Foreign laboratories	N	**1.58**
201	3- Foreign laboratories	K	**1.08**
201	3- Foreign laboratories	X	**1.12**

- The general mean is 0,76 %. Values lie between 0,63 % and 0,89 % (A.M.U). (see general summary table at the beginning of the report).
- The results of the mean obtained are very satisfactory whatever the method or the populations.





MnO - By population Group & Method

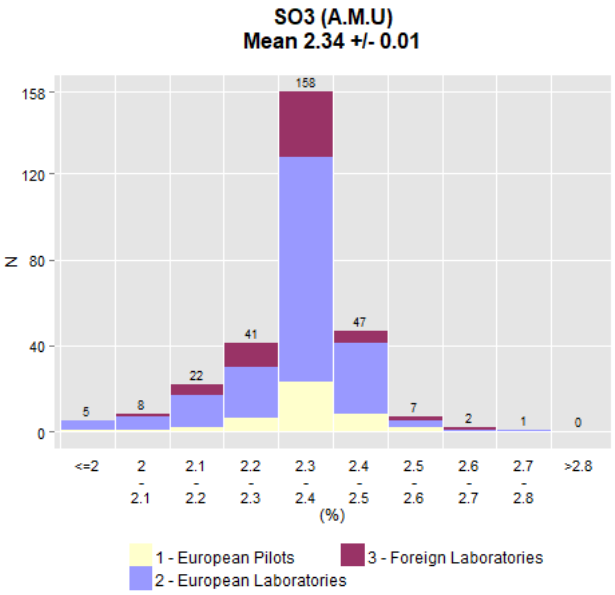
Population	Method	Number of Results	$\bar{x}$	Ɛ	S_R	CV (%)	Lm95%	LM95%
1 – European pilots	A.M.U	18	**0.12**	0.00	0.01	7.3	**0.10**	**0.14**
2 – European laboratories	A.M.U	66	**0.11**	0.01	0.02	22.1	**0.06**	**0.16**
3 – Foreign laboratories	A.M.U	18	**0.10**	0.02	0.04	43.2	**0.01**	**0.18**

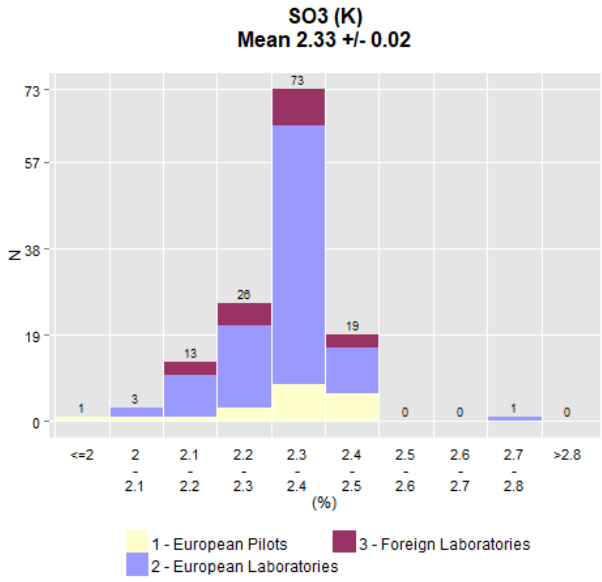
Population	Method	Number of Results	$\bar{x}$	Ɛ	S_R	CV (%)	Lm95%	LM95%
1 - European pilots	X	18	**0.12**	0.00	0.01	7.3	**0.10**	**0.14**
2 - European laboratories	N	12	**0.12**	0.01	0.01	11.4	**0.09**	**0.15**
2 - European laboratories	X	54	**0.11**	0.01	0.03	23.8	**0.06**	**0.16**
3- Foreign laboratories	N	2	**0.13**	0.00	0.00	0.0	**0.13**	**0.13**
3- Foreign laboratories	X	16	**0.09**	0.02	0.04	45.8	**0.00**	**0.18**

MnO - Eliminated Outliers
Confidence Level = 2%

N°Lab	Population	Method	Value
14	1 - European pilots	X	**0.06**
155	2 - European laboratories	X	**0.74**
155	2 - European laboratories	X	**0.74**

- The general mean is 0,11 % (see general summary table at the beginning of the report).
- The results of the mean obtained are very satisfactory whatever the method or the populations. High coefficients of variation which can be explained by low values on mean.





SO_3 - By population Group & Method

Population	Method	Number of Results	$\bar{x}$	Ɛ	S_R	CV (%)	Lm95%	LM95%
1 – European pilots	A.M.U	42	**2.35**	0.03	0.09	4.0	**2.16**	**2.54**
2 – European laboratories	A.M.U	181	**2.35**	0.01	0.09	3.9	**2.17**	**2.52**
3 – Foreign laboratories	A.M.U	53	**2.33**	0.02	0.08	3.5	**2.16**	**2.49**

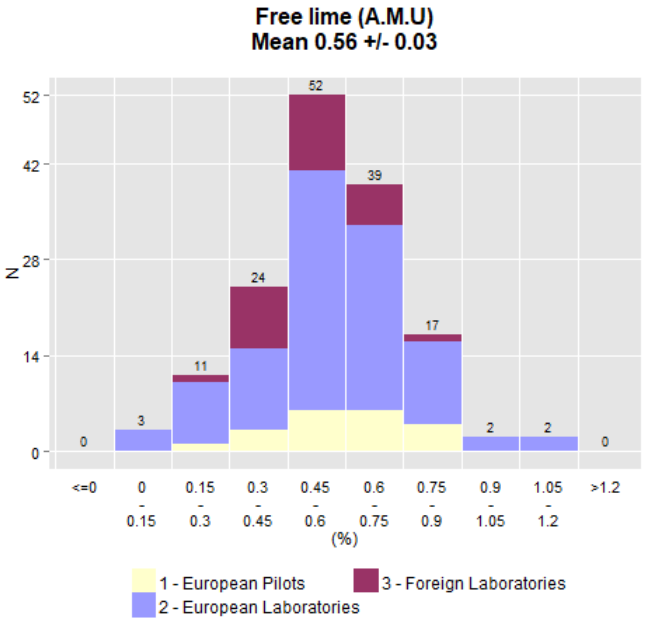
Population	Method	Number of Results	$\bar{x}$	Ɛ	S_R	CV (%)	Lm95%	LM95%
1 - European pilots	X	20	**2.36**	0.04	0.09	3.7	**2.17**	**2.54**
1 - European pilots	K	19	**2.33**	0.05	0.11	4.5	**2.11**	**2.55**
2 - European laboratories	K	94	**2.33**	0.02	0.08	3.6	**2.16**	**2.49**
2 - European laboratories	N	19	**2.43**	0.03	0.05	2.2	**2.32**	**2.54**
2 - European laboratories	X	68	**2.35**	0.02	0.10	4.1	**2.16**	**2.54**
3- Foreign laboratories	K	19	**2.32**	0.05	0.09	4.1	**2.12**	**2.51**
3- Foreign laboratories	N	7	**2.36**	0.05	0.05	2.1	**2.24**	**2.48**
3- Foreign laboratories	X	27	**2.33**	0.03	0.08	3.5	**2.16**	**2.50**

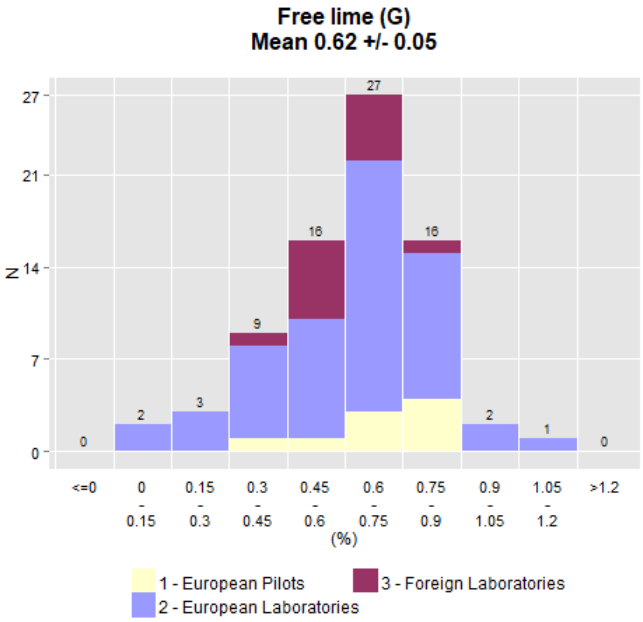
SO_3 - Eliminated Outliers
Confidence Level = 2%

N°Lab	Population	Method	Value
8	1 - European pilots	K	**1.93**
28	2 - European laboratories	X	**1.89**
28	2 - European laboratories	X	**1.80**
47	2 - European laboratories	K	**2.02**
47	2 - European laboratories	X	**1.92**
65	2 - European laboratories	X	**2.01**
77	2 - European laboratories	K	**2.73**
124	2 - European laboratories	X	**2.70**
137	2 - European laboratories	X	**1.91**
138	2 - European laboratories	K	**2.04**
144	2 - European laboratories	X	**2.01**
144	2 - European laboratories	N	**2.19**
201	3- Foreign laboratories	X	**2.58**
223	3- Foreign laboratories	X	**2.63**
231	3- Foreign laboratories	X	**2.09**

- Overall results show excellent mean values for the all methods used.

- The overall mean for all methods used is 2,34 % for 276 tests. (see general summary table at the beginning of the report).





Free lime - By population Group & Method

Population	Method	Number of Results	$\bar{x}$	Ɛ	S_R	CV (%)	Lm95%	LM95%
1 – European pilots	A.M.U	20	**0.60**	0.08	0.17	28.9	**0.24**	**0.96**
2 – European laboratories	A.M.U	96	**0.56**	0.04	0.17	30.8	**0.22**	**0.91**
3 – Foreign laboratories	A.M.U	28	**0.52**	0.05	0.14	26.5	**0.24**	**0.80**

Population	Method	Number of Results	$\bar{x}$	Ɛ	S_R	CV (%)	Lm95%	LM95%
1 - European pilots	C	7	**0.53**	0.12	0.13	24.4	**0.21**	**0.85**
1 - European pilots	G	9	**0.69**	0.13	0.17	25.1	**0.29**	**1.08**
2 - European laboratories	C	29	**0.54**	0.03	0.08	14.3	**0.38**	**0.70**
2 - European laboratories	G	51	**0.62**	0.05	0.19	30.3	**0.24**	**1.00**
2 - European laboratories	N	13	**0.41**	0.10	0.17	41.3	**0.04**	**0.78**
3- Foreign laboratories	B	7	**0.38**	0.07	0.07	19.3	**0.20**	**0.56**
3- Foreign laboratories	C	5	**0.52**	0.17	0.13	25.9	**0.14**	**0.89**
3- Foreign laboratories	G	13	**0.61**	0.07	0.11	18.4	**0.36**	**0.85**

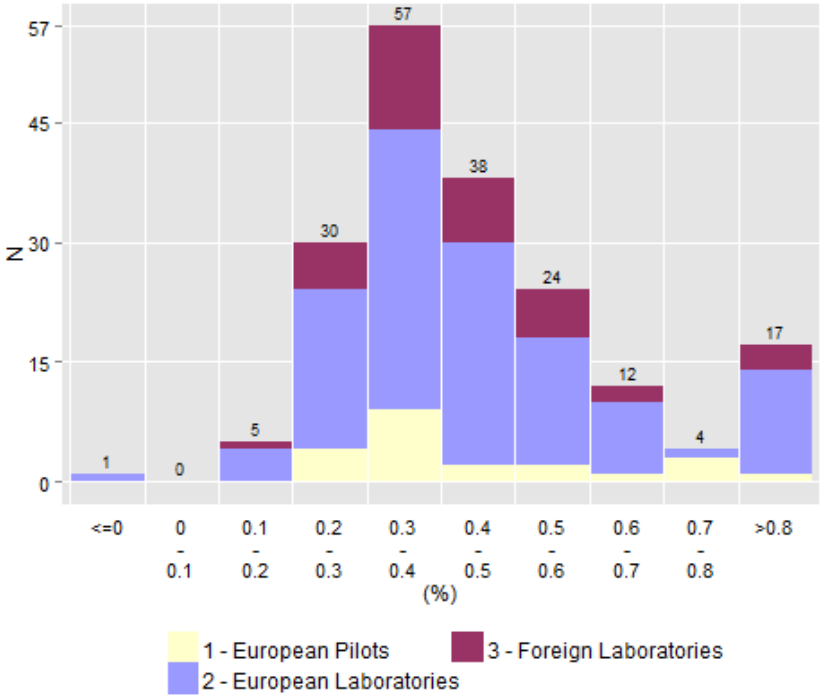
Free lime - Eliminated Outliers
Confidence Level = 2%

N°Lab	Population	Method	Value
47	2 - European laboratories	N	**1.14**
63	2 - European laboratories	C	**0.88**
65	2 - European laboratories	G	**0.06**
77	2 - European laboratories	G	**1.13**
108	2 - European laboratories	G	**0.11**
108	2 - European laboratories	C	**0.12**

- As always, the results present high coefficients of variation but the means are satisfactory. However, please note a upper mean for the acidimetry glycol method (G) (0,69%, 0,62% and 0,61%) than other determinations such as the glycol complexometry (C) method (0,53 %, 0,54% and 0,52%) and the alcohol glycerin method (B) (0,38%). However, for each of these methods, the homogeneity of the means is good.

- Though none of these methods are standardized, the overall mean value for all methods is 0,56 %.

Insoluble residue (A.M.U)
Mean 0.44 +/- 0.03



Insoluble - By population Group & Method

Population	Method	Number of Results	$\bar{x}$	Ɛ	S_R	CV (%)	Lm95%	LM95%
1 – European pilots	A.M.U	22	**0.46**	0.09	0.21	45.0	**0.03**	**0.89**
2 – European laboratories	A.M.U	120	**0.44**	0.03	0.19	43.0	**0.07**	**0.81**
3 – Foreign laboratories	A.M.U	37	**0.43**	0.06	0.19	44.9	**0.04**	**0.83**

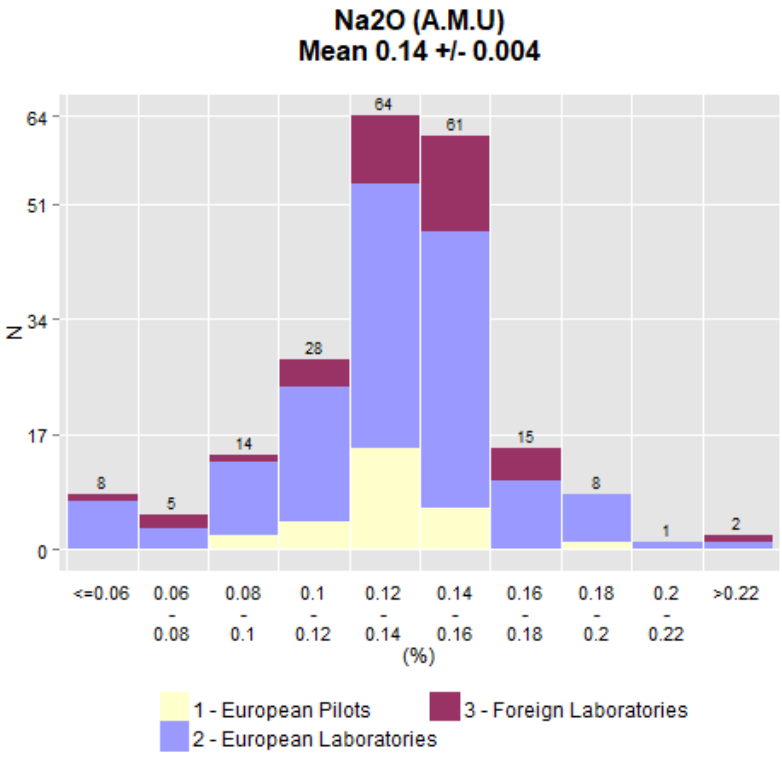
Population	Method	Number of Results	$\bar{x}$	Ɛ	S_R	CV (%)	Lm95%	LM95%
1 – European pilots	K	22	**0.46**	0.09	0.21	45.0	**0.03**	**0.89**
2 – European laboratories	K	117	**0.44**	0.03	0.19	42.9	**0.07**	**0.82**
3 – Foreign laboratories	K	29	**0.44**	0.08	0.21	48.6	**0.00**	**0.88**
3 – Foreign laboratories	N	8	**0.41**	0.09	0.10	25.5	**0.16**	**0.66**

Insoluble - Eliminated Outliers
Confidence Level = 2%

N°Lab	Population	Method	Value
59	2 – European laboratories	K	**2.20**
59	2 – European laboratories	K	**2.35**
79	2 – European laboratories	K	**1.59**
143	2 – European laboratories	K	**1.47**
151	2 – European laboratories	K	**1.51**
151	2 – European laboratories	K	**1.92**
157	2 – European laboratories	K	**1.75**
213	3 – Foreign laboratories	K	**1.36**
215	3 – Foreign laboratories	K	**2.25**

- As always, the results present high coefficients of variation but the means are satisfactory.

- The overall mean for all methods used is 0,44 % for 179 tests with 94% of the tests carried out according to the gravimetric method (see the general summary table at the beginning of the report).



Na_2O - By population Group & Method

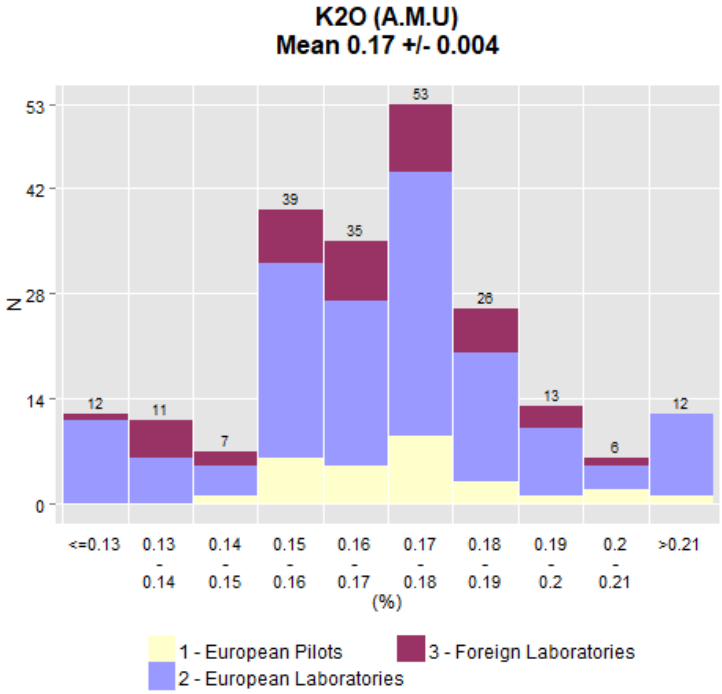
Population	Method	Number of Results	$\bar{x}$	Ɛ	S_R	CV (%)	Lm95%	LM95%
1 – European pilots	A.M.U	27	**0.13**	0.01	0.02	11.5	**0.10**	**0.16**
2 – European laboratories	A.M.U	133	**0.14**	0.00	0.03	20.3	**0.08**	**0.20**
3 – Foreign laboratories	A.M.U	36	**0.14**	0.01	0.03	19.3	**0.09**	**0.20**

Population	Method	Number of Results	$\bar{x}$	Ɛ	S_R	CV (%)	Lm95%	LM95%
1 – European pilots	X	20	**0.13**	0.01	0.02	11.7	**0.10**	**0.16**
1 – European pilots	K	6	**0.14**	0.02	0.01	10.6	**0.10**	**0.18**
2 – European laboratories	X	83	**0.14**	0.01	0.03	18.1	**0.09**	**0.19**
2 – European laboratories	K	30	**0.13**	0.01	0.04	26.7	**0.06**	**0.20**
2 – European laboratories	M	10	**0.15**	0.01	0.02	12.0	**0.11**	**0.19**
3 – Foreign laboratories	X	28	**0.14**	0.01	0.03	20.4	**0.08**	**0.20**

Na_2O - Eliminated Outliers
Confidence Level = 2%

Labo	Groupe de Labo	Méthode	Valeur
13	1 – European pilots	X	**0.19**
33	2 – European laboratories	X	**0.03**
42	2 – European laboratories	X	**0.05**
82	2 – European laboratories	K	**0.00**
120	2 – European laboratories	X	**0.28**
130	2 – European laboratories	X	**0.05**
138	2 – European laboratories	A	**0.01**
221	3 – Foreign laboratories	K	**0.03**
223	3 – Foreign laboratories	X	**0.30**

- Homogeneous mean for most methods used: flame photometry and X-ray fluorescence.
  The general mean for Na_2O is 0,14 %.



K_2O - By population Group & Method

Population	Method	Number of Results	$\bar{x}$	ε	S_R	CV (%)	Lm95%	LM95%
1 – European pilots	A.M.U	27	**0.18**	0.01	0.01	8.3	**0.15**	**0.21**
2 – European laboratories	A.M.U	140	**0.18**	0.01	0.03	17.3	**0.12**	**0.24**
3 – Foreign laboratories	A.M.U	41	**0.17**	0.01	0.02	10.7	**0.13**	**0.21**

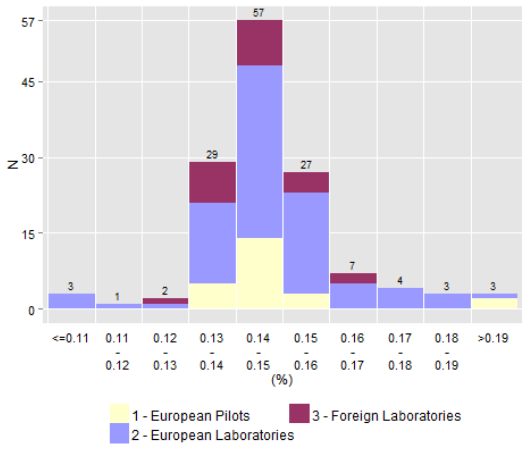
Population	Method	Number of Results	$\bar{x}$	ε	S_R	CV (%)	Lm95%	LM95%
1 – European pilots	X	21	**0.18**	0.01	0.01	8.5	**0.14**	**0.21**
1 – European pilots	K	5	**0.17**	0.01	0.01	6.6	**0.14**	**0.21**
2 – European laboratories	X	98	**0.17**	0.00	0.02	12.5	**0.13**	**0.21**
2 – European laboratories	K	20	**0.18**	0.01	0.03	16.9	**0.11**	**0.24**
2 – European laboratories	M	10	**0.19**	0.03	0.05	24.9	**0.08**	**0.30**
2 – European laboratories	A	9	**0.20**	0.05	0.06	29.5	**0.07**	**0.34**
3 – Foreign laboratories	X	31	**0.17**	0.01	0.02	11.9	**0.13**	**0.21**

K_2O - Eliminated Outliers
Confidence Level = 2%

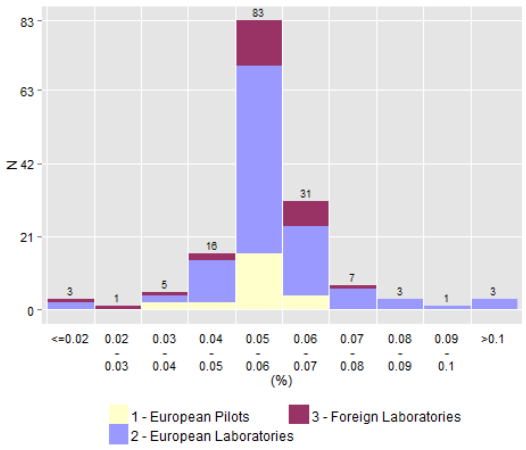
Lab	Population	Method	Value
13	1 – European pilots	X	**0.22**
27	2 – European laboratories	X	**0.07**
82	2 – European laboratories	K	**1.63**
83	2 – European laboratories	X	**0.01**
144	2 – European laboratories	X	**0.25**
212	3 – Foreign laboratories	X	**0.12**

- Homogeneous mean for most methods used: flame photometry and X-ray fluorescence.
  The general mean for K_2O is 0,17 %.

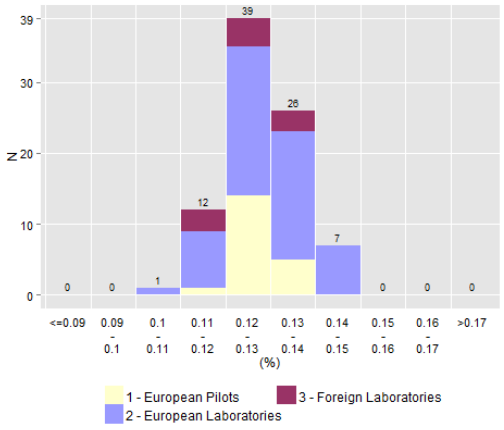
TiO2 (A.M.U)
Mean 0.15 +/- 0.003



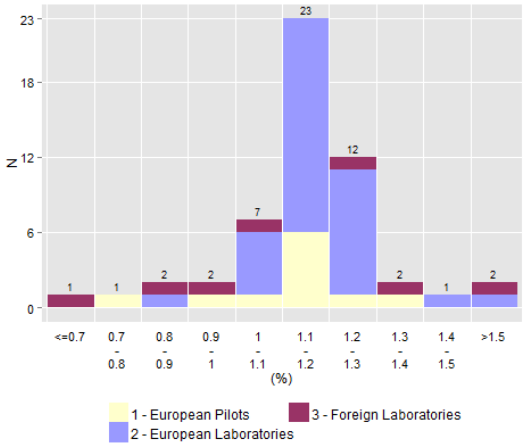
P2O5 (A.M.U)
Mean 0.06 +/- 0.002



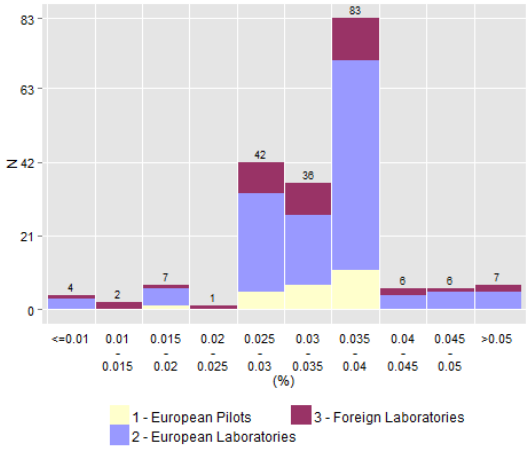
SrO (A.M.U)
Mean 0.13 +/- 0.002



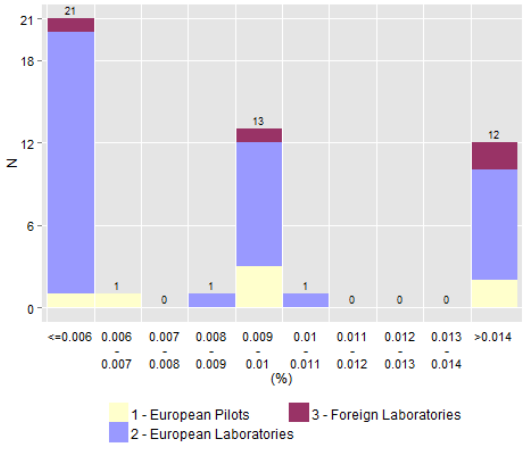
CO2 (A.M.U)
Mean 1.15 +/- 0.04



Chloride (A.M.U)
Mean 0.04 +/- 0.001



S-- (A.M.U)
Mean 0.01 +/- 0.003



TiO_2 - By population Group & Method

Population	Method	Number of Results	$\bar{x}$	Ɛ	S_R	CV (%)	Lm95%	LM95%
1 – European pilots	A.M.U	22	**0.15**	0.00	0.01	4.2	**0.14**	**0.16**
2 – European laboratories	A.M.U	85	**0.15**	0.00	0.01	8.9	**0.13**	**0.18**
3 – Foreign laboratories	A.M.U	24	**0.15**	0.00	0.01	6.8	**0.13**	**0.17**

TiO_2 - Eliminated Outliers
Confidence Level = 2%

N° Lab	Population	Method	Value
2	1 – European pilots	X	**0.25**
2a	1 – European pilots	X	**0.25**
51	2 – European laboratories	X	**0.10**
118	2 – European laboratories	X	**0.26**

P_2O_5 - By population Group & Method

Population	Method	Number of Results	$\bar{x}$	Ɛ	S_R	CV (%)	Lm95%	LM95%
1 – European pilots	A.M.U	22	**0.06**	0.00	0.00	7.7	**0.05**	**0.07**
2 – European laboratories	A.M.U	100	**0.06**	0.00	0.01	18.6	**0.04**	**0.08**
3 – Foreign laboratories	A.M.U	25	**0.06**	0.00	0.01	16.9	**0.04**	**0.08**

P_2O_5 - Eliminated Outliers
Confidence Level = 2%

N° Lab	Population	Method	Value
3	1 - European pilots	X	**0.04**
28	2 - European laboratories	X	**0.19**
37	2 - European laboratories	X	**0.13**
215	3 – Foreign laboratories	X	**0.02**

SrO - By population Group & Method

Population	Method	Number of Results	$\bar{x}$	Ɛ	S_R	CV (%)	Lm95%	LM95%
1 – European pilots	A.M.U	20	**0.13**	0.00	0.00	3.5	**0.12**	**0.14**
2 – European laboratories	A.M.U	54	**0.13**	0.00	0.01	6.4	**0.12**	**0.15**
3 – Foreign laboratories	A.M.U	10	**0.13**	0.01	0.01	5.8	**0.11**	**0.15**

SrO - Eliminated Outliers
Confidence Level = 2%

N° Lab	Population	Method	Value
143	2 - European laboratories	X	**0.11**

CO_2 - By population Group & Method

Population	Method	Number of Results	$\bar{x}$	Ɛ	S_R	CV (%)	Lm95%	LM95%
1 – European pilots	A.M.U	11	**1.11**	0.12	0.17	15.6	**0.72**	**1.49**
2 – European laboratories	A.M.U	33	**1.18**	0.03	0.08	6.7	**1.01**	**1.34**
3 – Foreign laboratories	A.M.U	5	**1.08**	0.24	0.19	17.6	**0.55**	**1.61**

CO_2 - Eliminated Outliers
Confidence Level = 2%

N° Lab	Population	Method	Value
20	2 - European laboratories	N	**0.81**
144	2 - European laboratories	N	**1.53**
203	3 – Foreign laboratories	N	**0.38**
218	3 – Foreign laboratories	N	**1.81**

Chlorure - By population Group & Method

Population	Method	Number of Results	$\bar{x}$	Ɛ	S_R	CV (%)	Lm95%	LM95%
1 – European pilots	A.M.U	23	**0.04**	0.00	0.00	11.3	**0.03**	**0.04**
2 – European laboratories	A.M.U	125	**0.04**	0.00	0.01	19.1	**0.02**	**0.05**
3 – Foreign laboratories	A.M.U	37	**0.03**	0.00	0.01	22.0	**0.02**	**0.05**

Chlorure - Eliminated Outliers
Confidence Level = 2%

N° Lab	Population	Method	Value
13	1 - European pilots	X	**0.02**
27	2 - European laboratories	P	**0.06**
50	2 - European laboratories	X	**0.00**
79	2 - European laboratories	M	**3.67**
85	2 - European laboratories	P	**0.00**
138	2 - European laboratories	K	**0.33**
220	3- Foreign laboratories	P	**0.06**
221	3- Foreign laboratories	P	**0.06**
226	3- Foreign laboratories	K	**0.01**

S^{--} - By population Group & Method

Population	Method	Number of Results	$\bar{x}$	Ɛ	S_R	CV (%)	Lm95%	LM95%
1 – European pilots	A.M.U	7	**0.01**	0.01	0.01	64.4	**-0.01**	**0.03**
2 – European laboratories	A.M.U	36	**0.01**	0.00	0.01	116.5	**-0.01**	**0.02**
3 – Foreign laboratories	A.M.U	4	**0.01**	0.01	0.01	72.1	**-0.02**	**0.04**

S^{--} - Eliminated Outliers
Confidence Level = 2%

Lab	Population	Method	Value
24	2 - European laboratories	N	**0.48**
32	2 - European laboratories	N	**0.04**

Cr^{6+} - By population Group & Method

Population	Method	Number of Results	$\bar{x}$	Ɛ	S_R	CV (%)	Lm95%	LM95%
1 – European pilots	A.M.U	12	**0.000137**	0.000018	0.000028	20.1	**0.000076**	**0.000198**
2 – European laboratories	A.M.U	77	**0.000154**	0.000028	0.000125	81.0	**-0.00009**	**0.000402**
3 – Foreign laboratories	A.M.U	11	**0.000140**	0.000016	0.000024	16.8	**0.000088**	**0.000193**

Cr^{6+} - Eliminated Outliers
Confidence Level = 2%

N° Lab	Population	Method	Value
57	2 - European laboratories	N	**0.000018**
133	2 - European laboratories	K	**0.000000**
159	2 - European laboratories	N	**0.010000**

5. Remarks on the Chemical Analysis

- This year's cement was a **CEM I 52,5 N.**

- Mean results for the three groups are very satisfactory. We note homogeneous results for the major elements, whatever the method used or the group.

- Considering the whole of the proportioning and determinations liable to be done using X-ray fluorescence spectrometry, we note that **72 %** of the tests were indeed done using this method, which is slight increase with last year's results. Variations in the free lime contents are mainly due to a lack of standard operating procedure.

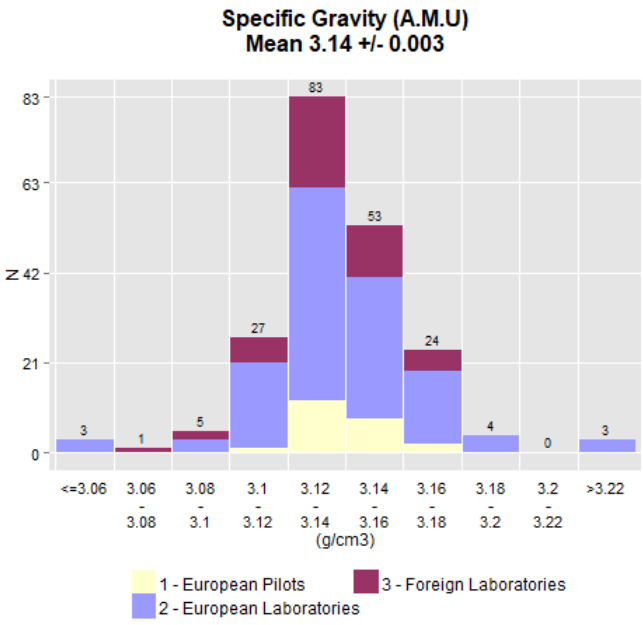
- Low contents tests usually display high coefficients of variation showing an important dispersion. This is the case in particular of the chromium VI content. This is due to the fact that the content values are close to the detection limits and the values are small in relation to the precision of the method.

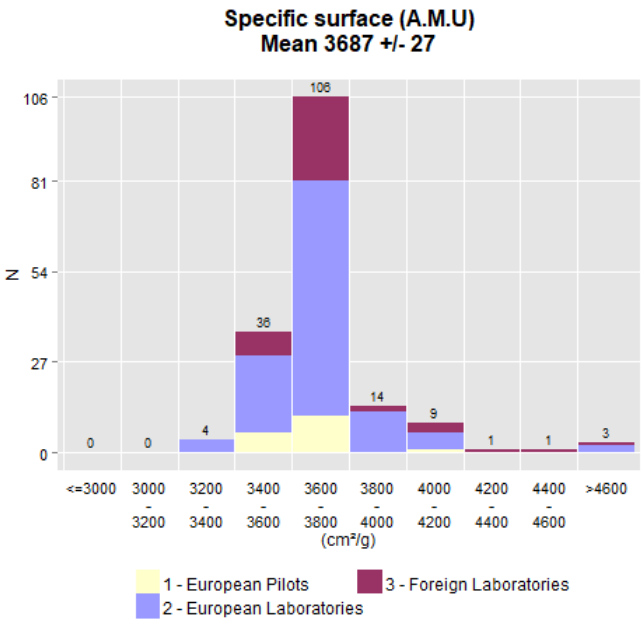
We can also report:

- A noticeable deviation of the mean values for CaO determination by AMU and X-ray fluorescence analysis for European laboratories compared to the other two groups (**66,78 %** and **67,15 %** compared to **66,89 %** and **66,95 %** for European pilot laboratories and **66,98 %** and **66,92 %** for laboratories outside Europe).

- Please note a upper mean for the acidimetry glycol method (G) (**0,69%**, **0,62%** and **0,61%**) than other determinations such as the glycol complexometry (C) method (**0,53 %**, **0,54%** and **0,52%**) and the alcohol glycerin method (B) (**0,38%**).

6. Physical measurement and Physical tests





Specific gravity – By population Group & Method

Population	Method	Number of Results	$\bar{x}$	Ɛ	S_R	CV (%)	Lm95%	LM95%
1 – European pilots	A.M.U	23	**3.15**	0.01	0.02	0.5	**3.11**	**3.18**
2 – European laboratories	A.M.U	127	**3.14**	0.00	0.02	0.7	**3.10**	**3.19**
3 – Foreign laboratories	A.M.U	46	**3.14**	0.01	0.02	0.6	**3.10**	**3.18**

Specific gravity - Eliminated Outliers
Confidence Level = 2%

N° Lab	Population	Method	Value
33	2 - European laboratories	V	3.02
79	2 - European laboratories	V	3.26
79	2 - European laboratories	V	3.25
83	2 - European laboratories	A	3.06
137	2 - European laboratories	V	3.03
148	2 - European laboratories	V	3.24
218	3 – Foreign laboratories	V	3.08

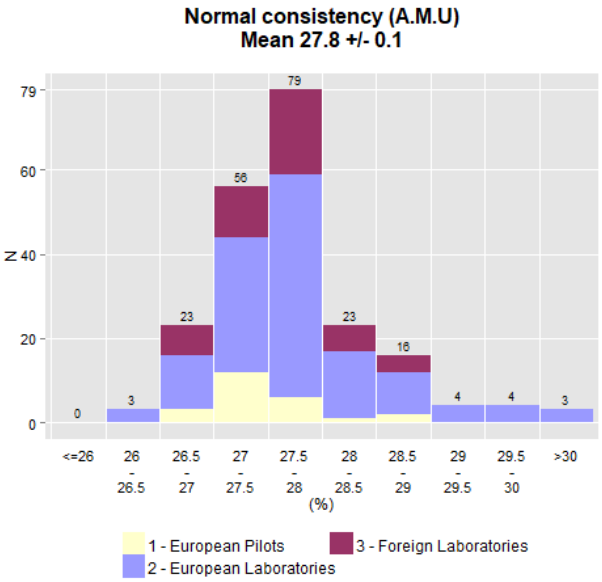
Corrected surface - By population Group & Method

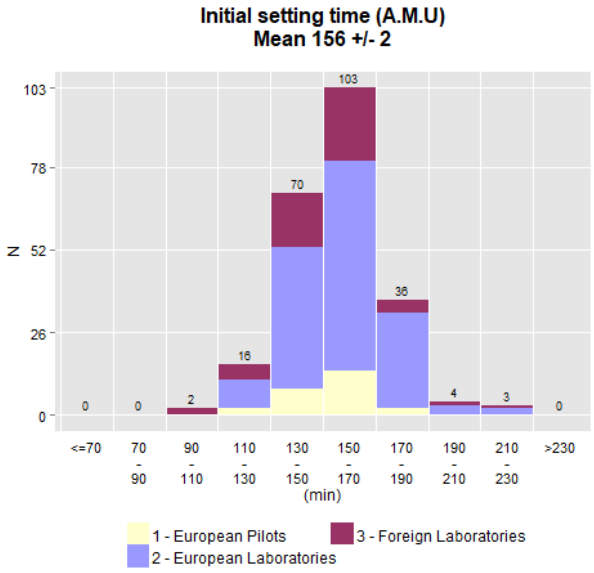
Population	Method	Number of Results	$\bar{x}$	Ɛ	S_R	CV (%)	Lm95%	LM95%
1 – European pilots	A.M.U	17	**3647**	32	63	1.7	**3514**	**3781**
2 – European laboratories	A.M.U	108	**3685**	26	137	3.7	**3413**	**3956**
3 – Foreign laboratories	A.M.U	36	**3700**	53	157	4.2	**3382**	**4019**

Corrected surface - Eliminated Outliers
Confidence Level = 2%

N° Lab	Population	Method	Value
13	1 - European pilots	G	4065
73	2 - European laboratories	G	4844
157	2 - European laboratories	A	5000
201	3- Foreign laboratories	N	5213
218	3- Foreign laboratories	G	4286
220	3- Foreign laboratories	N	4582

- The results obtained for these two tests are homogeneous for all populations.
- There is no standard for determining the specific gravity. Specific surface area determination is described in European standard NF EN 196-6.
- Errors in determining density affect specific surface area measurement, both in the porosity of the powder layer, and in the computation of the results. To amend this, we have corrected specific surface values with the difference between the density determined by the laboratory and the computed mean value, so that specific surfaces given here are corrected specific surfaces.





Normal consistency - By population Group

Population	Method	Number of Results	$\bar{x}$	Ɛ	S_R	CV (%)	Lm95%	LM95%
1 – European pilots	A.M.U	24	**27.6**	0.2	0.5	1.9	**26.5**	**28.7**
2 – European laboratories	A.M.U	130	**27.8**	0.1	0.6	2.2	**26.6**	**29.0**
3 – Foreign laboratories	A.M.U	49	**27.7**	0.2	0.5	1.9	**26.7**	**28.8**

Normal consistency - Eliminated Outliers
Confidence Level = 2%

N° Lab	Population	Method	Value
48	2 - European laboratories		29.7
48	2 - European laboratories		29.6
54	2 - European laboratories		31.0
78	2 - European laboratories		30.8
83	2 - European laboratories		30.0
120	2 - European laboratories		26.1
158	2 - European laboratories		29.6

Initial setting time
By population Group & Method

Population	Method	Number of Results	$\bar{x}$	Ɛ	S_R	CV (%)	Lm95%	LM95%
1 – European pilots	A.M.U	25	**155**	5	12	7.5	**131**	**179**
2 – European laboratories	A.M.U	152	**157**	3	16	10.5	**125**	**190**
3 – Foreign laboratories	A.M.U	49	**152**	5	16	10.8	**119**	**185**

Population	Method	Number of Results	$\bar{x}$	Ɛ	S_R	CV (%)	Lm95%	LM95%
1 - European pilots	A	22	**154**	5	12	7.9	**129**	**180**
2 - European laboratories	A	115	**157**	3	16	10.2	**125**	**189**
2 - European laboratories	M	37	**159**	6	18	11.2	**123**	**195**
3- Foreign laboratories	A	23	**159**	5	11	6.8	**137**	**182**
3- Foreign laboratories	M	26	**145**	7	18	12.2	**109**	**181**

Initial setting time - Eliminated Outliers
Confidence Level = 2%

N° Lab	Population	Method	Value
10	1 - European pilots	A	115
75	2 - European laboratories	A	230
83	2 - European laboratories	M	215
88	2 - European laboratories	A	200
202	3- Foreign laboratories	M	225
228	3- Foreign laboratories	A	193
236	3- Foreign laboratories	M	105
237	3- Foreign laboratories	M	109

- The results obtained for these two tests are homogeneous for all populations.

- The normal consistency and initial setting time are described in European standard NF EN 196-3 (2017)

Soundness - By population Group

Population	Method	Number of Results	$\bar{x}$	Ɛ	S_R	CV (%)	Lm95%	LM95%
1 – European pilots		20	**0.43**	0.23	0.48	114.0	**-0.59**	**1.44**
2 – European laboratories		113	**0.51**	0.08	0.44	85.3	**-0.36**	**1.38**
3 – Foreign laboratories		39	**0.58**	0.13	0.41	70.7	**-0.25**	**1.42**

Soundness - Eliminated Outliers
Confidence Level = 2%

N° Lab	Population	Method	Value
2a	1 - European pilots		2.00
12	1 - European pilots		2.00
27	2 - European laboratories		2.00
44	2 - European laboratories		2.00
53	2 - European laboratories		2.00

- 178 determinations have been done. The standard is NF EN 196-3. The mean AMU is **0,52 mm ± 0,44** a low value, due to the low content in free lime.

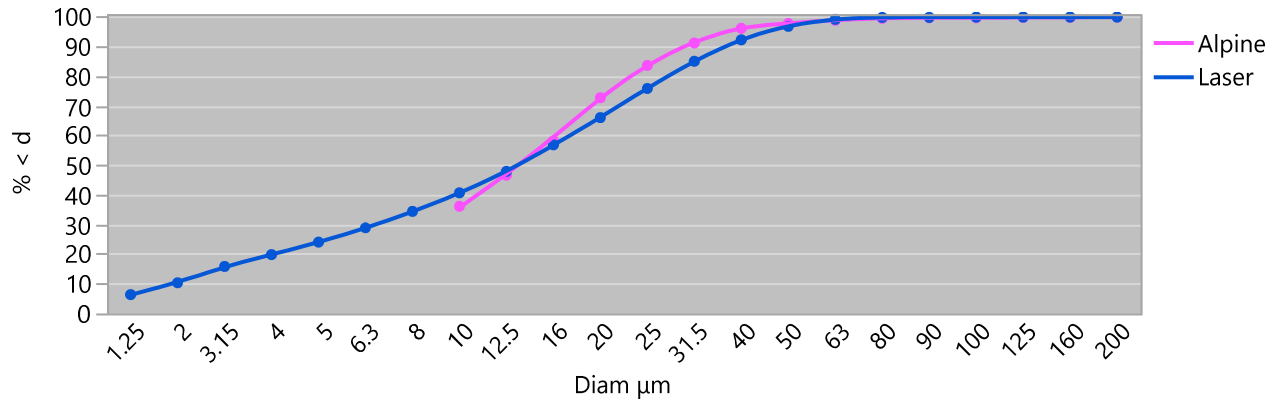
Workability - By population Group

Population	Method	Number of Results	$\bar{x}$	Ɛ	S_R	CV (%)	Lm95%	LM95%
2 - European laboratories		5	**3.7**	0.6	0.5	12.6	**2.4**	**5.0**

Fluidity - By population Group

Population	Method	Number of Results	$\bar{x}$	Ɛ	S_R	CV (%)	Lm95%	LM95%
2 - European laboratories		1	**5.1**	-	-	-	-	-

7. Granulometry - Alpine / Laser



Granulometry all population and all methods used - By Alpine sieving and laser particle size

	Sieve																					
	1.25	2	3.15	4	5	6.3	8	10	12.5	16	20	25	31.5	40	50	63	80	90	100	125	160	200
	Mean x̄																					
Alpine	-	-	-	-	-	-	-	36.1	46.6	58.2	72.7	83.7	91.3	96.2	97.8	98.9	99.5	99.7	99.7	99.8	99.9	100
Laser	6.3	10.3	15.8	19.8	24.0	28.8	34.4	40.7	47.9	56.8	66.1	75.9	85.0	92.3	96.8	99.2	99.8	99.9	99.9	100	100	100

Granulometry – By population AMU

	Labo Group																	
	1 - European Pilots						2 - European Laboratories						3 - Foreign Laboratories					
	Mean	Ɛ (5%)	Repro Std	CV (%)	Lm95 %	LM95 %	Mean	Ɛ (5%)	Repro Std	CV (%)	Lm95 %	LM95 %	Mean	Ɛ (5%)	Repro Std	CV (%)	Lm95 %	LM95 %
Dimension	A.M.U						A.M.U						A.M.U					
1.25	6.7	1.9	2.6	38.6	0.9	12.6	6.3	0.7	2.2	34.5	1.9	10.7	5.5	1.5	2.0	35.8	1.0	10.1
2	10.8	2.0	3.0	27.3	4.2	17.4	10.3	0.8	2.8	26.7	4.8	15.8	9.8	1.6	2.4	24.7	4.4	15.1
3.15	16.7	2.2	3.3	20.0	9.3	24.1	15.7	0.8	2.7	17.1	10.3	21.1	15.5	1.9	2.8	18.2	9.2	21.9
4	20.6	2.3	3.4	16.6	12.9	28.2	19.7	0.9	3.2	16.1	13.4	26.1	19.4	2.0	2.9	15.1	12.9	26.0
5	25.0	2.4	3.6	14.4	16.9	33.0	23.9	0.9	3.3	13.7	17.3	30.4	23.6	2.0	2.9	12.4	17.1	30.2
6.3	30.1	2.6	3.8	12.6	21.6	38.6	28.6	0.9	3.3	11.6	21.9	35.3	28.8	2.1	2.9	10.3	22.1	35.4
8	35.8	2.8	4.2	11.7	26.5	45.1	34.0	0.9	3.3	9.7	27.3	40.6	34.6	1.9	2.8	8.2	28.3	40.9
10	42.3	3.0	4.5	10.6	32.3	52.2	40.3	0.9	3.2	8.0	33.9	46.8	40.4	1.9	2.9	7.2	34.0	46.9
12.5	49.5	3.1	4.7	9.5	39.1	59.9	47.4	0.9	3.2	6.8	41.0	53.8	48.2	2.1	3.3	6.9	40.9	55.5
16	57.5	2.9	4.1	7.0	48.4	66.7	56.6	1.0	3.5	6.2	49.5	63.6	57.5	2.2	3.4	6.0	49.9	65.1
20	67.7	3.4	5.1	7.6	56.3	79.1	65.9	1.1	3.9	5.9	58.2	73.7	66.8	2.1	3.3	4.9	59.6	74.0
25	78.6	3.5	5.9	7.5	65.8	91.4	75.9	1.2	4.4	5.8	67.1	84.7	76.7	2.5	4.0	5.2	67.9	85.4
31.5	87.1	2.7	4.5	5.1	77.3	96.8	85.1	1.0	3.6	4.2	78.0	92.3	85.4	2.1	3.3	3.8	78.2	92.6
40	94.3	1.5	3.1	3.3	87.8	100.8	93.3	0.6	2.7	2.9	87.9	98.7	94.8	1.2	2.7	2.9	89.1	100.4
50	97.4	0.9	1.8	1.9	93.6	101.2	97.1	0.3	1.3	1.3	94.5	99.6	97.6	0.5	1.2	1.2	95.1	100.2
63	99.3	0.3	0.6	0.6	98.0	100.6	99.0	0.1	0.6	0.7	97.7	100.3	99.0	0.3	0.6	0.6	97.7	100.3
80	99.9	0.1	0.2	0.2	99.4	100.3	99.7	0.1	0.4	0.4	98.9	100.4	99.6	0.1	0.3	0.3	98.9	100.3
90	99.9	0.1	0.2	0.2	99.5	100.2	99.8	0.1	0.3	0.3	99.3	100.3	99.8	0.1	0.2	0.2	99.4	100.2
100	99.9	0.1	0.2	0.2	99.5	100.3	99.8	0.1	0.2	0.2	99.4	100.3	99.9	0.1	0.2	0.2	99.6	100.3
125	99.9	0.1	0.1	0.1	99.6	100.2	99.9	0.0	0.1	0.1	99.6	100.2	100.0	0.0	0.1	0.1	99.8	100.1
160	99.9	0.1	0.1	0.1	99.7	100.1	100.0	0.0	0.1	0.1	99.8	100.1	100.0	0.0	0.0	0.0	99.9	100.1
200	100.0	0.0	0.0	0.0	100.0	100.0	100.0	0.0	0.0	0.0	99.9	100.1	100.0	0.0	0.0	0.0	100.0	100.0

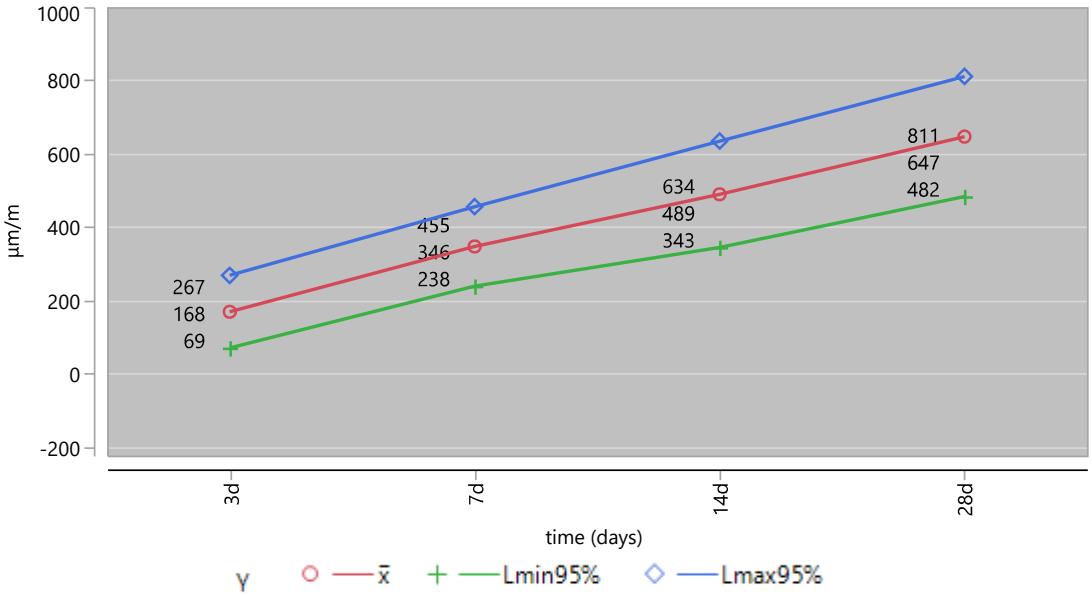
- Comparative curves for these two methods are presented here (for some 100 determinations per particle size bracket).The various dimensions defined by the participating laboratories were brought back to standard as per the R10 series by using a logarithmic interpolation. Results display a wider scattering between groups in the lower diameters. On the whole, tests results were satisfactory.
- The number of analyses carried out is summed up in tables at the end of the report.
- Alpine sieving is often used in the cement industry. Its main principle lies in separating particles by air depression through a sieve.
- For each particle size analysis method, the specific size criterion is related to the physical phenomenon involved. This criterion should be translated into an equivalent size, this particle size representing the same value of the specific size criterion than the particle being observed.

Granulometry - Eliminated Outliers
Confidence Level = 2%

Diam µm	Labo	Groupe de Labo	Méthode	Valeur
1.25	2	1 - Pilotes Européens	Laser	17.2
1.25	2a	1 - Pilotes Européens	Laser	17.4
2	2	1 - Pilotes Européens	Laser	21.2
2	2a	1 - Pilotes Européens	Laser	21.7
3.15	2	1 - Pilotes Européens	Laser	26.5
3.15	2a	1 - Pilotes Européens	Laser	27.1
4	2	1 - Pilotes Européens	Laser	30.5
4	2a	1 - Pilotes Européens	Laser	31.1
5	2	1 - Pilotes Européens	Laser	35.1
5	2a	1 - Pilotes Européens	Laser	35.7
6.3	2	1 - Pilotes Européens	Laser	41.1
6.3	2a	1 - Pilotes Européens	Laser	41.4
8	2	1 - Pilotes Européens	Laser	48.4
8	2a	1 - Pilotes Européens	Laser	48.5
10	2	1 - Pilotes Européens	Laser	55.9
10	2a	1 - Pilotes Européens	Laser	55.7
12.5	2	1 - Pilotes Européens	Laser	63.6
12.5	2a	1 - Pilotes Européens	Laser	63.3
16	2	1 - Pilotes Européens	Laser	72.5
16	2a	1 - Pilotes Européens	Laser	72.0
20	2	1 - Pilotes Européens	Laser	80.0
16	14	1 - Pilotes Européens	Laser	68.0
40	26	2 - Laboratoires Européens	Laser	85.3
50	26	2 - Laboratoires Européens	Laser	90.8
63	26	2 - Laboratoires Européens	Laser	94.6
90	26	2 - Laboratoires Européens	Laser	97.7
80	26	2 - Laboratoires Européens	Laser	96.9
100	26	2 - Laboratoires Européens	Laser	98.3
125	26	2 - Laboratoires Européens	Laser	99.1
32	41	2 - Laboratoires Européens	Laser	73,4
20	63	2 - Laboratoires Européens	Laser	76.4
200	65	2 - Laboratoires Européens	Alpine	99.3
160	72	2 - Laboratoires Européens	Laser	98.5
200	72	2 - Laboratoires Européens	Laser	98.8
3,2	101	2 - Laboratoires Européens	Laser	23.6
20	107	2 - Laboratoires Européens	Alpine	79.6
200	143	2 - Laboratoires Européens	Alpine	99.4
6.3	223	3 - Laboratoires Etrangers	Laser	19.2

8. SKRINKAGE IN AIR and SWELLING UNDER WATER

Skrinkage - Mean A.M.U



Skrinkage 3d – By Population A.M.U

Population	Method	Number of Results	x̄	Ɛ	S_R	CV (%)	Lm95%	LM95%
1 – European pilots		3	**194**	192	77	39.8	**-138**	**527**
2 – European laboratories		15	**165**	14	26	15.7	**109**	**220**
3 – Foreign laboratories		3	**198**	154	62	31.3	**-69**	**465**

Skrinkage 3d - Eliminated Outliers
Confidence Level = 2%

N° Lab	Population	Method	Value
79	2 – European laboratories		50

Skrinkage 7d - By Population A.M.U

Population	Method	Number of Results	x̄	Ɛ	S_R	CV (%)	Lm95%	LM95%
1 – European pilots		3	**365**	229	92	25.3	**-32**	**762**
2 – European laboratories		17	**324**	20	39	12.1	**240**	**407**
3 – Foreign laboratories		8	**387**	33	39	10.1	**295**	**480**

Skrinkage 14d - By Population A.M.U

Population	Method	Number of Results	x̄	Ɛ	S_R	CV (%)	Lm95%	LM95%
1 – European pilots		2	**451**	302	34	7.4	**24**	**878**
2 – European laboratories		16	**459**	25	46	10.1	**360**	**557**
3 – Foreign laboratories		8	**535**	51	61	11.4	**391**	**679**

Skrinkage 14d - Eliminated Outliers
Confidence Level = 2%

N° Lab	Population	Method	Value
9	2 – European laboratories		681

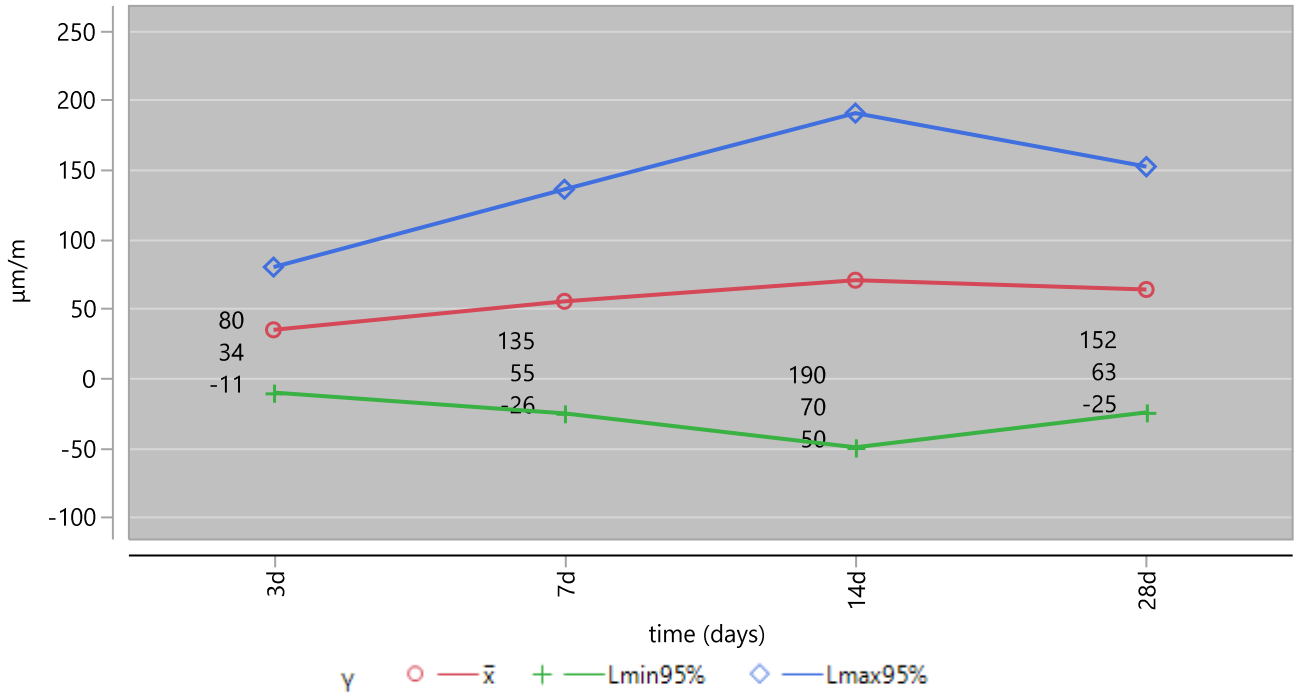
Skrinkage 28d - By Population A.M.U

Population	Method	Number of Results	x̄	Ɛ	S_R	CV (%)	Lm95%	LM95%
1 – European pilots		4	**637**	79	50	7.8	**479**	**796**
2 – European laboratories		17	**615**	35	68	11.0	**471**	**758**
3 – Foreign laboratories		8	**691**	51	61	8.9	**547**	**836**

Skrinkage 28d - Eliminated Outliers
Confidence Level = 2%

N° Lab	Population	Method	Value
9	2 – European laboratories		862

Swelling – Mean A.M.U



Swelling 3d - By Population A.M.U

Population	Method	Number of Results	x̄	ε	S_R	CV (%)	Lm95%	LM95%
1 – European pilots		3	45	18	7	15.7	**15**	**76**
2 – European laboratories		11	31	16	24	76.3	**-22**	**84**
3 – Foreign laboratories		1	39	-	-	-	**-**	**-**

Swelling 7d - By Population A.M.U

Population	Method	Number of Results	x̄	ε	S_R	CV (%)	Lm95%	LM95%
1 – European pilots		3	59	28	11	19.0	**11**	**108**
2 – European laboratories		9	41	17	22	54.3	**-10**	**93**
3 – Foreign laboratories		1	57	-	-	-	**-**	**-**

Swelling 7d - Eliminated Outliers
Confidence Level = 2%

N° Lab	Population	Method	Value
79	2 – European laboratories		165

Swelling 14d - By Population A.M.U

Population	Method	Number of Results	$\bar{x}$	Ɛ	S_R	CV (%)	Lm95%	LM95%
1 – European pilots		3	66	68	27	41.6	**-52**	**183**
2 – European laboratories		10	53	24	33	62.5	**-22**	**128**
3 – Foreign laboratories		1	82	-	-	-	**-**	**-**

Swelling 7d - Eliminated Outliers
Confidence Level = 2%

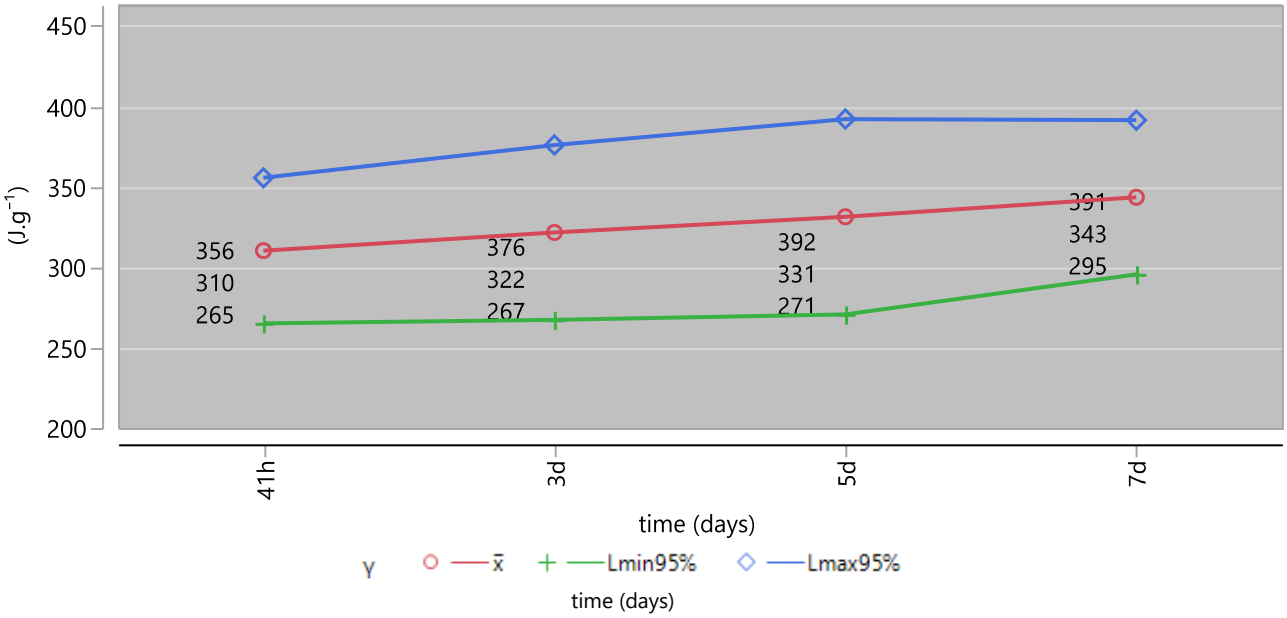
N° Lab	Population	Method	Value
79	2 – European laboratories		242

Swelling 28d - By Population A.M.U

Population	Method	Number of Results	$\bar{x}$	Ɛ	S_R	CV (%)	Lm95%	LM95%
1 – European pilots		4	52	87	54	105.0	**-121**	**225**
2 – European laboratories		11	66	27	40	60.5	**-23**	**155**
3 – Foreign laboratories		1	83	-	-	-	**-**	**-**

- Dimensional variations such **as shrinkage in air and swelling under water** were carried out following French standard NF P 15-433 (Feb. 1994). The values taken into account represent the mean values of the results observed on three specimens at 3, 7, 14 and 28 days, expressed in µm/m, and with the tests results rounded up to the nearest tens. Coefficients of variation are high. The results of every participant are presented in the figure opposite. The spindle shape represents the limits within which 95% of the values stand.

9. Heat of Hydration - Mean A.M.U



Heat of hydration 41h - By Population - Semi-adiabatic method

Population	Method	Number of Results	x̄	Ɛ	S_R	CV (%)	Lm95%	LM95%
1 – European pilots		11	**321**	10	15	4.8	**287**	**355**
2 – European laboratories		23	**311**	9	20	6.5	**269**	**353**
3 – Foreign laboratories		6	**300**	19	18	6.0	**253**	**346**

Heat of hydration 41h - Eliminated Outliers
Confidence Level = 2%

N° Lab	Population	Method	Value
146	2 – European laboratories		239

Heat of hydration 3j - By Population - Semi-adiabatic method

Population	Method	Number of Results	x̄	Ɛ	S_R	CV (%)	Lm95%	LM95%
1 – European pilots		7	**338**	21	23	6.9	**281**	**394**
2 – European laboratories		19	**318**	14	30	9.4	**255**	**381**
3 – Foreign laboratories		7	**315**	12	13	4.1	**283**	**347**

Heat of hydration 5j - By Population - Semi-adiabatic method

Population	Method	Number of Results	x̄	Ɛ	S_R	CV (%)	Lm95%	LM95%
1 – European pilots		7	**349**	27	29	8.3	**278**	**420**
2 – European laboratories		18	**326**	15	31	9.5	**261**	**390**
3 – Foreign laboratories		5	**328**	24	20	6.0	**273**	**382**

Heat of hydration7j – By population - Solution method

Population	Method	Number of Results	x̄	Ɛ	S_R	CV (%)	Lm95%	LM95%
1 – European pilots		3	**354**	61	25	7.0	**248**	**460**
2 – European laboratories		6	**342**	24	23	6.8	**282**	**401**
3 – Foreign laboratories		6	**340**	24	23	6.8	**280**	**399**

Maximale Flux – By population

Population	Method	Number of Results	$\bar{x}$	Ɛ	S_R	CV (%)	Lm95%	LM95%
1 – European pilots		8	**43.8**	2.0	2.4	5.5	**38.1**	**49.4**
2 – European laboratories		15	**42.5**	1.8	3.2	7.6	**35.6**	**49.4**

Maximale Flux - Eliminated Outliers
Confidence Level = 2%

Labo	Groupe de Labo	Method	Value
152	2 – European laboratories		**33.3**
152	2 – European laboratories		**35.3**

Age at maximale flux – By population

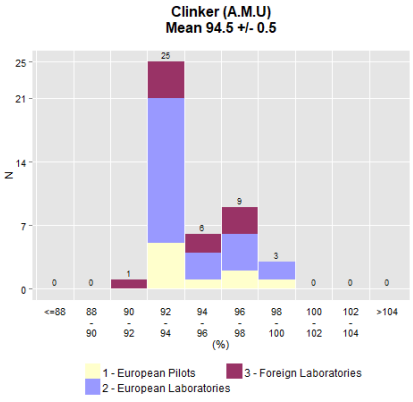
Population	Method	Number of Results	$\bar{x}$	Ɛ	S_R	CV (%)	Lm95%	LM95%
1 – European pilots		7	**7.0**	0.1	0.1	1.8	**6.7**	**7.3**
2 – European laboratories		16	**7.3**	0.3	0.5	7.3	**6.2**	**8.4**

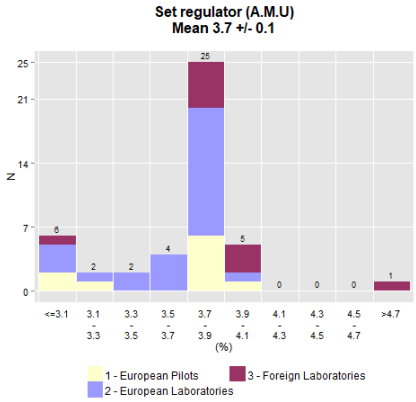
Age at maximale flux - Eliminated Outliers
Confidence Level = 2%

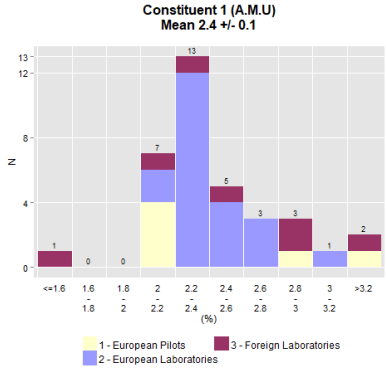
Labo	Groupe de Labo	Method	Value
15	1 – European pilots		**5,5**

- 27 laboratories carried out **the heat of hydration using the semi-adiabatic method** (described in European standard **EN 196-9**) and **14 the dissolution method** (**EN 196-8**). Hydration heat calculations were carried out at 41 hours, 3, 5, and 7 days. The standard deviation reproducibility at 41 hours specified in European standard **EN 196-9,** is 15 $J.g^{-1}$. Comparison between the two methods used for hydration heat determination is not possible, as there are too few results available for the dissolution method. Deviations between laboratories may be due to imperfectly controlled heat losses just before starting measures, or as always, to the calibration of the calorimeter, the temperature in the testing room, or air circulation speed around the apparatus, this last a very influential factor.

10- Mineralogy







Clinker - By population Group & Method

Population	Method	Number of Results	$\bar{x}$	Ɛ	S_R	CV (%)	Lm95%	LM95%
1 – European pilots		8	**94.4**	0.9	1.1	1.1	**91.9**	**97.0**
2 – European laboratories		23	**94.5**	0.6	1.4	1.5	**91.6**	**97.3**
3 – Foreign laboratories		10	**94.5**	1.4	1.9	2.0	**90.2**	**98.9**

Clinker - Eliminated Outliers
Confidence Level = 2%

N° Lab	Population	Method	Value
13	1 – European pilots		**100.0**
146	2 – European laboratories		**100.0**

Set Regulator - By population Group & Method

Population	Method	Number of Results	$\bar{x}$	Ɛ	S_R	CV (%)	Lm95%	LM95%
1 – European pilots		9	**3.7**	0.3	0.4	9.6	**2.9**	**4.5**
2 – European laboratories		24	**3.7**	0.1	0.3	7.1	**3.1**	**4.2**
3 – Foreign laboratories		9	**3.8**	0.2	0.3	8.0	**3.1**	**4.5**

Set Regulator - Eliminated Outliers
Confidence Level = 2%

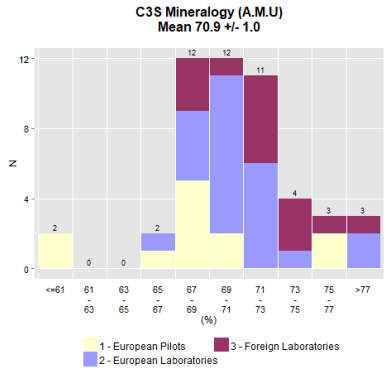
N° Lab	Population	Method	Value
16	1 - European pilots		**1.8**
47	2 – European laboratories		**1.8**
218	3 – Foreign laboratories		**4.9**

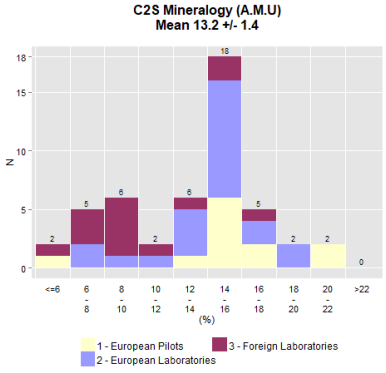
Minor additional constituents - By population Group & Method

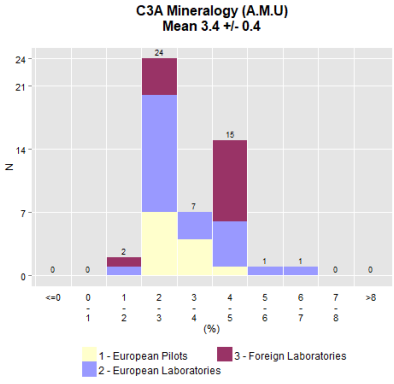
Population	Method	Number of Results	$\bar{x}$	Ɛ	S_R	CV (%)	Lm95%	LM95%
1 – European pilots		6	**2.6**	0.6	0.6	22.1	**1.1**	**4.0**
2 – European laboratories		21	**2.4**	0.1	0.2	7.1	**2.0**	**2.7**
3 – Foreign laboratories		5	**2.6**	0.5	0.4	14.7	**1.5**	**3.6**

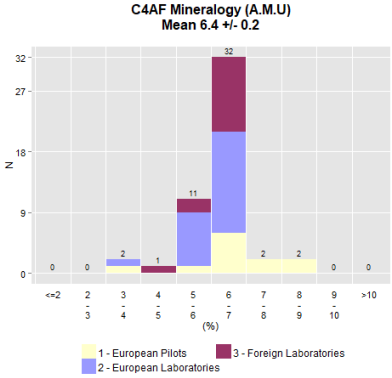
Minor additional constituents - Eliminated Outliers
Confidence Level = 2%

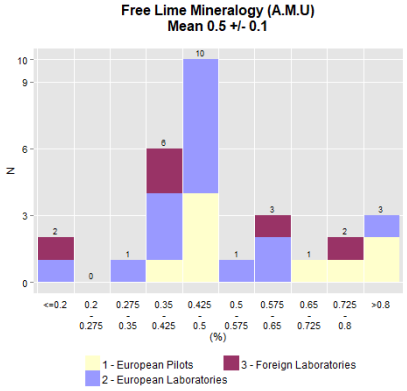
N° Lab	Population	Method	Value
104	2 – European laboratories		**3.2**
203	3 – Foreign laboratories		**0.0**
218	3 – Foreign laboratories		**4.1**

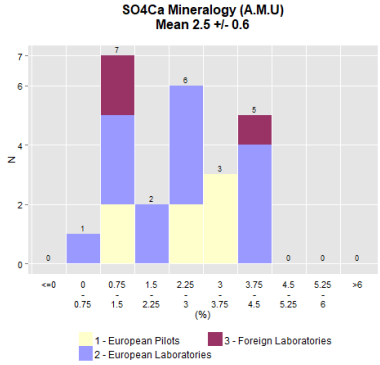












Mineralogy C_3S - By population Group & Method

Population	Method	Number of Results	$\bar{x}$	ε	S_R	CV (%)	Lm95%	LM95%
1 – European pilots		10	**69.9**	2.5	3.5	5.1	**61.9**	**77.9**
2 – European laboratories		22	**70.5**	1.0	2.3	3.2	**65.8**	**75.2**
3 – Foreign laboratories		14	**72.3**	1.7	2.9	4.0	**66.0**	**78.6**

Mineralogy C_3S - Eliminated Outliers
Confidence Level = 2%

N° Lab	Population	Method	Value
2	1 – European pilots		**58.9**
2a	1 – European pilots		**58.1**
28	2 – European laboratories		**83.7**

Mineralogy C_2S - By population Group & Method

Population	Method	Number of Results	$\bar{x}$	ε	S_R	CV (%)	Lm95%	LM95%
1 – European pilots		12	**15.3**	2.6	4.2	27.2	**6.2**	**24.5**
2 – European laboratories		22	**13.9**	1.4	3.1	21.9	**7.6**	**20.3**
3 – Foreign laboratories		14	**10.1**	1.9	3.3	32.2	**3.1**	**17.2**

Mineralogy C_3A - By population Group & Method

Population	Method	Number of Results	$\bar{x}$	Ɛ	S_R	CV (%)	Lm95%	LM95%
1 – European pilots		12	**2.9**	0.5	0.8	28.7	**1.1**	**4.8**
2 – European laboratories		23	**3.2**	0.5	1.1	33.5	**1.0**	**5.5**
3 – Foreign laboratories		14	**4.0**	0.7	1.3	32.3	**1.2**	**6.8**

Mineralogy C_3A - Eliminated Outliers
Confidence Level = 2%

N° Lab	Population	Method	Value
109	2 – European laboratories		6.6

Mineralogy C_4AF - By population Group & Method

Population	Method	Number of Results	$\bar{x}$	Ɛ	S_R	CV (%)	Lm95%	LM95%
1 – European pilots		11	**7.0**	0.5	0.8	10.8	**5.3**	**8.6**
2 – European laboratories		23	**6.1**	0.2	0.4	7.2	**5.2**	**7.0**
3 – Foreign laboratories		14	**6.4**	0.4	0.6	9.8	**5.1**	**7.8**

Mineralogy C_4AF - Eliminated Outliers
Confidence Level = 2%

N° Lab	Population	Method	Value
11	1 – European pilots		3.7
109	2 – European laboratories		3.4

Mineralogy Free lime - By population Group & Method

Population	Method	Number of Results	$\bar{x}$	Ɛ	S_R	CV (%)	Lm95%	LM95%
1 – European pilots		9	**0.7**	0.2	0.2	36.4	**0.1**	**1.2**
2 – European laboratories		14	**0.4**	0.1	0.1	34.5	**0.1**	**0.7**
3 – Foreign laboratories		5	**0.4**	0.4	0.3	67.1	**-0.4**	**1.2**

Mineralogy Free lime - Eliminated Outliers
Confidence Level = 2%

N° Lab	Population	Method	Value
47	2 – European laboratories		1.1

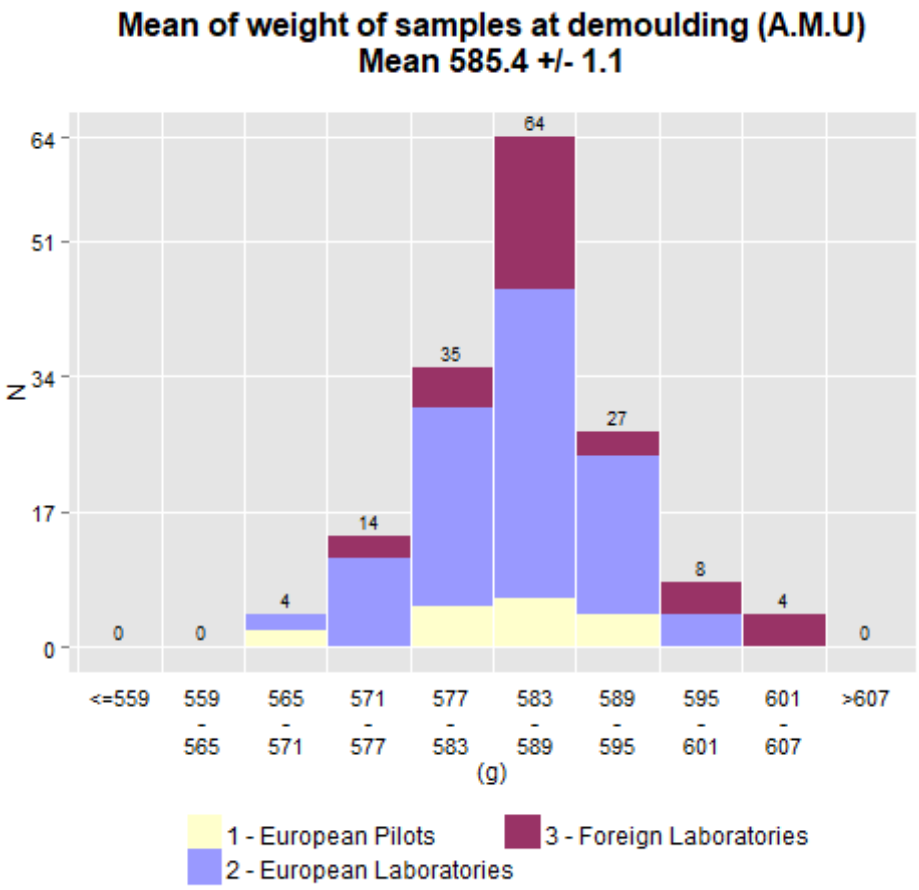
Mineralogy SO_4Ca - By population Group & Method

Population	Method	Number of Results	$\bar{x}$	Ɛ	S_R	CV (%)	Lm95%	LM95%
1 – European pilots		7	**2.6**	0.9	1.0	39.4	**0.1**	**5.0**
2 – European laboratories		14	**2.5**	0.7	1.3	51.6	**-0.3**	**5.2**
3 – Foreign laboratories		3	**2.1**	3.6	1.5	69.4	**-4.2**	**8.4**

- Clinker, set control agent and minor additional constituents material determination were realised following Technical Report CEN/TR 196-4 on quantitative determination of constituents. Results were very homogenous.

- 61 laboratories participated in the mineralogical tests. Mineral composition of cement may be determined using the chemical analysis results and the Bogue equations but using X-ray diffraction analysis is more reliable. Results were relatively homogenous.

11. Mechanical Tests



Mean of mass on demoulding 4x4x16 - By population Group & Method

Population	Method	Number of Results	$\bar{x}$	ε	S_R	CV (%)	Lm95%	LM95%
1 – European pilots		15	**586.0**	3.0	5.4	0.9	**574.5**	**597.5**
2 – European laboratories		99	**585.0**	1.1	5.7	1.0	**573.7**	**596.4**
3 – Foreign laboratories		35	**586.4**	2.2	6.5	1.1	**573.1**	**599.6**

Mean of mass on demoulding 4x4x16 - Eliminated Outliers
Confidence Level = 2%

N° Lab	Population	Method	Value
7a	1 – European pilots		**565.8**
13a	1 – European pilots		**569.1**
121	2 – European laboratories		**567.3**
121a	2 – European laboratories		**569.4**
220	3 – Foreign laboratories		**601.8**
228	3 – Foreign laboratories		**602.8**
235b	3 – Foreign laboratories		**602.3**

Bending 1 day - By population Group & Method

Population	Method	Number of Results	$\bar{x}$	Ɛ	S_R	CV (%)	Lm95%	LM95%
1 – European pilots		12	**4.6**	0.2	0.3	7.3	**3.8**	**5.3**
2 – European laboratories		41	**4.8**	0.1	0.3	7.1	**4.1**	**5.4**
3 – Foreign laboratories		18	**4.9**	0.2	0.5	9.7	**3.9**	**6.0**

Bending 1 day - Eliminated Outliers
Confidence Level = 2%

N° Lab	Population	Method	Value
70	2 – European laboratories		3.3
71	2 – European laboratories		5.9
128	2 – European laboratories		3.4
202	3- Foreign laboratories		6.2
216	3- Foreign laboratories		6.4

Bending 2 days - By population Group & Method

Population	Method	Number of Results	$\bar{x}$	Ɛ	S_R	CV (%)	Lm95%	LM95%
1 – European pilots		12	**6.0**	0.3	0.5	7.9	**5.0**	**7.1**
2 – European laboratories		44	**6.1**	0.1	0.4	5.9	**5.4**	**6.8**
3 – Foreign laboratories		20	**6.2**	0.3	0.5	8.7	**5.1**	**7.3**

Bending 2 days - Eliminated Outliers
Confidence Level = 2%

N° Lab	Population	Method	Value
39	2 - European laboratories		7.4
128	2 - European laboratories		4.2
212	3- Foreign laboratories		9.0

Bending 7 days - By population Group & Method

Population	Method	Number of Results	$\bar{x}$	Ɛ	S_R	CV (%)	Lm95%	LM95%
1 – European pilots		12	**7.7**	0.4	0.6	7.3	**6.5**	**9.0**
2 – European laboratories		45	**8.1**	0.1	0.5	6.2	**7.1**	**9.1**
3 – Foreign laboratories		20	**7.9**	0.3	0.7	8.6	**6.5**	**9.4**

Bending 7 days - Eliminated Outliers
Confidence Level = 2%

N° Lab	Population	Method	Value
128	2 - European laboratories		5.0
212	3- Foreign laboratories		11.0

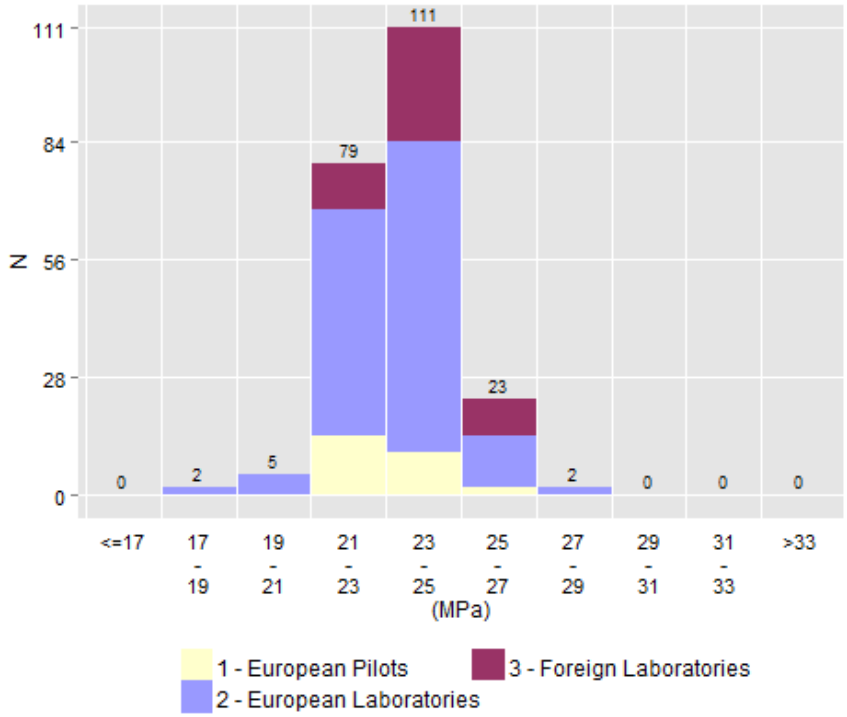
Bending 28 days - By population Group & Method

Population	Method	Number of Results	$\bar{x}$	Ɛ	S_R	CV (%)	Lm95%	LM95%
1 – European pilots		12	**9.0**	0.4	0.6	6.8	**7.7**	**10.4**
2 – European laboratories		46	**9.3**	0.2	0.6	6.1	**8.1**	**10.4**
3 – Foreign laboratories		19	**9.2**	0.3	0.6	7.0	**7.8**	**10.6**

Bending 28 days - Eliminated Outliers
Confidence Level = 2%

N° Lab	Population	Method	Value
128	2 - European laboratories		6.2
212	3- Foreign laboratories		12.5
216	3- Foreign laboratories		11.3

Compression 1 day (A.M.U)
Mean 23.3 +/- 0.2



Compressive strength 1 day - By population Group & Method

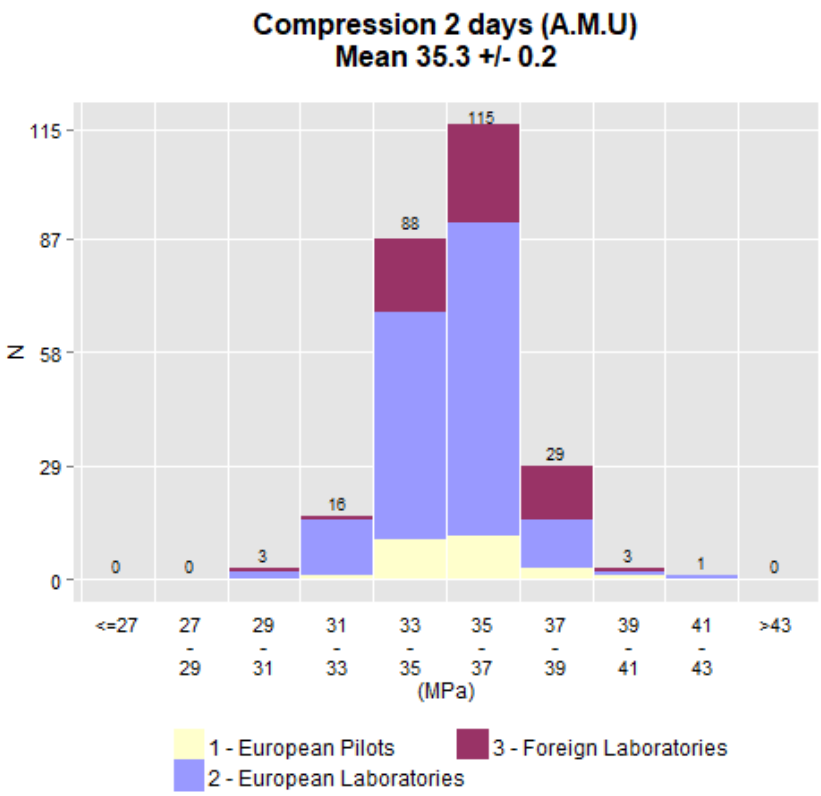
Population	Method	Number of Results	$\bar{x}$	Ɛ	S_R	CV (%)	Lm95%	LM95%
1 – European pilots	A.M.U	26	**23.0**	0.4	1.1	4.8	**20.8**	**25.3**
2 – European laboratories	A.M.U	145	**23.2**	0.2	1.3	5.4	**20.8**	**25.7**
3 – Foreign laboratories	A.M.U	46	**23.7**	0.4	1.3	5.4	**21.1**	**26.3**

Population	Method	Number of Results	$\bar{x}$	Ɛ	S_R	CV (%)	Lm95%	LM95%
1 - European pilots	A	22	**23.1**	0.5	1.2	5.1	**20.6**	**25.5**
2 - European laboratories	A	114	**23.3**	0.2	1.2	4.9	**21.1**	**25.6**
2 - European laboratories	D	25	**23.0**	0.6	1.5	6.8	**19.8**	**26.2**
3- Foreign laboratories	A	28	**23.6**	0.6	1.5	6.3	**20.6**	**26.7**
3- Foreign laboratories	B	7	**23.8**	1.1	1.1	4.8	**21.0**	**26.5**

Compressive strength 1 day - Eliminated Outliers
Confidence Level = 2%

N° Lab	Population	Method	Value
70	2 - European laboratories	A	**17.8**
88	2 - European laboratories	A	**18.7**
112	2 - European laboratories	A	**27.4**
112	2 - European laboratories	D	**28.0**
226	3- Foreign laboratories	A	**27.0**

- The mean for compressive strength at 1 day between the three populations are excellent.



Compressive strength 2 days - By population Group & Method

Population	Method	Number of Results	$\bar{x}$	Ɛ	S_R	CV (%)	Lm95%	LM95%
1 – European pilots	A.M.U	25	**35.3**	0.5	1.3	3.7	**32.6**	**38.0**
2 – European laboratories	A.M.U	162	**35.2**	0.2	1.5	4.1	**32.3**	**38.0**
3 – Foreign laboratories	A.M.U	59	**35.7**	0.4	1.4	3.8	**33.0**	**38.4**

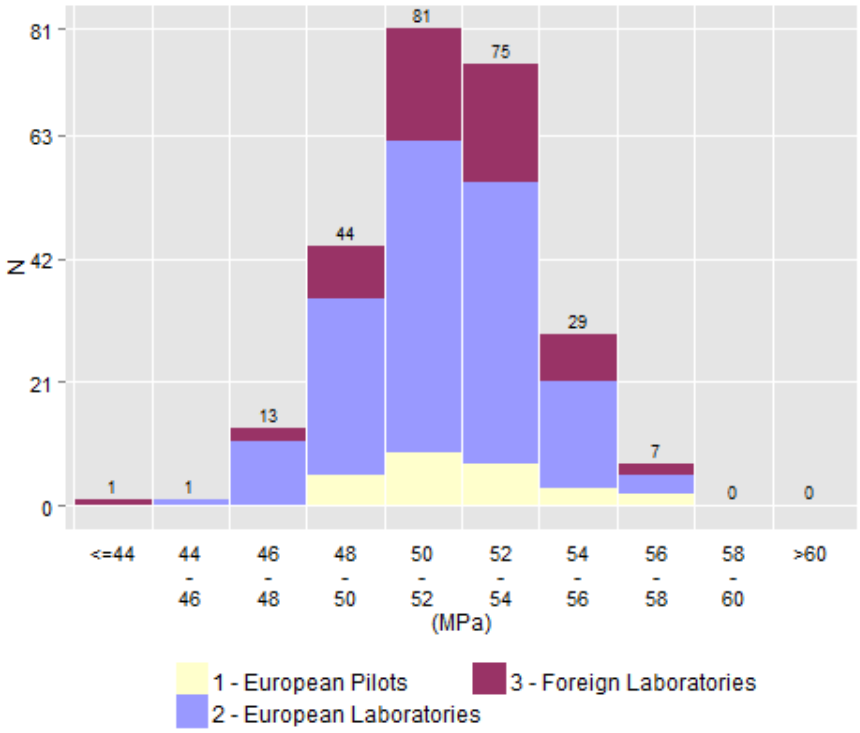
Population	Method	Number of Results	$\bar{x}$	Ɛ	S_R	CV (%)	Lm95%	LM95%
1 - European pilots	A	21	**35.2**	0.6	1.4	3.9	**32.3**	**38.1**
2 - European laboratories	A	130	**35.2**	0.2	1.4	4.1	**32.3**	**38.0**
2 - European laboratories	D	26	**35.1**	0.6	1.4	4.1	**32.1**	**38.1**
3- Foreign laboratories	A	27	**35.4**	0.6	1.6	4.6	**32.1**	**38.8**
3- Foreign laboratories	B	13	**35.3**	0.6	1.0	2.8	**33.1**	**37.5**
3- Foreign laboratories	C	11	**36.9**	0.5	0.8	2.1	**35.2**	**38.6**

Compressive strength 2 days - Eliminated Outliers
Confidence Level = 2%

N° Lab	Population	Method	Value
17	1 - European pilots	A	**39.6**
21a	2 - European laboratories	A	**30.2**
32	2 - European laboratories	A	**31.4**
76a	2 - European laboratories	A	**41.3**
88	2 - European laboratories	A	**30.6**
118	2 - European laboratories	D	**40.2**
152b	2 - European laboratories	D	**31.1**
226	3- Foreign laboratories	A	**39.5**
228	3- Foreign laboratories	A	**30.9**

- Homogeneity means for compressive strength to two days, whatever the population and the methods used.
- Note, a higher mean for foreign laboratories (36.9 MPa) having used their own sand and their national standard (method C).

Compression 7 days (A.M.U)
Mean 51.6 +/- 0.3



Compressive strength 7 days - By population Group & Method

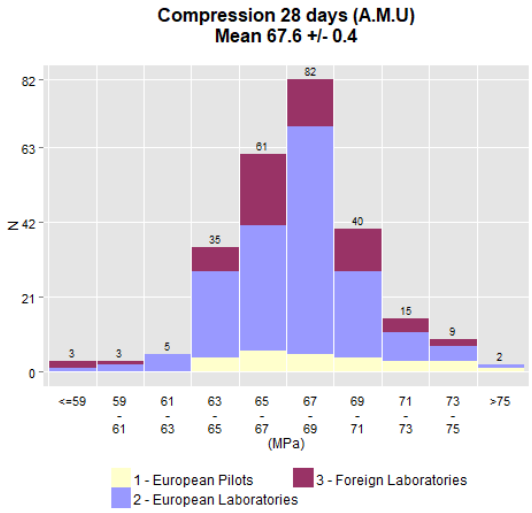
Population	Method	Number of Results	$\bar{x}$	Ɛ	S_R	CV (%)	Lm95%	LM95%
1 – European pilots	A.M.U	25	**51.9**	0.9	2.1	4.0	**47.6**	**56.2**
2 – European laboratories	A.M.U	163	**51.5**	0.3	2.2	4.2	**47.3**	**55.8**
3 – Foreign laboratories	A.M.U	59	**51.7**	0.6	2.1	4.1	**47.4**	**56.0**

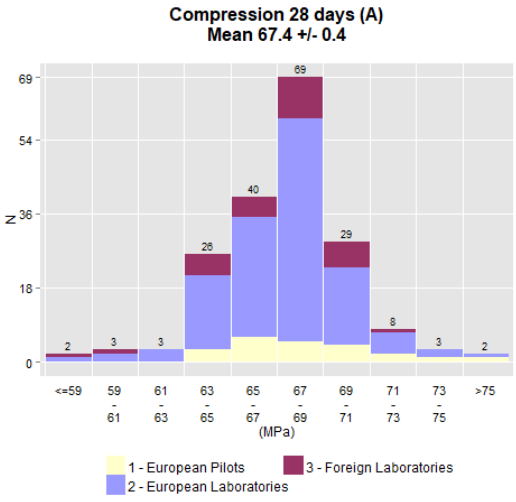
Population	Method	Number of Results	$\bar{x}$	Ɛ	S_R	CV (%)	Lm95%	LM95%
1 - European pilots	A	21	**51.7**	1.0	2.2	4.2	**47.2**	**56.3**
2 - European laboratories	A	130	**51.5**	0.4	2.1	4.1	**47.3**	**55.6**
2 - European laboratories	D	27	**51.9**	0.9	2.3	4.5	**47.1**	**56.6**
3- Foreign laboratories	A	27	**51.6**	0.9	2.2	4.3	**47.0**	**56.1**
3- Foreign laboratories	B	13	**50.4**	1.1	1.8	3.5	**46.6**	**54.3**
3- Foreign laboratories	C	11	**53.4**	0.9	1.3	2.4	**50.6**	**56.3**

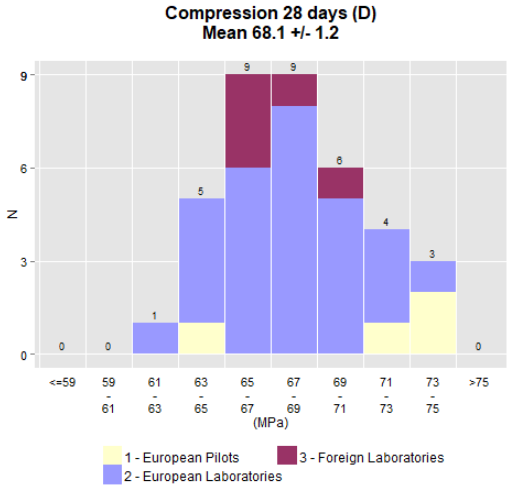
Compressive strength 7days - Eliminated Outliers
Confidence Level = 2%

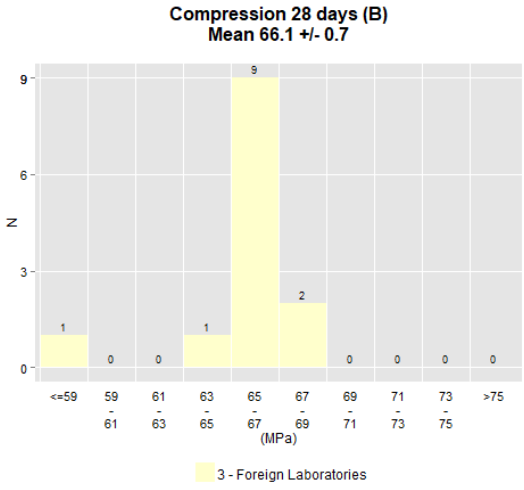
N° Lab	Population	Method	Value
17a	1 - European pilots	A	**57.5**
114	2 - European laboratories	A	**45.3**
213	3- Foreign laboratories	A	**57.4**
228	3- Foreign laboratories	A	**41.8**

- Homogeneous results for compressive strength to seven days whatever the population and the methods used.
- Note, a higher mean for foreign laboratories (53,4 MPa) having used their own sand and their national standard (method C).









Compressive strength 28 days - By population Group & Method

Population	Method	Number of Results	$\bar{x}$	Ɛ	S_R	CV (%)	Lm95%	LM95%
1 – European pilots	A.M.U	25	**68.5**	1.3	3.3	4.8	**61.8**	**75.3**
2 – European laboratories	A.M.U	161	**67.3**	0.4	2.3	3.4	**62.8**	**71.9**
3 – Foreign laboratories	A.M.U	58	**67.8**	0.7	2.5	3.7	**62.7**	**72.9**

Population	Method	Number of Results	$\bar{x}$	Ɛ	S_R	CV (%)	Lm95%	LM95%
1 - European pilots	A	21	**68.1**	1.3	2.8	4.1	**62.3**	**73.8**
2 - European laboratories	A	128	**67.3**	0.4	2.1	3.2	**63.1**	**71.5**
2 - European laboratories	D	28	**67.8**	1.1	2.9	4.2	**62.0**	**73.7**
3- Foreign laboratories	A	27	**67.6**	0.8	2.1	3.1	**63.3**	**72.0**
3- Foreign laboratories	B	12	**66.1**	0.6	0.9	1.4	**64.1**	**68.1**
3- Foreign laboratories	C	11	**71.0**	1.4	2.1	2.9	**66.4**	**75.7**

Compressive strength 28 days - Eliminated Outliers
Confidence Level = 2%

N° Lab	Population	Method	Value
17a	1 - European pilots	A	75.7
51	2 - European laboratories	A	74.9
51a	2 - European laboratories	A	74.5
54	2 - European laboratories	A	77.1
88	2 - European laboratories	A	57.0
107	2 - European laboratories	N	74.9
114	2 - European laboratories	A	59.4
158	2 - European laboratories	A	60.3
215	3- Foreign laboratories	B	57.9
220	3- Foreign laboratories	A	59.7
228	3- Foreign laboratories	A	54.1

Remarks on compression tests at 28 days

- The biggest mean A deviation between compressive strength values of European pilots labs and European laboratories at 28 days is **1,2 MPa**, whatever the standard followed or the type of sand used. This deviation for a **CEM I 52,5 N** is an good result.
- Compressive strength tests results are homogeneous, the maximum difference for mean values at 28 days is **4,9 MPa** (between laboratories outside Europe using Afnor CEN sand and their national standard and laboratories outside Europe using their national sand and their national standard). This difference can be explained both on the sands used, which for a AMU average of **67.6 MPa**, can produce a difference of the order of **2 MPa** and on the other hand by the different operating modes resulting from different standards.
- Several factors are involved in compressive strength results, the main ones being the procedure for making the specimen (mixing, vibrating technique, curing), the operating procedures and the type of sand . The ensuing differences in values found at 28 days call for the following comments:
  - The difference of **0,8 MPa** between European laboratories and European pilot laboratories using the same sand and following the same standard (EN 196-1) is an excellent result.
  - The difference of **2,0 MPa** between laboratories from outside Europe and European laboratories using the same sand but following different standards allows us to evaluate the influence of the operating procedures. This is a satisfactory result for a **CEM I 52,5 N**.
  - This year, we note a difference of **0,5 MPa** between the European laboratories following the same European standard EN 196-1 but with various types of CEN sands. It's a good result.

Coefficients of variation (%) for the physical and the mechanical tests

	Specific gravity	Specific surface	Normal consistency	Initial setting time	Skrinkage at 28 days	Heat of Hydration 5 days	Mass on Demoulding	C 1 Day	C 2 Days	C 7 Days	C28 Days
1988 CPA HPR	0,7	1,8	2,3	15,6	14,5	7,0	1,0	8,4	5,8	4,9	3,9
1989 CPJ 45	0,9	2,7	2,2	11,0	14,6	6,0	0,9	10,5	5,6	4,5	3,9
1990 CPA 55	0,5	2,2	1,7	16,1	10,0	7,6	0,8	6,9	5,0	3,9	3,8
1991 CPJ 55 R	0,6	2,2	1,9	11,5	8,5	9,6	1,0	9,5	4,8	4,2	4,1
1992 CPA 55	0,6	2,3	2,0	11,7	11,5	10,0	1,1	8,7	4,6	4,3	4,1
1993 CPJ 45	0,8	2,4	2,8	13,8	10,0	11,7	1,0	9,6	5,0	4,7	4,5
1994 CPA HPR	0,8	2,3	2,7	14,0	12,7	9,5	1,0	6,6	4,7	4,4	4,4
1995 CPJ-CEM II/A 42,5 R	0,8	2,6	2,0	13,1	12,8	8,9	1,1	6,3	5,3	4,6	5,0
1996 CPA-CEM I 42,5 R	0,8	2,6	2,1	15,1	14,6	8,4	1,1	5,9	4,2	4,6	4,4
1997 CPJ-CEM II/A 32,5 R	0,8	3,4	3,3	14,5	8,4	7,9	1,2	8,7	5,6	6,1	6,1
1998 CPA-CEM I 52,5 R	0,8	2,3	2,7	14,4	11,5	11,1	1,1	6,1	5,2	4,5	4,7
1999 CPJ-CEM II/A 52,5 R	0,9	2,3	2,3	13,2	14,2	6,3	1,2	8,9	4,6	4,9	4,7
2000 CPA-CEM I/A 52,5	0,9	2,9	2,1	10,8	17,4	10,2	1,0	7,0	4,9	4,6	4,1
2001 CEM III/A 42,5	0,8	2,9	2,4	10,0	18,3	5,5	1,0	10,1	6,6	4,7	3,7
2002 CEM I 52,5 R	0,9	2,8	2,2	10,2	17,5	10,1	1,1	5,7	4,0	3,6	3,7
2003 CEM II/B-M 32,5 R	1,0	3,8	3,7	6,7	12,6	5,4	1,0	14,9	6,4	4,1	3,7
2004 CEM I 52,5 N	0,7	2,6	2,7	12,7	17,8	5,9	1,2	5,7	4,3	4,3	4,4
2005 CEM II/A-LL 32,5 R	0,8	2,4	2,6	12,2	17,8	5,5	1,1	8,6	5,5	4,8	4,6
2006 CEM I 52,5 R	0,8	2,7	2,1	11,2	10,8	5,0	1,1	5,8	4,1	3,8	3,7
2007 CEM II/B-L 32,5 R	0,8	2,5	2,2	11,4	11,6	7,6	1,1	10,2	6,3	5,5	5,7
2008 CEM I 52,5 N	0,7	2,8	1,9	10,7	16,0	7,8	1,3	6,7	5,1	4,5	4,4
2009 CEM II/B-V 32,5 R	0,9	3,1	2,5	12,5	12,1	7,6	0,9	10,2	7,9	4,3	3,8
2010 CEM I 52,5 N	0,6	3,1	1,8	13,4	14,1	8,1	1,0	5,9	4,8	4,2	3,7
2011 CEM II/B-M 32,5 R	0,7	2,4	2,1	11,9	14,9	8,1	1,2	8,5	4,9	4,0	4,0
2012 CEM I 52,5 N	0,6	2,4	2,0	10,9	14,1	8,1	1,3	4,9	4,1	4,1	3,8
2013 CEM II/A-LL 32,5 R	0,7	3,0	2,0	10,2	18,5	6,7	1,0	7,4	5,0	4,1	3,9
2014 CEM I 52,5 R	0,7	2,5	2,0	11,6	18,5	9,1	1,1	4,7	3,6	3,6	3,5
2015 CEM II/B-M 32,5 R	0,6	2,8	1,8	10,4	12,2	9,4	0,9	9,0	4,8	3,7	3,6
2016 CEM I 52,5 N	0,6	2,8	2,5	11,3	10,1	10,5	1,1	6,3	4,0	4,1	3,9
2017 CEM II/B-LL 32,5 R	0,8	3,6	2,0	10,2	12,0	6,6	1,2	6,0	5,1	4,7	5,0
2018 CEM I 52,5N	0,6	3,7	2,1	10,3	11,0	9,0	1,0	5.4	4,1	4,2	3,7

12. Conclusion

The 2018 round-robin test collected **183 participants**, from 36 countries. The cement used this year was a **CEM I 52,5 N**.

The results call for the following comments:

- **Chemical analyses** brought forth satisfactory results. Recurring high dispersions due to low contents concern chiefly free CaO, insoluble residues and Na_2O. We note that **72 %** of the tests were done using X-ray fluorescence analysis, which is slight increase with last year's results. We have again processed the statistics for the determination of hexavalent chromium. You will find the comments on the chemical analysis results starting on **p.23**.

- **Physical tests** gave homogenous results like every year.

- **Mechanical tests** showed the differences in means are satisfactory for a cement of this type, namely:

  - Satisfactory mean differences in compressive strength at 28 days between European pilot laboratories and European laboratories (**68.5 MPa** and **67.3 MPa**).

  - a maximum difference for compression strength mean values at 28 days of **4,9 MPa** between laboratories outside Europe using Afnor CEN sand and national standard and laboratories outside Europe using their national sand and their own standard). Operating modes and differences in sand can explain this difference at 28 days.

  - Lastly, a difference of **0,5 MPa** between the European laboratories following the same European standard EN 196-1 but using various types of CEN sands. It's a good gap.

- Laboratory results for this **2018** campaign are homogenous and variation coefficients satisfactory. We insist again on the fact that when standard operating procedures exists, laboratories should undertake to follow them.

- Reports are emailed directly with pdf format attachment. Your outliers and/or suspect values will be sent in a table along with the General Report. You will then check possible defective values with your laboratory number. In the report, outlier values are mentioned after each test.

- I am glad to have the opportunity to thank the whole of the participating laboratories for their collaboration in efficiently following our instructions. Most of the comments made by the laboratories to improve the Excel spreadsheet have been taken into account. For example this year, the determination of **MnO** has been added.

- We thank those laboratories that have sent us comments aiming to improve the Excel sheet and we invite other participants to share their reviews, comments and suggestions in this same spirit of overall streamlining and clarification.

Annexes

Labs	Loss on ignition (%)	SiO2 (%)	Al2O3 (%)	Fe2O3 (%)	CaO (%)	MgO (%)	MnO (%)	SO3 (%)	Free lime (%)	Insoluble residue (%)	Na2O (%)	K2O (%)	TiO2 (%)	Chloride (%)	P2O5 (%)	SrO (%)	CO2 (%)	S-- (%)	Cr6+ (%)
1	N 1.71	X 22.22	X 3.34	X 2.16	X 66.42	X 0.78	X 0.12	X 2.36	G 0.73	K 0.27	X 0.15	X 0.20	X 0.15	M 0.04	X 0.06	X 0.13	N 1.11		N0.000163
1		X 22.10	X 3.26	X 2.19	X 66.91	X 0.78	X 0.13	X 2.38			X 0.13	X 0.18	X 0.15		X 0.06	X 0.13			
2	K 1.45	K 22.05	K 3.53	K 2.18	K 67.08	K 0.74	X 0.11	K 2.31	N0.59		K 0.16	K 0.18	X 0.25	M 0.03	X 0.06	X 0.13	N 1.39	N0.01	K0.000167
2		X 22.29	X 3.24	X 2.08	X 66.65	X 0.74		X 2.55			X 0.14	X 0.16							
2a	K 1.51	K 22.14	K 3.63	K 2.11	K 66.98	K 0.70	X 0.11	K 2.31	N0.56	K 0.53	K 0.15	K 0.16	X 0.25	M 0.04	X 0.06	X 0.13	N 1.23	N0.00	K0.000166
2a		X 22.31	X 3.24	X 2.08	X 66.69	X 0.74		X 2.53			X 0.15	X 0.18							
3	K 1.56	X 21.95	X 3.16	X 2.17	X 67.12	X 0.72	X 0.12	K 2.35	G 0.72	K 0.33	X 0.11	X 0.18	X 0.15	P 0.04	X 0.04	X 0.13			0.000084
3	K 1.56	X 21.97	X 3.17	X 2.17	X 67.14	X 0.73	X 0.12	K 2.34		K 0.31	X 0.10	X 0.19	X 0.14		X 0.04	X 0.13			
3								X 2.34											
3								X 2.35											
4	K 1.53	X 22.28	X 3.28	X 2.18	X 66.80	X 0.69	X 0.13	X 2.39	C 0.46	K 0.77	X 0.14	X 0.15	X 0.15	P 0.03	X 0.06	X 0.14	N 1.14	N0.02	K0.000162
4	K 1.58	X 22.21	X 3.31	X 2.19	X 66.86	X 0.68	X 0.13	X 2.39	C 0.47	K 0.94	X 0.14	X 0.16	X 0.15		X 0.06	X 0.14			
5	K 1.45	X 22.12	X 3.25	X 2.23	X 67.24	X 0.73	X 0.13	K 2.42	G 0.31	K 0.50	X 0.15	X 0.17	X 0.15	M 0.03	X 0.06		N 1.05		
5								X 2.37											
6	K 1.56	X 22.32	X 3.22	X 2.21	X 66.78	X 0.73	X 0.12	K 2.44	G 0.78	K 0.29	M 0.15	M0.20	X 0.15	P 0.03	X 0.05	X 0.14	N 0.92	K 0.01	N0.000134
6	K 1.56	X 22.30	X 3.19	X 2.23	X 66.91	X 0.72	X 0.12	K 2.37					X 0.15		X 0.06	X 0.13			
6								N 2.40											
7	D 1.53	X 22.23	X 3.21	X 2.18	K 66.45	X 0.78		K 2.41	C 0.71	K 0.80	K 0.12	K 0.17	X 0.16	M 0.03	X 0.06				
7		X 22.36	X 3.22	X 2.19	X 66.78	X 0.79		K 2.38	C 0.73	K 0.77	K 0.13	X 0.18	X 0.16	K 0.04	X 0.06				
7								X 2.33			X 0.12	X 0.18							
7								X 2.36			X 0.13								
8	K 1.71	X 22.29	X 3.27	X 2.18	X 66.88	X 0.73	X 0.13	K 1.93	C 0.47		X 0.13	X 0.16	X 0.15	M 0.04	X 0.06	X 0.13			
9	K 1.53	X 21.93	X 3.16	X 2.16	X 67.36	X 0.78	X 0.11	K 2.47	C 0.45	K 0.39	X 0.14	X 0.18	X 0.14	M 0.03	X 0.06	X 0.13	1.12	0.01	0.000144
9	K 1.58	X 21.76	X 3.20	X 2.15	X 67.30	X 0.78	X 0.11	K 2.46	C 0.43	K 0.35	X 0.14	X 0.17	X 0.14	K 0.03	X 0.06	X 0.13			
9	N 1.50							X 2.24											
9								X 2.19											
10	K 1.54	K 21.81	K 3.16	K 2.06	K 67.25	K 0.81		K 2.41		K 0.38	K 0.14	K 0.19		M 0.04			N 1.20		N0.000107
10				N 2.14															
11	K 1.60	K 22.21	K 3.27	K 2.17	K 66.88	K 0.77		K 2.37	G 0.51	K 0.55	K 0.13	K 0.17	X 0.15	M 0.03	X 0.07	X 0.14			
12	N 1.70	X 22.21	X 3.38	X 2.16	X 66.19	X 0.74	X 0.11	K 2.31	B 0.68	K 0.68	X 0.14	X 0.16	X 0.16	M 0.03	X 0.06	X 0.12			
12								X 2.35											
13	K 1.50	K 21.82	K 3.30	K 2.24	K 66.70	K 0.89		K 2.29	G 0.76	K 0.40	X 0.19	X 0.21	X 0.15	M 0.04	X 0.05	X 0.13	1.14		0.000160
13	K 1.53	X 21.85	X 2.96	X 2.10	X 67.43	X 0.73		X 2.21		K 0.46		X 0.22		X 0.02					
13								N 2.36											
14	K 1.51	X 22.03	X 3.27	X 2.20	X 67.15	X 0.76	X 0.06	X 2.45	G 0.70	K 0.31	X 0.14	X 0.18	X 0.14	P 0.03	X 0.06		N 0.72	N0.01	0.000123
15	K 1.59	X 22.07	X 3.24	X 2.16	X 66.79	X 0.73		K 2.22	N0.25	K 0.30	X 0.11	X 0.16	X 0.14	M 0.04	X 0.06	X 0.13			N0.000130
15								X 2.38						P 0.04					
16	K 1.61	X 22.25	X 3.21	X 2.17	X 67.35	X 0.74	X 0.11	K 2.11	G 0.80	K 0.22	X 0.14	X 0.18	X 0.15	P 0.04	X 0.07	X 0.13			N0.000108
16								K 2.10		K 0.26				X 0.04					
16								X 2.33											
17	D 1.61	X 21.97	X 3.18	X 2.17	X 66.99	X 0.69	X 0.11	K 2.24	G 0.87	K 0.31	X 0.13	X 0.17	X 0.15	P 0.04	X 0.07	X 0.13	1.16	0.02	
17		X 22.00	X 3.16	X 2.14	X 67.13	X 0.68	X 0.11	X 2.30			X 0.10	X 0.19	X 0.14	X 0.04	X 0.06	X 0.13			
17								X 2.39											
17								N 2.43											
20	N 1.53	X 22.01	X 3.20	X 2.20	X 67.39	X 0.74	X 0.12	K 2.34	G 0.66	K 0.35	X 0.13	X 0.17	X 0.15	P 0.04	X 0.05		N 0.81	N0.00	K0.000110
20								X 2.39											
20								N 2.39											
21	K 1.45	X 21.21	X 3.96	X 2.22	X 67.62	X 0.76		X 2.48	G 0.90	K 0.39	X 0.13	X 0.17		N 0.03	X 0.09			N0.00	N0.000134
21	K 1.50	X 21.27	X 3.99	X 2.22	X 67.91	X 0.75		X 2.49		K 0.35	X 0.13	X 0.17			X 0.09				
22								K 2.15		K 0.40									0.000150
23	K 1.49	X 22.13	X 3.22	X 2.19	X 66.88	X 0.74		K 2.37	C 0.56	K 0.45	X 0.14	X 0.15	X 0.15	P 0.03	X 0.06				N 0.000110
23								X 2.38											
24	K 1.56	X 22.31	X 3.26	X 2.12	X 67.43	X 0.72		X 2.40	C 0.55		X 0.15	X 0.16		X 0.03	X 0.06		1.23	0.48	0.000116
24	K 1.54	X 22.34	X 3.26	X 2.12	X 67.37	X 0.72		X 2.39	C 0.53		X 0.15	X 0.16			X 0.06				
25	K 1.51	X 22.11	X 3.27	X 2.18	X 66.86	X 0.75		X 2.36	C 0.61	K 0.29	X 0.14	X 0.16	X 0.15	P 0.04	X 0.06		1.15	0.00	0.000157
26	K 1.59	X 22.56	X 3.28	X 2.18	X 67.60	X 0.74	X 0.11	N 2.40	G 0.78	N 0.24	M 0.14	M 0.18	X 0.16	P 0.03	X 0.06	X 0.13	N 1.14	K 0.01	K 0.000128
26	K 1.62	X 22.43	X 3.28	X 2.15	X 67.71	X 0.73	X 0.11						X 0.17		X 0.06	X 0.13			
27	K 1.64	X 20.54	X 2.87	X 2.20	X 65.95	X 0.70		K 2.32	G 0.75	K 0.27	X 0.20	X 0.07		P 0.06				0.00	N0.000150
27	K 1.78							X 2.17											
27	D 1.82																		
27	B 1.80																		
28	K 1.57	X 21.20	X 3.51	X 2.19	X 68.33	X 0.57	X 0.04	X 1.89	C 0.29	K 0.16	X 0.15	X 0.19	X 0.19	M 0.04	X 0.19				0.000056
28	K 1.62	X 21.25	X 3.47	X 2.16	X 68.01	X 0.56	X 0.03	X 1.80			X 0.15	X 0.18	X 0.19	P 0.03	X 0.19				
29	K 1.60	X 22.22	X 3.28	X 2.18	X 66.84	X 0.73		X 2.38	C 0.54	K 0.39	X 0.14	X 0.15	X 0.15	P 0.03	X 0.06		N 1.11	N0.00	K0.000129
29														X 0.03					
30	K 1.58	X 22.02	X 3.19	X 2.20	X 66.83	X 0.83		X 2.33	C 0.61		X 0.18	X 0.17		P 0.03	X 0.05				
31	K 1.57	X 22.11	X 3.15	X 2.19	X 67.11	X 0.74	X 0.13	X 2.39			X 0.14	X 0.16	X 0.15	P 0.03	X 0.06	X 0.13		N0.00	K0.000125
32	K 1.63	X 21.96	X 3.18	X 2.25	X 66.49	X 0.80	X 0.11	K 2.36	G 0.65	K 1.02	X 0.12	X 0.23	X 0.16	P 0.04	X 0.02		N 1.29	N0.04	0.000126
32								X 2.48											
32								N 2.47											
33	D 1.42	X 21.86	X 3.21	X 2.16	X 67.12	X 0.71	X 0.11	X 2.45			X 0.03	X 0.16	X 0.14	P 0.04	X 0.08			N0.00	0.000170
34	K 1.57	X 22.05	X 3.55	X 2.05	X 67.30	X 0.74		X 2.49	C 0.54	K 0.28	X 0.11	X 0.20	X 0.16	P 0.03	X 0.06				0.000115
34								N 2.55											

Labs	Loss on ignition (%)	SiO2 (%)	Al2O3 (%)	Fe2O3 (%)	CaO (%)	MgO (%)	MnO (%)	SO3 (%)	Free lime (%)	Insoluble residue (%)	Na2O (%)	K2O (%)	TiO2 (%)	Chloride (%)	P2O5 (%)	SrO (%)	CO2 (%)	S-- (%)	Cr6+ (%)
35	K 1.56	K 22.08	K 3.67	K 2.27	K 66.26	K 0.85		K 2.14	G 0.82	K 1.30	K 0.18	K 0.22		M 0.03	X 0.06				K0.000105
36	K 1.54	X 22.24	X 3.16	X 2.17	X 67.29	X 0.72	X 0.13	X 2.37	G 0.66	K 0.41	X 0.16	X 0.13	X 0.15	P 0.03	X 0.09	X 0.14	1.25	0.02	0.000125
37	K 0.99	K 21.94	K 3.24	K 2.16	K 66.99	K 0.64	X 0.14	K 2.43	G 0.50	K 0.20	K 0.06	X 0.13	X 0.16	P 0.03	X 0.13			P 0.00	N0.000170
37	K 0.99									K 0.23									
38	K 1.57	X 22.21	X 3.23	X 2.16	X 67.02	X 0.76		X 2.32	C 0.50	K 0.48	X 0.16	X 0.18	X 0.14	P 0.03	X 0.06	X 0.13			K0.000100
39	K 1.59							K 2.22		K 0.48									0.000140
39	K 1.54							K 2.22		K 0.50									
40	K 1.56	X 22.25	X 3.30	X 2.18	X 66.96	X 0.72		X 2.40	C 0.50	K 0.30	X 0.16	X 0.14	X 0.15		X 0.06		K 1.25		K0.000151
41	K 1.54	X 22.12	X 3.21	X 2.17	X 66.95	X 0.74		X 2.40	C 0.61	K 0.38	X 0.15	X 0.16	X 0.15	P 0.04	X 0.06	X 0.13	K 1.26	N0.01	0.000141
42	K 1.64	X 22.21	X 3.22	X 2.05	X 66.99	X 0.75	X 0.10	X 2.35	G 0.50		X 0.05	X 0.18	X 0.18	P 0.03	X 0.08		N 1.22	N0.00	K0.000132
43	K 1.70	X 21.87	K 3.11	X 2.11	X 67.21	X 0.72	X 0.12	X 2.31	G 0.73	K 0.23	X 0.13	X 0.17	X 0.15	X 0.04	X 0.06	X 0.14			K0.000130
44	K 1.61	X 22.93	X 3.18	X 2.18	X 67.49	X 0.70		K 2.28	C 0.59	K 0.84	M 0.14	X 0.16	X 0.18	P 0.04	X 0.06			N0.01	N0.000124
44								X 2.35				M0.16							
45	K 1.55	X 22.06	X 3.35	X 2.23	X 67.26	X 0.73		X 2.13	G 1.00		X 0.14	X 0.19	X 0.16	X 0.04	X 0.07				
46	K 1.55	K 22.00	K 3.19	K 2.18	K 66.80	K 0.73	X 0.11	K 2.40	C 0.50	K 0.40	K 0.15	K 0.16	X 0.14	M 0.03	X 0.06	X 0.13		N0.01	K 0.000150
47	K 1.55	X 22.20	X 3.25	X 2.25	X 67.26	X 0.69	X 0.13	K 2.02	G 0.35	K 0.29	X 0.17	X 0.16	X 0.16	M 0.04	X 0.06	X 0.12			0.000090
47								X 1.92	C 0.59										
47									N1.14										
48	K 1.63	X 22.14	X 3.19	X 2.20	X 67.02	X 0.72		K 2.38		K 0.35	X 0.11	X 0.16		X 0.04	X 0.07			N0.00	N0.000162
48	K 1.60	X 22.18	X 3.20	X 2.20	X 66.94	X 0.73		K 2.37		K 0.31	X 0.12	X 0.16			X 0.06				
49	K 1.66	X 22.15	X 3.19	X 2.19	X 67.39	X 0.72		K 2.33	G 0.78	K 0.39	X 0.11	X 0.14		X 0.04	X 0.04			N0.00	N 0.000130
49								K 2.34		K 0.41									
49								X 2.28											
50	K 1.60	X 22.25	X 3.18	X 2.20	X 67.50	X 0.74		K 2.37	G 0.75	K 0.36	X 0.12	X 0.20		X 0.00	X 0.06			N0.00	0.000130
50	K 1.62	X 22.23	X 3.19	X 2.21	X 67.59	X 0.73		K 2.36		K 0.32	X 0.14	X 0.22			X 0.05				
51	K 1.54	X 22.24	X 3.20	X 2.28	X 67.06	X 0.71	X 0.03	K 2.21	G 0.70	K 0.83	X 0.09	X 0.18	X 0.10	X 0.03	X 0.06	X 0.13	1.11	0.00	0.000120
51	K 1.57	X 21.38	X 3.09	X 2.25	X 67.69	X 0.72	X 0.03	K 2.39		K 0.63	X 0.09	X 0.18	X 0.10		X 0.06	X 0.13			
51								X 2.46											
51								X 2.41											
52	K 1.55	X 22.16	X 3.18	X 2.16	X 67.31	X 0.78		K 2.38	G 0.63	K 0.38	X 0.12	X 0.19							
53	K 1.55	X 22.19	X 3.21	X 2.21	X 67.40	X 0.75		X 2.06		K 0.60	X 0.11	X 0.17		X 0.02				0.03	0.000000
54	K 1.62	X 22.07	X 3.23	X 2.22	X 67.18	X 0.81	X 0.13	K 2.40	G 0.78	K 0.38	X 0.18	X 0.19		X 0.04	X 0.07			0.02	0.000149
54								X 2.36											
55	K 1.58	X 22.06	X 3.15	X 2.21	X 67.31	X 0.71	X 0.13	K 2.35	G 0.74	K 0.36	X 0.09	X 0.18	X 0.16	X 0.03	X 0.05	X 0.13		0.01	0.000146
55	K 1.61	X 22.11	X 3.18	X 2.23	X 67.26	X 0.72	X 0.13	K 2.38		K 0.33	X 0.10	X 0.19	X 0.15		X 0.06	X 0.13			
56	K 1.61	X 22.32	X 3.19	X 2.20	X 67.55	X 0.69		K 2.20		K 0.24	X 0.13	X 0.19		X 0.03	X 0.08			0.00	0.000120
56	K 1.57	X 22.46	X 3.18	X 2.19	X 67.76	X 0.68		K 2.35		K 0.38	X 0.10	X 0.20			X 0.05				
56								X 2.39											
56								X 2.33											
57	K 1.68	X 21.22	X 3.18	X 2.21	X 66.69	X 0.69	X 0.12	K 2.31	G 0.63	K 0.48	X 0.13	X 0.16	X 0.15	M 0.00	X 0.06				N0.000018
57								X 2.10											
58	K 1.50	X 22.03	X 3.19	X 2.20	X 66.84	X 0.82		X 2.32	C 0.60	K 0.42	X 0.18	X 0.17							0.000950
59	K 1.88	X 23.16	X 3.15	X 2.09	X 66.34	X 0.73		K 2.35	G 0.78	K 2.20	K 0.10	X 0.18		X 0.03	X 0.06			0.01	0.000110
59	K 1.99	X 23.09	X 3.15	M 2.09	X 66.13	X 0.73		K 2.32		K 2.35	K 0.12	X 0.19			X 0.06				
60	K 1.62							N 2.46						M 0.03					
60	K 1.60																		
61	K 1.64	X 21.81	X 3.27	X 2.23	X 67.25	X 1.00		X 2.36	C 0.65	K 0.35		X 0.18							0.000800
62	K 1.61	X 22.23	X 3.23	X 2.17	X 66.91	X 0.74	X 0.06	X 2.40	C 0.46	K 0.35	X 0.13	X 0.16	X 0.15	P 0.03	X 0.06		N 1.19	0.01	K 0.000148
63	K 1.55	X 21.97	X 3.26	X 2.25	X 67.07	X 0.71		X 2.43	C 0.88		X 0.13	X 0.14	X 0.16	X 0.04	X 0.07				0.000113
64	K 1.63							K 2.29	N0.61	K 0.17									
65	K 1.85	X 21.74	X 3.45	X 2.06	X 65.50	X 0.73	X 0.11	X 2.01	G 0.06		X 0.13	X 0.17	X 0.15		X 0.08	X 0.12			N0.000126
71	D 1.50	N 24.54	N 2.93	N 1.95	N 65.26	N 0.67	N 0.11	K 2.18			A 0.15	A 0.18		P 0.04					
74	N 1.39	M 22.78	M 3.18	M 2.10	M 68.24	M 0.73	N 0.11	K 2.27	G 0.24		M 0.15	M0.18	N 0.15	M 0.04	N 0.05				
75	K 1.34	N 21.94	M 3.91	M 2.70	M 66.10	M 0.91	N 0.14	N 2.39			M 0.16	M0.15	N 0.18		N 0.07				
77	K 1.55							K 2.73	G 1.13	K 0.91									
78	D 1.53							K 2.39						M 0.04					
79	K 1.65							K 2.35		K 1.59				M 3.67					
80																			N0.000100
80a	K 1.58	M 21.81	M 3.16	M 2.21	M 67.30	M 0.75	N 0.14	K 2.37	G 0.62	K 0.48	K 0.15	K 0.18	N 0.14	M 0.05	N 0.05	N 0.15	1.17	0.01	
80a	K 1.58							K 2.35		K 0.48				K 0.05					
80c	K 1.52	M 22.10	M 3.17	M 2.17	M 67.14	M 0.75	N 0.11	K 2.41	G 0.76	K 0.36	K 0.15	K 0.18	N 0.14	M 0.04	N 0.06	N 0.14	1.11	0.01	0.000131
80c	K 1.53							K 2.38		K 0.35				K 0.04					
80d																			N0.000100
80f	K 1.58	M 22.05	M 3.24	M 2.19	M 67.32	M 0.76	N 0.14	K 2.35	G 0.71	K 0.43	K 0.15	K 0.18	N 0.14	M 0.03	N 0.06	N 0.15	1.15	0.01	0.000132
80f	K 1.58							K 2.33		K 0.50				K 0.04					
81	D 1.55							N 2.54	G 0.52					N 0.04					
82	K 1.52							K 2.22		K 0.63	K 0.00	K 1.63		K 0.02					
82	K 1.51							K 2.21		K 0.57	K 0.00								
83	K 1.64							X 2.21			X 0.14	X 0.01		X 0.03					
85	N 1.85	M 20.02	M 3.13	M 2.39	M 64.40	M 0.79	N 0.13	K 2.14		K 0.00	M 0.20	M0.32	N 0.14	P 0.00	N 0.02		1.21	K 0.00	
85											A 0.22	A 0.36							
87	K 1.82	M 22.64	M 3.12	M 2.19	M 66.39	M 0.78	N 0.11	K 2.37		K 0.42	M 0.14	M0.19	N 0.14	M 0.04					
87	K 1.90							K 2.37		K 0.51									
100	N 1.52	X 22.26	X 3.22	X 2.11	X 67.21	X 0.75	X 0.11	X 2.34	G 0.82	K 0.52	X 0.15	X 0.17	X 0.15	P 0.03	X 0.06	X 0.13			N0.000149
100								N 2.38						X 0.04					

Labs	Loss on ignition (%)	SiO2 (%)	Al2O3 (%)	Fe2O3 (%)	CaO (%)	MgO (%)	MnO (%)	SO3 (%)	Free lime (%)	Insoluble residue (%)	Na2O (%)	K2O (%)	TiO2 (%)	Chloride (%)	P2O5 (%)	SrO (%)	CO2 (%)	S-- (%)	Cr6+ (%)
101	N 1.68	X 22.01	X 3.15	X 2.12	X 66.65	X 0.69		X 2.25	G 0.88		X 0.13	X 0.15		X 0.02					
102	K 1.61	K 22.02	K 3.24	K 2.14	K 66.59	K 0.68		K 2.32	C 0.52	K 0.30	K 0.16	K 0.20		M 0.04					N0.000147
103	N 1.55	X 22.16	X 3.27	X 3.17	X 67.05	X 0.80	X 0.09	N 2.43	G 0.74	K 0.39	X 0.17	X 0.15	X 0.14	N 0.03	X 0.07	X 0.13	N 1.02		N0.000155
103		M 21.83	M 3.21	M 3.15	M 65.97	M 0.72	N 0.11				M 0.14	M0.18	N 0.14		N 0.06	N 0.13			
104	N 1.49	X 22.14	X 3.17	X 2.20	X 66.99	X 0.81	X 0.13	N 2.35	N0.50	K 0.49	X 0.17	X 0.19	X 0.14	P 0.03	N 0.06	X 0.15	1.14		0.000146
105	K 1.63																		
106	K 1.52	K 22.24	K 3.34	K 2.51	K 66.69	K 0.96		K 2.32	N0.18	K 0.57	K 0.20	K 0.20		M 0.04					0.000097
107	K 1.54	K 22.23	K 3.15	K 2.17	K 67.52	K 0.69		K 2.43	G 0.80	K 0.30	K 0.16	K 0.20	X 0.15	M 0.03	X 0.06				0.000143
107		X 22.24	X 3.18	X 2.18	X 67.78	X 0.77		X 2.38			X 0.13	X 0.18		X 0.04					
108	K 1.60	K 21.88	K 3.82	K 2.19	K 66.99	K 0.99		K 2.20	G 0.11	K 0.27	K 0.11	K 0.22		M 0.04					0.000330
108	K 1.57	K 21.92	K 3.32	K 2.23	K 67.19	K 0.98		K 2.20	C 0.12	K 0.25	K 0.12	X 0.20		K 0.04					
109	K 1.67	X 21.50	X 3.20	X 2.21	X 67.60	X 0.89		K 2.40		K 0.56	X 0.17	X 0.18		X 0.03					
109	K 1.68	X 21.80	X 3.23	X 2.18	X 67.35	X 0.78		K 2.40		K 0.57	X 0.16	X 0.19							
109								X 2.45											
109								X 2.52											
110	K 1.51	K 22.23	K 3.33	K 2.15	K 66.63	K 0.73		K 2.40	N0.31	K 0.29	X 0.12	X 0.18		M 0.04					0.000156
110	K 1.51													K 0.04					
111	K 1.55	K 22.37	K 3.25	K 2.04	K 66.49	K 0.72		K 2.33	N0.36	K 0.25	K 0.10	K 0.11		M 0.04					0.000154
111	K 1.53	K 22.38	K 3.25	K 2.06	K 66.48	K 0.72		K 2.31		K 0.31	K 0.12			K 0.04					
112	K 1.43	X 21.98	X 3.17	X 2.16	X 67.19	X 0.76	X 0.11	K 2.25	G 0.31	K 0.53	X 0.14	X 0.18	X 0.16	P 0.04	X 0.06	X 0.14			
112	K 1.51	X 21.97	X 3.17	X 2.16	X 67.20	X 0.76	X 0.11	K 2.12		K 0.41	X 0.14	X 0.18	X 0.15		X 0.06	X 0.14			
112	D 1.41		M 3.31	M 2.21	M 67.15	M 0.75	N 0.13	X 2.42			M 0.16	M0.19							
112								X 2.43											
113	K 1.52	K 22.24	K 3.34	K 2.51	K 66.69	K 0.96		K 2.32	N0.18	K 0.57	K 0.20	K 0.20		M 0.04					0.000097
114	K 1.34	K 23.46	K 3.48	K 2.24				K 2.40		K 0.62	K 0.13	K 0.18		M 0.04					
115	K 1.39	K 22.41	K 3.37	K 2.03	K 66.90	K 0.79		K 2.38	C 0.52	K 0.56	X 0.15	X 0.16	X 0.16	M 0.04	X 0.06	X 0.12			
115	K 1.37	K 22.46	K 3.32	K 2.06	K 67.04	K 0.80		K 2.38	C 0.57	K 0.61	X 0.14	X 0.16	X 0.17	K 0.04	X 0.06	X 0.12			
116	K 1.59	X 22.56	X 3.24	X 2.07	X 67.12	X 0.75	X 0.15	X 2.34	G 0.44	K 0.33	X 0.13	X 0.13	X 0.16	P 0.03	X 0.07				N 0.000185
116	K 1.58	X 22.52	X 3.20	X 2.07	X 67.29	X 0.76	X 0.14	X 2.31			X 0.13	X 0.11	X 0.16		X 0.07				
117	K 1.51	K 21.92	K 3.76	K 2.20	K 68.40	K 0.43		K 2.23	G 0.26	K 0.43	X 0.13	X 0.17	X 0.14	M 0.04	X 0.06	X 0.14			K 0.000180
117	K 1.47	X 22.35	X 3.25	X 2.20	X 66.98	X 0.77		K 2.21		K 0.44				K 0.04					
117								X 2.23											
118	K 1.51	X 22.32	X 3.27	X 2.20	X 66.97	X 0.89		X 2.33		K 0.29	M 0.15	X 0.16	X 0.26	M 0.04	X 0.07	X 0.14	N 1.21		
118	K 1.53	X 22.24	X 3.22	X 2.20	X 67.35	X 0.78		X 2.34		K 0.35		X 0.15	X 0.18	K 0.04	X 0.07	X 0.14			
118												M0.17							
119	K 1.65	X 22.28	X 3.25	X 2.16	X 67.12	X 0.72		N 2.40	B 0.55	K 0.27	X 0.11	X 0.19	X 0.15	M 0.04	X 0.06	X 0.14			K0.000152
120	K 1.53	X 22.42	X 3.09		X 67.48	X 0.83	X 0.11	X 2.27			X 0.28	X 0.22							
121	K 1.63	K 21.57	N 3.67	K 2.25	K 68.99	N 0.81		K 2.43	G 0.42	K 1.20	A 0.19	A 0.21	N 0.16						0.000156
121a	K 1.63	K 22.17	K 3.34	K 2.19	K 66.83	K 0.74	N 0.11	K 2.39	G 0.57	K 0.29	A 0.15	A 0.21	N 0.13	M 0.04	N 0.06		1.19	0.02	
121a		K 22.19	N 3.31	N 2.24	N 66.81	N 0.70		N 2.36						N 0.04					
122	D 1.61	X 21.91	X 3.08	X 2.18	X 67.08	K 0.75	X 0.11	X 2.35	G 0.73	K 0.21	X 0.15	X 0.18	X 0.15	P 0.04	X 0.06	X 0.14	1.09	0.00	0.000160
123	K 1.60	X 22.20	X 3.16	X 1.98	X 67.37	X 0.73	X 0.10	K 2.37	C 0.54	K 0.52	K 0.12	K 0.13	X 0.14	M 0.04	X 0.06	X 0.14	1.14	0.01	0.000140
123								X 2.34			X 0.12	X 0.18		P 0.04		N0.13			
123								N 2.38			N 0.11	N 0.11							
124	K 1.34	X 21.95	X 3.15	X 2.16	X 67.04	X 0.76		X 2.70	G 0.34		X 0.14	X 0.17	X 0.15		X 0.06				
125	K 1.53	K 22.17	K 3.20	K 2.15	K 66.76	K 0.74		K 2.36	G 0.61	K 0.53	K 0.18	K 0.19		M 0.04					
125		X 22.15	X 3.21	X 2.16	X 66.80	X 0.74		X 2.33	C 0.62		X 0.19	X 0.18		X 0.03					
126	N 1.53	X 22.21	X 3.24	X 2.18	X 66.98	X 0.76	X 0.10	X 2.45	N0.48	N 0.31	X 0.14	X 0.16	X 0.15	M 0.04	X 0.07	X 0.14	N 1.16		0.000147
126		X 22.21	X 3.28	X 2.17	X 66.82	X 0.77	X 0.10	X 2.44			X 0.15	X 0.17	X 0.15		X 0.06	X 0.14			
126								N 2.45											
127	K 1.50																		
127	K 1.49																		
128	K 1.57	X 20.88	X 3.10	X 2.26	X 67.84	X 0.11	X 0.11		C 0.67			X 0.21	X 0.15	X 0.05	X 0.05		1.13	0.00	
128	K 1.57																		
129	K 1.54	X 22.23	X 3.27	X 2.17	X 67.08	X 0.79	X 0.11	K 2.33	C 0.43	K 0.56	A 0.13	A 0.17	X 0.15	M 0.04	X 0.07				0.000105
130	K 1.51	K 21.70	K 3.23	K 2.11	K 67.40	K 1.09		K 2.35	B 0.56	K 0.63	X 0.05	X 0.19		M 0.05					
131	K 1.61	K 22.19	K 3.35	K 2.16	K 66.91	K 0.77		K 2.34	G 0.51	K 0.48	K 0.14	K 0.17		M 0.04					
132	K 1.53	K 22.12	K 3.26	K 2.13	K 66.70	K 0.72	X 0.13	K 2.35	G 0.72	K 0.66	X 0.13	X 0.16	X 0.16	P 0.04	X 0.06	X 0.13			0.000090
132		X 22.22	X 3.23	X 2.13	X 66.63	X 0.70		X 2.38			A 0.16	A 0.17							
133	N 1.48	N 22.18	N 3.23	N 2.16	N 67.21	N 0.68		N 2.43	N0.57	N 0.38	N 0.15	N 0.18	N 0.15	N 0.04	N 0.08				K0.000000
134	K 2.57	X 21.87	X 3.72	X 2.30	X 68.21	X 0.88		X 2.17	G 0.93		X 0.11	X 0.16	X 0.15	X 0.03	X 0.06	X 0.14			0.000152
135	K 1.55	X 22.56	X 3.20	X 2.10	X 66.22	X 0.76	X 0.12	K 2.35		K 0.58	X 0.16	X 0.16		X 0.04	X 0.06				
135								X 2.33											
136	K 1.56	X 22.70	X 3.10	X 2.18	X 67.61	X 0.81		K 2.23	G 0.47	K 0.37	X 0.15	X 0.17	X 0.15	K 0.03	X 0.04	X 0.13			K0.000144
136								K 2.11		K 0.28				X 0.04					
136								X 2.24											
137	K 1.65	X 22.27	X 3.10	X 2.36	X 66.29	X 1.52		X 1.91	N0.28	K 0.44	K 0.07	K 0.20		X 0.02			1.10		0.000150
137	K 1.65																		
138	K 1.39	K 22.50	K 3.14	K 2.22	K 65.73	K 1.12	X 0.12	K 2.24	G 0.56	K 0.45	X 0.10	X 0.16	X 0.14	M 0.03	X 0.06	X 0.12	N 1.27		N0.000146
138	D 1.49	K 22.20	K 2.63	K 2.09	K 65.71	K 0.95	X 0.12	K 2.04	C 0.50		X 0.10	X 0.17	X 0.15	K 0.33	X 0.05	X 0.12			
138		X 21.30	X 2.63	X 2.00	X 65.18	X 0.82		X 2.15	C 0.60		A 0.01	A 0.18		X 0.03					
138		X 21.87	X 2.77	X 2.03	X 66.76	X 0.73		X 2.17	N0.72										
139	K 1.69	K 20.72	K 3.53	K 2.37	K 66.68	K 0.97		K 2.25	B 0.28	K 0.39				M 0.05					0.000113
139	K 1.67	K 20.81	K 3.51	K 2.32	K 66.60	K 0.96		K 2.24	N0.30	K 0.42				K 0.05					
139														P 0.05					
140	K 1.55	K 22.26	K 3.47	K 2.26	K 66.20	K 0.85	X 0.10	K 2.47		K 0.79	K 0.09	K 0.16	X 0.11	M 0.04	X 0.06				0.000170

Labs	Loss on ignition (%)	SiO2 (%)	Al2O3 (%)	Fe2O3 (%)	CaO (%)	MgO (%)	MnO (%)	SO3 (%)	Free lime (%)	Insoluble residue (%)	Na2O (%)	K2O (%)	TiO2 (%)	Chloride (%)	P2O5 (%)	SrO (%)	CO2 (%)	S-- (%)	Cr6+ (%)
141	K 1.53	X 22.09	X 3.20	X 2.10	X 66.95	X 0.75	X 0.11	X 2.40	N0.32	K 0.34	X 0.20	X 0.16	X 0.14	N 0.02	X 0.05	X 0.15		0.02	
142	K 1.50	K 22.34	K 3.06	K 2.09	K 67.43	K 0.80		K 2.44	N0.54	K 0.65	X 0.13	X 0.14		M 0.04					N0.000165
142		X 22.31	X 3.02	X 2.07	X 67.04	X 0.72		X 2.38											
143	K 1.66	K 22.74	K 3.22	K 2.16	K 66.31	K 0.74	X 0.12	K 2.36	G 0.63	K 1.47	A 0.15	X 0.18	X 0.17	K 0.04	X 0.05	X 0.11	N 1.20		K0.000123
143	N 1.38	X 22.90	X 3.23	X 2.13	X 66.53	X 0.71						A 0.18							
144	K 1.35	X 21.55	X 3.34	X 2.16	X 68.03	X 0.88	X 0.11	X 2.01	G 0.32	K 0.41	X 0.08	X 0.25	X 0.12	M 0.03	X 0.10		N 1.53		
144								N 2.19						X 0.03					
145	K 1.55	K 22.21	K 3.23	K 2.15	K 66.68	K 0.71	X 0.13	K 2.36	G 0.63	K 0.66	X 0.16	X 0.18	X 0.16	M 0.04	X 0.05	X 0.12			0.000102
145		X 22.22	X 3.24	X 2.16	X 66.65	X 0.72		X 2.36			A 0.15	A 0.18							
146	K 1.66	K 21.91	K 3.25	K 2.22	K 66.83	K 0.66	X 0.11	K 2.38	G 0.79	K 0.59	X 0.18	X 0.18	X 0.16	M 0.04	X 0.05	X 0.14	N1.10		N0.000143
146	N 1.62	K 22.09	K 3.28	K 2.18	K 66.73	K 0.74		K 2.35		K 0.46				K 0.03					
146								N 2.46						X 0.05					
147	K 1.57	X 22.38	X 3.21	X 2.21	X 67.59	X 0.76	X 0.11	N 2.46		K 0.18	X 0.15	X 0.19	X 0.15	N 0.03	X 0.07	X 0.13			K0.000150
148	K 1.67	X 22.71	X 3.32	X 2.10	X 66.79	X 0.75	X 0.12	K 2.22	G 0.33	K 0.57	X 0.16	X 0.18	X 0.16	P 0.04	X 0.06	X 0.12	K 1.23	K 0.02	0.000088
148		X 22.71	X 3.31	X 2.11	X 66.72	X 0.75	X 0.12				X 0.16	X 0.18	X 0.16		X 0.06	X 0.12			
149	K 1.41	X 22.30	X 3.30	X 2.10	X 66.90	X 0.78		K 2.36	G 0.60	K 0.45	K 0.12	X 0.17	X 0.17	M 0.04	X 0.06		K 1.16	K 0.01	
149	K 1.35	X 22.30	X 3.30	X 2.10	X 66.90	X 0.79		K 2.39		K 0.43	K 0.13	X 0.13	X 0.18	K 0.04	X 0.07				
150	K 1.55	K 22.35	K 3.23	K 2.18	K 67.33	K 0.74	X 0.13	K 2.44		K 0.65	K 0.08	K 0.12	X 0.15	P 0.03	X 0.06	X 0.13			
150	K 1.51	K 22.36	K 3.23	K 2.18	K 67.31	K 0.74	X 0.13	K 2.40			K 0.09	X 0.14	X 0.15		X 0.06	X 0.13			
151	N 1.65	X 22.14	X 3.26	X 2.19	X 67.29	X 0.81	X 0.11	X 2.38	C 0.42	K 1.51	X 0.15	X 0.19	X 0.15	X 0.03	X 0.06	X 0.14	N 1.09		
151								N 2.43		K 1.92									
152	K 1.57	K 22.17	K 3.24	K 2.18	K 67.10	K 0.71	X 0.13	K 2.36	C 0.53	K 0.44	K 0.15	K 0.17	X 0.14	M 0.04	X 0.07	X 0.13	1.12	0.00	0.000160
152	K 1.64	K 22.18	K 3.27	K 2.38	K 67.16	K 0.64	X 0.13	K 2.42	C 0.52	K 0.34	K 0.15	X 0.16	X 0.14	K 0.04	X 0.06	X 0.13			
152		X 22.17	X 3.24	X 2.18	X 67.07	X 0.69		X 2.34											
152		X 22.09	X 3.24	X 2.18	X 67.16	X 0.69		X 2.36											
153	K 1.65	X 22.41	X 3.52	X 2.11	X 67.35	X 0.88		K 2.22	G 0.56	K 0.43	X 0.12	X 0.23							
154	K 1.61		K 3.21	K 2.25				K 2.27		K 0.37				M 0.04					
155	K 1.58	K 22.26	X 3.14	X 2.15	X 67.34	X 0.74	X 0.74	K 2.34	G 0.63	K 0.31	K 0.15	K 0.18	X 0.14	X 0.04	X 0.06	X 0.14			
155	K 1.57	K 22.31	X 3.14	X 2.18	X 67.23	X 0.74	X 0.74	K 2.40		K 0.38	K 0.14	X 0.14	X 0.15	N 0.04	X 0.06	X 0.14			
155								X 2.39			X 0.13	X 0.16							
155								X 2.41			X 0.14	N 0.18							
156	D 1.53	X 22.26	X 3.31	X 2.14	X 66.71	X 0.76													
157	K 1.54	X 21.80	X 3.16	X 2.09	X 66.62	X 0.77	X 0.11	X 2.38		K 1.75	X 0.13	X 0.18	X 0.16		X 0.06	X 0.13	N 1.45		K0.000142
158	K 1.65							K 2.50		K 0.36				M 0.03					
159	D 1.61	M 22.13	M 3.31	M 2.16	M 66.82	M 0.74	N 0.11	N 2.42	G 0.22	K 0.49	M 0.15	M0.22	N 0.15	P 0.04	N 0.07	N 0.12	N 1.17		0.010000
200	N 1.64	N 22.24	N 3.27	N 2.19	N 66.71	N 1.58		N 2.46	N0.37	N 0.55		N 0.19		N 0.03					
201	K 1.48	K 22.43	K 3.33	K 2.04	K 66.84	K 1.08		K 2.46	C 0.38	K 0.43	X 0.13	X 0.16		M 0.01			N 1.03		
201		X 22.39	X 3.28	K 1.94	X 66.76	X 1.12		X 2.58				X 0.14		X 0.01					
201				X 2.04															
202	N 1.52	X 22.50	N 3.20	X 2.09	X 66.60	X 0.71		X 2.42	N0.58	N 0.48	A 0.15	X 0.15	X 0.14	N 0.02			N 0.92		
202		N 22.28		N 2.27	N 67.60	N 0.82		N 2.39			N 0.10	A 0.18							
202												N 0.16							
203	K 1.70	K 21.95	K 3.26	K 2.18	K 67.08	K 0.75	X 0.07	K 2.26	G 0.35	K 0.37	K 0.18	K 0.17	X 0.15	X 0.03	X 0.06	N 0.14	0.38	0.02	0.000145
203		X 22.00	X 3.22	X 2.19	X 67.02	X 0.75		X 2.25			X 0.15	X 0.17	N 0.17	N 0.03	N 0.07				
203			M 3.26	M 2.25		M 0.76					M 0.16	M0.18							
204	K 1.66	M 21.75	M 3.38	M 2.29	M 66.99	M 0.78	N 0.13	K 2.28	G 0.52	K 0.26	M 0.14	M0.17	N 0.15	P 0.04	N 0.08				N0.000119
204	K 1.67	N 21.95	N 3.37	N 2.29	N 66.81	N 0.78		K 2.31	N0.52	K 0.22	N 0.16	N 0.17		N 0.04					
204								N 2.35											
205	K 1.60	X 22.00	X 3.21	X 2.24	X 67.10	X 0.72		K 2.39	C 0.70	K 0.17	X 0.11	X 0.16		K 0.05	X 0.07				0.000115
205								X 2.34											
206	K 1.59							K 2.32	G 0.73	K 0.23									K0.000151
206	K 1.62							K 2.40		K 0.32									
207	K 1.45																		
208	K 1.55	X 22.37	X 3.30	X 2.08	X 66.87	X 0.76	X 0.11	X 2.31	B 0.43	N 0.34	X 0.15	X 0.16	X 0.14	P 0.04	X 0.07	X 0.12	1.21	0.00	0.000150
210	K 1.53																		
211	K 1.50	X 22.33	X 3.25	X 2.15	X 66.31	X 0.76	X 0.11	X 2.30	G 0.50	N 0.52	X 0.14	X 0.19	X 0.16	P 0.04	X 0.07	X 0.12			
211								N 2.32											
212	K 1.52	X 22.24	X 3.11	X 2.17	X 67.11	X 0.73	X 0.02	X 2.38	C 0.57	K 0.58	X 0.10	X 0.14	X 0.15	P 0.05	X 0.06	X 0.14			
212	K 1.48	X 22.34	X 3.10	X 2.19	X 67.03	X 0.73	X 0.02	X 2.36	C 0.54	K 0.60	X 0.12	X 0.12	X 0.15		X 0.06	X 0.14			
213	K 1.47	X 22.12	X 3.54	X 2.18	X 66.18	X 0.83		X 2.35	G 0.66	K 1.36	X 0.16	X 0.20		X 0.03	X 0.07				
213	K 1.46	X 22.11	X 3.55	X 2.17	X 66.19	X 0.82		X 2.33		K 1.34	X 0.15	X 0.19			X 0.05				
215	N 1.60	X 22.08	X 3.19	X 2.23	X 67.18	X 0.74		X 2.42		K 2.25	X 0.18	X 0.14	X 0.13	X 0.02	X 0.02				
216	K 1.73																		
217	K 1.60	K 22.03	K 3.28	X 2.20	X 67.14	X 0.77	X 0.12	X 2.26	G 0.59	K 0.52	X 0.11	X 0.20	X 0.14	P 0.03	X 0.04				
217								N 2.32											
218	K 1.56							K 2.29		K 0.43	K 0.14	K 0.19		M 0.04			1.81		0.000160
219	K 1.95	X 22.23	X 4.00	X 2.18	X 67.24	X 0.74		K 2.18	B 0.37	K 0.45	X 0.12	X 0.14		M 0.03				0.02	
220	D 1.45							K 2.13		K 0.53				P 0.06					
220								K 2.19											
221	K 1.54	X 22.20	X 3.21	X 2.18	X 66.89	X 0.76		K 2.22	G 0.76	K 0.31	K 0.03	K 0.16		P 0.06			N 1.34		
221								X 2.31				X 0.17							
222	K 1.73																		
222	K 1.71																		
223	D 1.57	X 22.25	X 3.88	X 2.28	X 64.63	X 0.84		X 2.63	G 0.70	N 0.40	X 0.30	X 0.19		X 0.03					
224	K 1.54	X 22.21	X 3.54	X 2.15	X 67.76	X 0.72		X 2.12	G 0.59	N 0.40	X 0.13	X 0.16		X 0.03					
225	K 1.63	K 22.09	K 3.19	K 2.14	K 67.03	K 0.75	X 0.12	K 2.40	G 0.60	K 0.30	X 0.07	X 0.15	X 0.14	M 0.03	X 0.03	X 0.12			
225								X 2.36											

Labs	Loss on ignition (%)	SiO2 (%)	Al2O3 (%)	Fe2O3 (%)	CaO (%)	MgO (%)	MnO (%)	SO3 (%)	Free lime (%)	Insoluble residue (%)	Na2O (%)	K2O (%)	TiO2 (%)	Chloride (%)	P2O5 (%)	SrO (%)	CO2 (%)	S-- (%)	Cr6+ (%)
226	K 2.01	X 22.05	X 3.35	X 2.25	X 67.09	X 0.64		X 2.17	G 0.71	K 0.37	X 0.07	X 0.14		K 0.01					
227								K 2.36		K 0.40									
227								K 2.30		K 0.41									
228	K 1.59					M 0.63		K 2.47		K 0.65				K 0.03					N0.000118
228	K 1.59							K 2.41		K 0.68				P 0.03					
228								N 2.35											
229	K 1.54	X 22.09	X 3.22	X 2.17	X 66.97	X 0.77	X 0.13	X 2.33	G 0.55	K 0.44	X 0.13	X 0.18	X 0.16	M 0.04	X 0.06			0.01	
229	K 1.53	X 22.10	X 3.25	X 2.15	X 66.89	X 0.75	X 0.13	X 2.33		K 0.42	X 0.13	X 0.18	X 0.17	K 0.04	X 0.06				
229														P 0.04					
230	D 1.59	X 22.12	X 3.25	X 2.17	X 66.83	X 0.76	X 0.05	X 2.30	G 0.62	K 0.47	X 0.17	X 0.17	X 0.15		X 0.06				
230		X 22.08	X 3.25	X 2.18	X 66.90	X 0.76	X 0.05	X 2.28			X 0.16	X 0.17	X 0.15		X 0.06				
231	K 1.83	X 22.00	X 3.20	X 2.30	X 66.83	X 0.86		X 2.09	C 0.39	K 0.40	X 0.18	X 0.16		M 0.03					0.000185
232	N 1.90	X 22.04	X 3.20	X 2.09	X 66.46	X 0.78	X 0.11	X 2.33	B 0.37	N 0.23	X 0.18	X 0.18	X 0.14	P 0.03	X 0.06	X 0.13	N 0.90		
232														X 0.03					
233	N 1.63	X 22.20	X 3.32	X 2.18	X 66.98	X 0.77	X 0.13	X 2.33	B 0.31		X 0.15	X 0.18	X 0.15	X 0.04	X 0.06	X 0.13			
234	N 1.48	X 22.07	X 3.16	X 2.15	X 67.90	X 0.80		X 2.56			X 0.16	X 0.19	X 0.16	X 0.04	X 0.07				
236	N 1.46	X 22.22	X 3.26	X 2.17	X 66.86	X 0.72	X 0.05	X 2.30	B 0.28	K 0.37	X 0.14	X 0.18	X 0.15	P 0.03	X 0.05	X 0.13			K0.000140
236														X 0.04					
237	N 1.63	X 21.88	X 3.19	X 2.18	X 66.95	X 0.76		X 2.37	B 0.39	K 0.26	X 0.15	X 0.18	X 0.15	X 0.04	X 0.06				
238	N 1.56	X 22.43	X 3.30	X 2.18	X 67.92	X 0.75		X 2.38			X 0.15	X 0.18	X 0.16	X 0.04	X 0.06				
239	N 1.52	M 22.38	M 3.30	M 2.30	M 66.84	M 0.75	N 0.13	N 2.34	B 0.50	N 0.36	M 0.14	M0.17	N 0.14	P 0.04	N 0.06	N 0.13			0.000106
240	K 1.55	X 21.89	X 3.20	X 2.08	X 66.81	X 0.71	X 0.12	K 2.32		K 0.40	X 0.15	X 0.20	X 0.14	M 0.03	X 0.06				K0.000153
240	K 1.52	X 21.92	X 3.21	X 2.09	X 66.83	X 0.72	X 0.12	K 2.32		K 0.40	X 0.16	X 0.21	X 0.14	K 0.03	X 0.06				
240								X 2.37											
240								X 2.37											

Labs	Specific Gravity (g/cm3)	Specific Surface (cm^2/g)	Corrected Surface (cm^2/g)	Normal concistency (%)	Initial Setting Time (min)	Soundness (mn)	Workability (s)	Fluidity (s)
1	V 3.14	N 3713	3717	28.0	A 160	0.10		
1				28.0	A 160	0.10		
2	A 3.14	A 3600	3604	27.6	A 150	0.00		
2a	A 3.13	A 3570	3592	27.4	A 150	2.00		
3	V 3.13	G 3580	3593	27.4	A 155	0.00		
3	V 3.14			27.2	M 160			
4	A 3.15	A 3700	3686	27.2	A 150	0.00		
4	A 3.16			27.2	A 143			
4				27.2				
5	A 3.14	A 3557	3566	27.0	M 155	1.00		
6	V 3.14	N 3563	3567	28.2	A 135	0.00		
6					A 125			
7	A 3.16	A 3736	3703	28.8	A 171	0.00		
7				28.9	A 174	0.00		
8	A 3.13	N 3550	3572	27.5	A 154			
9	V 3.13	A 3680	3703	27.5	A 145	0.00		
10	V 3.15	N 3790	3775	26.6	A 115	0.50		
11	V 3.14	A 3690	3694	27.6	M 165	1.00		
12	A 3.15	N 3680	3666	27.5	A 155	2.00		
13	V 3.12	G 4020	4065	28.0	A 160	0.50		
13				28.0	A 170	0.50		
14	V 3.14	N 3614	3618		A 166	0.10		
14	V 3.14				A 165	0.20		
15	A 3.18	N 3730	3667	27.5	A 140	1.00		
16	A 3.18	G 3720	3687	27.5	A 152	1.00		
16	A 3.16							
17	A 3.16	G 3610	3596	27.5	A 165	1.50		
17	A 3.15			27.0	A 150	1.00		
20	V 3.10	G 3520	3595	27.8	A 160	0.70		
20					M 140			
21	A 3.18	N 3627	3558	28.3	A 154	0.00		
21	A 3.18			28.4	A 168	0.00		
22	A 3.19	A 3730	3634	29.0	A 185			
23		A 3692		27.7	A 168	0.50		
24	A 3.14	A 3699	3703					
25	A 3.14	A 3678	3682	27.0	A 150	1.00		
26	V 3.13	N 3630	3598	27.8	A 180	0.00		
26	V 3.16			27.4	A 180	1.00		
27	V 3.11	N 3317	3371	28.5	A 159	2.00		
28	V 3.14	N 3645	3649	27.3	A 158	1.00		
28				27.3	A 153			
29	A 3.17	A 3735	3693	27.7	A 165	0.00		
30	V 3.16	A 3720	3687					
31	V 3.16	A 3640	3611	27.7	A 162	0.50		
32	A 3.14	G 3615	3619	28.0	A 131	1.00		
33	V 3.02	G 3522	3737					
34	A 3.14	G 3630	3643	28.4	A 187	0.10	3.1	
34	V 3.13							
35	V 3.18	G 3783	3712	28.7	A 173	1.30		
36	A 3.14	A 3683	3687	27.6	A 152	1.00		
36				27.8	A 155	1.00		
37		N 3492						
38	A 3.14	A 3740	3744	27.9	A 166	0.50		
39				28.4	M 175			
39				28.4	M 177			
40		L 3653		27.9	A 163	1.00		
41	A 3.17	A 3682	3640	27.5	A 159	0.77		
42	A 3.14	G 3359	3363	29.4	A 191	0.30		
43	A 3.18	G 3800	3728		M 190	0.50		
44	V 3.14	G 3799	3803	28.0	A 174	2.00		
44				27.8	A 157	2.00		
45	A 3.18	G 3774	3703	26.8	M 140	1.00		
46		A 3674		27.1	A 139	0.50		
47	V 3.12	G 3790	3832	28.0	A 150	0.50		
48	V 3.14	G 3641	3663	29.7	A 149	0.00	4.0	
48	V 3.12			29.6	A 156	0.00	4.0	
48				29.0				
48				29.2				

Labs	Specific Gravity (g/cm3)	Specific Surface (cm^2/g)	Corrected Surface (cm^2/g)	Normal concistency (%)	Initial Setting Time (min)	Soundness (mn)	Workability (s)	Fluidity (s)
49	A 3.10	G 3564	3639	28.0	A 157	0.50		
50	V 3.14	G 3666	3670	27.4	A 160	1.00		
50				27.5	A 155	1.00		
51	A 3.14			27.8	A 150	1.50		
51				27.8	A 165			
51					M 170			
52	V 3.13	G 3681	3704	29.0	A 182			
53	V 3.20	G 3920	3807	27.8	A 175	2.00		
54	V 3.12	G 3947	3991	28.0	A 141	1.00		
54				31.0	A 154			
55	A 3.13	G 3673	3677	27.5	A 167	0.00		
55	A 3.14			28.0	M 160	0.00		
56	A 3.14	G 3650	3654	27.5	A 140	0.00		
56				27.2	A 160	0.00		
56					M 145			
57	V 3.16	A 3675	3643	29.0	A 150	0.00		
58	V 3.16	A 3718	3685	28.2	A 177	0.75		
59	V 3.12	G 3720	3771	27.4	A 180	1.00		
59	V 3.11							
60	A 3.14	G 4100	4125	28.0	A 170	1.00		
60	A 3.13							
61	V 3.16	L 3725	3692	28.0	A 162	1.00		
62	A 3.17	N 3685	3634	27.6	A 163	0.00		
63	A 3.17	G 3786	3734	26.3	A 130	0.00		
64	V 3.16	N 3678	3646	28.0	M 160	1.00		
65		G 3508		26.9	A 184	0.50		
71				27.5	A 152			
71					A 151			
72	A 3.15	G 3720	3706	27.4	A 170	1.00		
73	A 3.11	G 4767	4844	27.6	M 137	0.50		
74	V 3.15							
74	V 3.17							
75	A 3.20	A 3912	3807	28.3	A 230			
76	V 3.14	G 3960	3945					
76	V 3.16							
77	A 3.14	G 3740	3744	27.6	M 140			
78	A 3.16	G 3686	3653	30.8	A 194	0.30		
79	V 3.26	N 3893	3683	29.0	A 152	1.00		
79	V 3.25							
80	V 3.15	N 3660	3646	27.4	M 165	1.00		
80d	V 3.15	N 3630	3616	27.4	M 180	0.50	4.1	
80e	V 3.15	N 3770	3756	27.4	M 160	0.50		
81	V 3.14	G 3627	3631					
82	A 3.14	G 3450	3506		A 165			
82	A 3.11							
83	A 3.06	G 3456	3598	30.0	M 215	0.40		
87	V 3.13	G 4110	4135	27.2	A 130	0.30		
88	V 3.14			28.0	A 200		3.3	5.1
88	V 3.16							
100	A 3.15	N 3567	3553	28.2	A 152	0.50		
101	A 3.15	N 3720	3706	28.1	A 165	1.50		
102	V 3.14	A 3580	3584	27.4	A 155	1.00		
102				27.6	A 160			
103	A 3.14	N 3590	3594	27.8	A 155	0.50		
104	A 3.16	N 3790	3757	27.2	A 140	0.20		
105		N 4086		27.7	A 150			
106	V 3.12	N 3587	3627	27.0	A 120			
107	A 3.16	N 3680	3647	27.4	A 145	0.00		
108	V 3.13	N 3595	3617	26.8	M 150	0.00		
109	V 3.14	N 3875	3880		A 150	0.50		
109					A 170			
110	V 3.11	N 3657	3716	27.6	A 140			
111	V 3.11	N 3610	3668	26.8	A 150			
111					A 150			
111					M 160			
112	A 3.17	N 3812	3759	27.4	A 135	0.50		
112	A 3.17			27.6	A 135	0.40		
112					M 120			
112					M 120			
113	V 3.12	N 3587	3627	27.0	A 120			

Labs	Specific Gravity (g/cm3)	Specific Surface (cm^2/g)	Corrected Surface (cm^2/g)	Normal concistency (%)	Initial Setting Time (min)	Soundness (mn)	Workability (s)	Fluidity (s)
114	A 3.14	A 4047	4052	27.8	M 148	0.50		
115	V 3.11	N 3609	3667	28.5	M 180	0.80		
115					M 175	0.80		
116	A 3.16	G 3700	3667	27.0	A 155	0.00		
117	A 3.15	N 3397	3379	28.5	A 170	0.00		
117	A 3.15							
118	V 3.15	N 3684	3670	27.5	A 130			
119	A 3.14	A 3585	3589	27.5	A 160	1.00		
120	A 3.14	A 3620	3624	26.1	M 150			
121	A 3.18	N 3727	3657	28.4	A 165	0.30		
121						0.30		
122	A 3.17	A 3642	3592	27.2	M 145	0.00		
122						0.50		
123	A 3.16	G 3670	3638	27.5	A 135	0.50		
124	V 3.16	A 3750	3717	27.3	M 145	1.50		
125	V 3.14	A 3655	3659	27.8	A 150	0.50		
126	A 3.14	A 3710	3720	27.3	A 142	0.00		
126				27.6	A 141	0.00		
127	V 3.14	A 3595	3608	26.7	A 141			
127	V 3.13	N 3696	3719	26.5	A 137			
128	A 3.13	G 3695	3718	28.0	A 152	0.75		
128				28.0	A 170			
129	A 3.12	L 3620	3660	27.9	A 160	0.60		
129					M 162			
130	V 3.14	N 3852	3856	28.2	A 140	0.00		
130						0.00		
131	V 3.13	G 3580	3602	28.6	M 155	0.50		
132	V 3.15	G 3724	3710	27.8	A 151	0.80		
133	V 3.11	N 3580	3638	28.4	A 160	1.00		
134	A 3.14	N 3718	3722	27.4	A 149			
135				27.0	A 126			
136	A 3.10	N 3505	3579	28.0	A 172	0.15		
136				27.8				
136				27.9				
136				27.9				
137	V 3.03	N 3340	3528	28.6	A 134	0.00		
137						0.00		
138	A 3.19	A 3550	3469		A 140	0.50		
138	V 3.13	N 3750	3719		A 135	0.50		
139	A 3.14	N 4186	4191	29.2	A 180	1.00		
139				29.0	A 185	1.00		
139				29.0	M 185			
139				29.0	M 185			
140	A 3.11			27.0	A 125	0.00		
141	A 3.11	N 3881	3944	27.4	A 149	1.00		
142	V 3.17	A 3743	3691	27.4	A 161	1.00		
143	V 3.15	A 3620	3606	28.0	A 145	1.00		
143					M 155			
144	V 3.11	A 3506	3563	27.8	A 170	0.20		
145	V 3.14	A 3720	3724	28.0	A 150	1.00		
145					M 155			
146	V 3.13	A 3814	3857	28.0	A 180	0.00		
146	V 3.11					0.50		
147				27.0	M 136	0.00		
148	V 3.24	N 3885	3697	28.0	A 175	0.00		
148					A 177	0.00		
150	A 3.14	A 3619	3623	27.7	A 175	0.00		
151	A 3.14	A 3774	3778	27.8	A 140	1.00		
152	A 3.16	A 3720	3687	28.0	A 164	1.50		
152	A 3.15			28.0	A 162			
152	V 3.15				M 160			
153	V 3.18	A 3490	3424		A 160	0.00		
154	V 3.12	N 3540	3580	27.0	A 144	0.00		
155	A 3.14	N 3631	3617	28.0	A 175	0.50		
155	A 3.16			28.0	A 181	0.00		
156	V 3.14			27.4	M 165	1.00		
157	A 3.16	A 3482	3451					
157		N 5045	5000					
158	V 3.16	N 3680	3629	29.6	M 188	0.40		
158	V 3.17			29.6	M 177	0.00		

Labs	Specific Gravity (g/cm3)	Specific Surface (cm^2/g)	Corrected Surface (cm^2/g)	Normal concistency (%)	Initial Setting Time (min)	Soundness (mn)	Workability (s)	Fluidity (s)
159	A 3.14	N 3850	3854	27.7	A 160	0.50		
159				27.4	M 158			
159					M 165			
200	A 3.12	N 3604	3644	27.9	A 154	1.00		
201	V 3.15	G 5220	5213	27.8	A 169	1.00		
201	V 3.14			27.6	A 162	1.00		
201				27.6	M 165			
202	A 3.14	N 3680	3684	28.0	M 225	0.00		
203	V 3.14	A 3615	3619	27.0	M 144	0.50		
203	V 3.14			26.9	M 143	0.50		
204	A 3.10	A 3682	3760	27.5	A 175	0.00		
204	A 3.10	N 3670	3748	27.5	A 175	0.50		
205					A 187			
206				28.0	A 150	0.00		
207		N 3640		28.5	M 135	1.00		
208	A 3.13	N 3520	3542	27.4	M 170	0.50		
209	V 3.13	N 3734	3738	27.3	A 170			
209	V 3.14				A 170			
210	V 3.11	A 3414	3469					
211	V 3.14	N 3630	3634	28.0	M 170	0.50		
212	A 3.15	A 3867	3844	27.6	A 155	0.66		
212	A 3.16	L 4062	4035	27.6	A 157	0.66		
212		N 3653	3629	27.5				
213	A 3.18	G 3835	3763	27.8	A 155	0.00		
213	A 3.18			28.0	A 154	1.00		
213				28.2	M 141			
213				28.3	M 144			
214	A 3.11	A 3772	3837					
214	A 3.11							
215	V 3.14	N 3700	3709	27.0	M 140			
216	V 3.18	A 4090	4013	27.2	A 160			
217	V 3.14	G 3689	3693		A 150	0.40		
218	V 3.08	N 4157	4286	26.6	M 148	0.83		
219	V 3.14	A 3640	3644	27.5	M 155	0.80		
220	V 3.13	N 4554	4582	26.9	M 124			
221	V 3.15	G 3721	3707	27.8	A 140	0.00		
221					M 138			
222	V 3.15	N 3686	3672	29.0	M 171			
222	V 3.15				M 170			
223	V 3.14	N 3690	3694	28.7	A 150	0.90		
224	V 3.14	G 3700	3704	28.0	A 149	1.00		
225	V 3.14	G 3683	3687	27.4	M 135	0.00		
226	V 3.15	N 3762	3748	27.6	A 160	1.00		
228	V 3.13	N 4232	4258	28.3	A 193	0.10		
229	A 3.14	N 3655	3659	28.0	A 155	0.50		
229	V 3.14			28.0	A 155	0.50		
229				28.0	M 160			
229				28.0	M 160			
230	V 3.11	N 3687	3691	28.6	M 128	1.00		
230	V 3.14			28.7	M 138	1.00		
231	A 3.18	A 3470	3405	27.6	A 148	0.90		
232	V 3.17	A 3800	3747	28.3	A 165	0.00		
233	V 3.14	N 3528	3532	27.0	M 115	1.00		
234	V 3.15	N 3570	3556	27.8	M 114	1.00		
236	V 3.15	N 3550	3536	27.2	M 105	1.00		
237	V 3.11	N 3670	3729	27.0	M 109	1.00		
238	V 3.15	N 3660	3646	27.2	M 131	0.00		
239	V 3.14	A 3650	3654	28.3	M 115	1.00		
240	V 3.15	A 3600	3586	27.5	M 155	0.00		
240	V 3.15			27.5	M 155	0.00		

Labs	Shrinkage 3d (µm/m)	Shrinkage 7d (µm/m)	Shrinkage 14d (µm/m)	Shrinkage 28d (µm/m)	Swelling 3d (µm/m)	Swelling 7d (µm/m)	Swelling 14d (µm/m)	Swelling 28d (µm/m)
6	154	325	475	613				
9	283	471	681	862	47	64	91	122
12				700				
14	139	298	480	627	52	47	37	34
16				652				-8
17	145	300	428	585	38	68	70	60
42	160	337	462	604				
62	157	323	467	633	20	23	23	30
71	196	415	519	685	39	65	100	129
72	169	344	484	646	17	19	15	17
73	154	308	419	567	4	42	52	73
76	122	288	416	616				
76a	167	342	487	717				
78	175	310	413	633	40	67	109	67
79	50	319	521	565	89	165	242	129
80	167	344	511	696	27	27	38	39
80d	167	332	477	613	36	58	63	87
80e	167	367		681				
87	138	292	456	625	6	8	11	13
108	229	323	510	625	19	61	61	65
123	130	337	406	478	44		59	74
128		225	370	469				
152	175	300	423	600				
219	269	394	431	581				
229	173	338	460	622	39	57	82	83
232		385	571	735				
234		359	550	721				
236		413	597	727				
237		427	536	680				
238		443	601	761				
239	153	341	533	705				

Labs	Heat of Hydration 41h ($J.g^{-1}$)	Heat of Hydration 3d ($J.g^{-1}$)	Heat of Hydration 5d ($J.g^{-1}$)	Heat of Hydration 7d ($J.g^{-1}$)	Maximale Flux ($J.g^{-1}.h^{-1}$)	Age at maximale flux (h)
2				343		
2a				337		
3	314					
5	344	363	375	382		
6	310	325	337		38.8	7.0
8	305					
9	335	357	372		42.4	6.8
9					44.7	7.2
10	327	349	361			
12	316					
14	322	329	334		45.0	7.0
14					46.0	7.0
15	327				45.7	5.5
16	294	296	295			
17	340	347	370		42.8	7.0
17					44.9	7.0
39	337					
57	305					
62	335	350	359			
72	301	302	306			
73	319	327	334		40.0	8.0
73					40.0	8.0
73					41.0	8.0
76	289	286	286		46.7	6.7
76					44.6	6.9
76					44.2	6.7
78	348	365	379			
80	334	352	365		42.7	8.0
80d	305	311	320		41.3	8.0
80e	308	316	325		41.1	7.0
87	292	294	300	307		
102				335		
104	302				47.9	6.8
104					46.5	6.8
108	320					
118	318	326	331			
123		291	317	333		
124	295	300	310		40.5	7.2
124					42.9	6.8
126				357		
131	321	331	339	347		
138	275	284	287			
140	301					
146	239	257	268			
148	287					
150	335	354	366	374	42.3	7.2
152	322	355			33.3	7.5
152					35.3	7.2
154	278	300	314			
155	329	344	354			
203	302	324	344	363		
204	267	307		355		
208		305		345		
211	316	333	344	334		
223	312	319	324			
226	293	295	296	297		
229	308	321	331	344		

Labs	Clinker (%)	Set regulator (%)	Minor additional constituent	Minor additional constituent	Mineralogy C3S (%)	Mineralogy C2S (%)	Mineralogy C3A (%)	Mineralogy C4AF (%)	Mineralogy free lime (%)	Mineralogy SO4Ca (%)
1	94.0	3.8	2.2		69.3	15.6	3.1	5.6	0.5	
1	94.0	3.8	2.2							
2					58.9	20.8	3.7	8.1	1.1	3.2
2a					58.1	21.3	3.7	8.3	0.8	3.4
4	94.1	2.9	3.0		68.3	14.5	3.3	6.5	0.7	2.7
6	96.1	3.9			67.7	15.7	2.2	7.0	0.4	3.6
8					67.7	14.5	2.9	6.9		
9	93.9	4.0	2.2		67.4	16.5	2.4	6.8		0.9
9	94.0	3.8	2.2							
10	96.1	3.9			77.0	4.5	4.9	6.3		
11					75.5	13.4	2.4	3.7	0.9	1.5
13	100.0	3.8			68.7	15.2	2.1	7.1	0.5	2.6
16		1.8			70.3	15.6	2.1	7.2	0.5	
17	93.2	3.3	3.5		66.7	16.2	2.6	6.8	0.5	
26	93.8	3.9	2.3		70.2	14.9	2.7	6.2	0.4	
26	93.9	3.8	2.3							
28	96.7	3.3			83.7		5.6	6.7	0.3	
43					68.6	15.4	1.9	6.4	0.5	
47	95.0	1.8			71.8	13.3	2.4	5.4	1.1	0.8
80a	93.9	3.8	2.3		72.1	6.8	4.6	6.7		4.0
80b			2.3		68.1	14.3	2.9	6.0		2.7
80c	94.0	3.8	2.2		67.9	11.2	4.7	6.6		4.1
80f	94.0	3.7	2.3		69.5	9.5	4.9	6.6		4.0
80g			2.3		67.0	18.5	2.5	5.7		2.1
100	95.1	2.9	2.0		69.6	15.9	2.5	6.1	0.5	1.7
101					73.3	7.9	4.8	6.5		
104	93.0	3.8	3.2	0.0						
106	93.7	3.7	2.5							
109					69.8	14.2	6.6	3.4		
110	93.6	3.8	2.6							
111	94.0	3.7	2.3							
112		3.6								
112		3.4								
113	93.7	3.7	2.5							
117					69.9	16.9	2.7	6.0	0.4	0.6
119					70.9	15.5	2.2	5.7	0.4	
125	93.7	3.8	2.5	0.0						
132	93.6	3.8	2.6							
135					69.6	16.6	2.4	6.9	0.5	
136	93.7	3.9	2.3		71.3	15.6	2.2	6.1	0.5	1.4
137	96.9	3.1								
138	94.2	3.4	2.4		78.1	19.0	3.6	6.1		
140					71.2	14.2	2.6	5.5	0.6	2.5
141					69.6	14.6	2.8	5.7	0.5	
142					71.3	13.6	3.3	5.6	0.0	2.8
143	93.8	3.8	2.4		69.0	12.2	3.2	5.5	0.4	4.4
144	93.7	3.5	2.7							
145	93.6	3.8	2.6							
146	100.0	3.8			71.0	14.2	2.4	6.1	0.5	1.1
146	100.0	3.8								
152	97.7		2.3				4.8	6.6		
152	97.7		2.3							
157					71.1	12.3	2.7	6.1	0.6	2.4
200	93.2	3.9	2.9		67.3	16.5	2.4	6.3	0.8	1.2
201	94.0	3.9	2.1		70.4	14.1	2.9	6.0	0.4	
202					68.3	11.6	1.7	4.8	0.6	3.8
203	96.2	3.8	0.0	0.0	73.1	8.3	4.9	6.7		
204					76.5	9.8	2.1	5.6	0.0	1.3
208					72.7	14.6	2.7	6.2		
217	97.0	4.0								
217		3.0								
218	91.0	4.9	4.1							
219	97.0	3.9	3.0							
224	93.6	3.8	2.5							
226					73.0	8.0	5.0	7.0		
229	95.0	3.8	2.4							
229	95.2	3.9								
231	93.0				72.5	8.4	4.6	7.0	0.4	
232					71.8	9.1	5.0	6.4		
234					77.3	5.2	4.9	6.6		
236					71.7	9.7	5.0	6.7		
237					74.9	6.4	4.8	6.6		
238					74.0	8.0	5.0	7.0		
239					69.0	12.3	4.8	7.0		

Particle size distribution (opening sieve in µm and expression of results in %)

N° Labo	Method	1.25	2	3.15	4	5	6.3	8	10	12.5	16	20	25	31.5	40	50	63	80	90	100	125	160	200
1	Laser	8.5	11.9	17.7	20.8	25.8	30.9	36.2	43.3	50.4	58.3	66.7	75.0	83.7	88.8	93.3	97.9						
2	Alpine														96.5	97.9	99.3	99.5	99.6	99.6	99.7	99.8	
2	Laser	17.2	21.2	26.5	30.5	35.1	41.1	48.4	55.9	63.6	72.5	80.0	87.2	92.8	96.8	99.0	99.9	100.0	100.0	100.0	100.0	100.0	100.0
2a	Alpine														95.4	97.2	99.1	99.4	99.5	99.5	99.6	99.7	
2a	Laser	17.4	21.7	27.1	31.1	35.7	41.4	48.5	55.7	63.3	72.0	79.5	86.8	92.4	96.6	99.0	99.9	100.0	100.0	100.0	100.0	100.0	100.0
3	Alpine														97.2	98.3	99.4	99.7	99.8	99.8	99.9	99.9	100.0
4	Laser	1.5	4.8	10.3	14.2	18.3	23.3	29.3	35.8	43.5	53.4	63.3	73.3	83.0	91.1	96.3	99.3	100.0	100.0	100.0	100.0	100.0	
5	Laser	9.8	14.3	20.7	24.8	28.9	33.5	38.6	44.0	50.1	57.9	66.0	75.6	86.0	94.3	98.5	99.9	100.0	100.0	100.0	100.0	100.0	
6	Laser	4.6	7.3	12.5	17.2	22.9	30.1	38.6	47.0	55.8	66.4	76.8	86.6	94.0	98.4	99.9	100.0	100.0	100.0	100.0	100.0	100.0	100.0
7	Laser	.	12.3	18.3	21.5	25.5	29.7	34.0	40.9	47.8	55.4	64.3	73.2	82.5	88.1	93.1	98.2						
9	Laser	5.6	9.5	15.9	20.1	24.0	29.8	34.6	40.9	48.2	57.6	67.0	76.6	85.6	92.9	97.3	99.5	100.0	100.0	100.0	100.0	100.0	100.0
11	Laser	6.6	11.8	18.3	22.8	27.4	32.5	38.3	44.4	51.4	60.3	69.3	78.7	87.7	94.7	98.5	99.9	100.0	100.0	100.0	100.0	100.0	100.0
12	Alpine																		99.6	99.6	99.7	99.8	99.9
13	Alpine														96.4	98.5	99.1	99.7	99.8	99.8	99.9	99.9	100.0
13	Laser	5.6	8.6	13.1	16.3	19.8	24.1	29.5	35.6	43.1	53.0	63.0	73.3	83.3	91.6	96.9	99.6	100.0	100.0	100.0	100.0	100.0	
14	Laser	7.4	12.4	20.0	25.1	30.4	36.5	43.4	50.4	58.1	68.0	77.5	86.2	93.4	97.9	99.3	99.7	99.9	100.0	100.0			
15	Alpine														95.9	97.1	98.4	99.8	99.9				
16	Laser	7.5	11.7	17.9	21.7	26.3	31.5	37.5	43.7	50.7	59.4	68.1	76.9	85.2	92.1	96.4	98.9	99.9	99.9	100.0	100.0	100.0	100.0
17	Alpine														96.7	97.7	98.7	99.7	99.8	99.8	99.9	100.0	.
17	Laser	10.4	14.3	18.9	21.9	25.4	29.1	33.7	38.8	45.3	53.7	62.8	72.6	82.5	91.0	96.3	99.4	100.0	100.0	100.0	100.0	100.0	100.0
20	Alpine												86.0	91.9	98.0	98.5	99.0	99.5	99.8				
21	Laser	9.2	13.2	18.4	22.5	26.8	31.7	37.6	42.9	49.7	58.3	67.0	76.2	83.6	91.4	96.2	98.8	99.9	100.0				
23	Laser	5.1	8.2	14.4	17.7	22.6	27.7	32.9	40.1	47.4	55.4	65.2	74.9	85.0	90.3	95.0	99.8	99.9	100.0	100.0			
25	Laser	5.7	10.3	16.3	19.4	23.7	28.2	32.9	40.8	48.6	57.3	67.1	76.8	86.9	91.6	95.5	99.6	100.0	100.0	100.0	100.0	100.0	100.0
26	Alpine															97.4	99.1	99.6	99.8				
26	Laser	6.3	10.3	15.7	19.3	23.0	27.3	32.3	37.3	43.0	50.7	59.0	68.1	77.3	85.3	90.8	94.6	96.9	97.7	98.3	99.1	99.6	99.9
28	Laser	.	11.0	16.8	19.8	24.4	29.2	34.1	41.2	48.3	56.1	65.3	74.5	84.0	91.8	96.4	98.8	99.6	99.6	99.6			
29	Laser	5.0	9.8	15.4	18.6	22.1	26.2	31.5	37.9	45.7	55.7	65.4	75.5	85.0	92.9	97.3	99.1	99.6	99.7	99.7	99.8	100.0	100.0
30	Alpine																99.3	99.7	99.8				
30	Laser	8.1	13.5	18.8	21.6	26.7	32.0	37.5	45.5	53.4	62.2	70.9	79.5	88.5	94.2	96.7	99.2	99.5	99.6	99.6	99.8	99.9	100.0
32	Alpine														95.2	96.3	97.5	98.7	99.3				
34	Laser	6.5	10.4	16.1	19.8	24.1	28.9	34.7	41.6	48.8	58.3	67.7	76.9	85.8	92.1	97.2	99.6	99.9	100.0				
35	Laser	6.8	10.9	18.2	22.1	26.5	31.4	37.1	44.6	52.3	62.3	72.0	81.7	91.1	97.6	98.8	100.0						
36	Laser	10.0	14.3	21.0	24.8	29.6	34.8	40.8	47.0	53.9	62.4	70.8	79.3	87.2	93.7	97.9	99.9	100.0	100.0	100.0	100.0	100.0	100.0
38	Laser	5.3	8.8	14.3	17.2	21.0	24.9	29.0	35.3	41.6	48.6	58.2	67.9	77.9	86.3	92.5	96.9	98.8	99.6	99.8	99.9	100.0	100.0
40	Laser	5.1	9.2	14.9	17.9	22.4	27.0	31.8	39.9	48.1	57.1	66.6	76.0	85.8	90.6	94.6	98.8	99.4	99.6	99.6	99.7	99.9	100.0
41	Laser	10.1	14.6	19.6	22.2	25.6	29.1	32.7	39.0	45.4	52.4	59.2	65.9	72.9	81.1	88.8	96.8	98.3	98.8	99.3	.	.	.
42	Alpine	.	.	.	.	.	.	.	.	.	.	.	.	.	95.3	96.5	97.8	99.1	99.8	.	.	.	.
42	Laser	5.4	9.8	15.5	19.2	22.9	27.2	32.3	37.8	44.2	52.7	61.7	71.1	80.6	88.7	94.2	97.7	99.5	99.8	99.9	100.0	100.0	.
43	Laser	6.5	9.7	15.4	19.2	23.2	28.0	33.8	40.8	49.1	58.9	68.0	77.3	86.2	93.8	98.2	99.9	100.0	100.0				
45	Laser	10.3	14.5	20.4	24.3	28.7	33.2	38.8	44.4	49.9	57.6	65.6	73.5	81.5	88.5	92.9	95.8	97.2	98.7	100.0			
47	Laser	11.2	15.4	21.2	24.2	29.4	34.2	39.7	45.5	52.0	60.2	68.5	77.1	85.5	92.6	96.9	99.2	99.9	100.0	100.0			
48	Alpine														97.4	98.1	98.9	99.7	99.8				
48	Laser														84.3								
49	Alpine														97.0	97.9	98.8	99.7	99.8	99.8	99.9	100.0	
50	Alpine														97.0	97.9	98.8	99.7	99.8				
51	Alpine														96.5	97.6	98.7	99.8	99.8				
51	Laser												71.8										
53	Alpine														96.4	97.5	98.6	99.7					
54	Alpine														94.5	96.2	97.9	99.7					
56	Alpine														93.9	95.8	97.7	99.7	99.7	99.7	99.8	99.9	
57	Alpine														94.4								
58	Alpine															97.8							
59	Alpine														95.5	96.4	97.4	98.4					
61	Alpine															98.3							
62	Laser	2.5	5.3	11.7	15.0	20.2	25.6	31.2	38.8	46.5	54.9	64.5	74.0	83.9	89.4	94.3	99.3	99.8	100.0				
63	Laser	7.2	12.4	19.0	22.9	26.8	30.9	36.1	43.2	50.5	59.9	76.4	82.5	88.9	94.8	99.3	100.0	100.0	100.0	100.0	100.0	100.0	100.0
65	Alpine														95.7	96.2	96.7	97.3	97.5	97.7	98.2	98.8	99.3
72	Laser	4.4	8.1	12.6	15.6	19.3	24.5	31.7	40.5	51.0	63.3	73.8	82.5	89.2	93.7	96.0	97.2	97.8	98.0	98.3	98.4	98.5	98.8
75	Laser	6.5	10.2	15.8	19.7	24.0	29.0	34.1	40.3	47.0	55.5	64.1	73.4	82.9	90.6	95.2	98.1	99.8	100.0	100.0	100.0	100.0	100.0
78	Laser	7.3	11.5	17.7	21.7	25.7	30.3	35.5	41.4	47.3	55.4	63.8	72.6	81.4	89.1	94.3	97.6	99.3	99.6	99.9	100.0	100.0	100.0
79	Laser	6.4	11.1	16.8	20.2	24.5	27.2	31.6	36.7	43.3	52.5	61.8	72.1	82.1	90.5	95.8	98.9	99.9	100.0	100.0	100.0	100.0	100.0
80	Alpine															97.8	99.1	99.5	99.7	99.8	100.0	.	.
80	Laser	7.0	13.3	16.7	23.8	27.3	31.4	36.7	42.9	51.2	62.0	72.8	83.0	91.2	96.4	98.7	99.1	100.0	100.0	100.0	100.0	100.0	100.0
80d	Alpine															97.7	99.1	99.5	99.7	99.8	100.0		
80e	Alpine															98.3	99.3	99.7	99.9	99.9	100.0		
81	Alpine											76.6	84.7	93.0	97.1	98.8	99.3	99.8	99.9	100.0			
81	Laser	4.4	6.5	10.8	14.5	19.1	24.8	31.7	39.1	47.3	57.4	67.1	76.6	85.6	92.9	97.3	99.7						
83	Alpine																99.3	99.6	99.8	99.8	99.9	99.9	99.9
100	Alpine																		99.7				
100	Laser		8.5	13.6	16.9	20.2	24.2	29.2	34.8	41.8	51.2	61.4	72.8	83.9	92.5	96.8	98.4	99.0	99.2	99.4	99.9	100.0	
101	Alpine																99.4						
101	Laser	11.9	16.2	23.3	27.3	31.1	35.8	40.7	46.4	52.6	60.3	68.3	78.5	89.4	96.4	99.4	100.0	100.0	100.0	100.0			
102	Laser	5.2	8.3	12.4	15.1	18.2	22.3	27.9	34.6	42.7	53.2	63.2	72.8	81.6	89.5	95.4	98.4	99.5	99.7	99.9	99.9	99.9	
103	Laser	1.5	4.6	10.0	13.8	17.9	22.9	28.9	35.6	43.4	53.3	63.2	73.2	82.8	90.9	96.2	99.3	100.0	100.0	100.0	100.0	100.0	100.0
104	Laser		11.6	17.6	21.4	25.1	29.5	34.8	40.3	47.0	55.4	64.1	73.6	82.9	91.1	96.3	98.9	99.9	100.0	100.0	100.0	100.0	100.0

N° Labo	Method	1.25	2	3.15	4	5	6.3	8	10	12.5	16	20	25	31.5	40	50	63	80	90	100	125	160	200
106	Alpine																99.5	99.7	99.7	99.8	99.8	99.9	99.9
107	Alpine											79.6	84.5	89.6	94.8	98.1	99.5	99.6	99.7				
107	Laser	13.4	16.6	23.4	26.9	30.5	34.5	39.2	44.5	50.8	58.7	65.8	76.0	87.6	94.0	99.6	100.0	100.0	100.0	100.0			
108	Laser	3.6	5.6	9.9	13.5	18.0	23.5	30.2	37.3	45.3	55.2	64.9	74.6	83.9	91.6	96.6	99.4	100.0	100.0	100.0	100.0	100.0	100.0
109	Laser	5.0	8.1	12.8	16.2	19.9	24.5	30.1	36.3	43.6	52.9	62.3	72.1	81.6	89.8	95.3	98.7	100.0	100.0	100.0	100.0	100.0	100.0
110	Alpine															98.4	99.6	99.8	99.9	99.9	99.9	100.0	100.0
111	Alpine															98.3	99.3	99.6	99.8	99.8	99.8	99.9	99.9
113	Alpine																99.5	99.7	99.7	99.8	99.8	99.9	99.9
117	Laser	3.9	7.3	12.7	16.5	20.7	25.6	31.3	37.4	44.5	53.7	63.2	73.3	83.2	91.6	96.7	99.3	100.0	100.0	100.0	100.0	100.0	100.0
119	Laser		9.6	15.4	18.9	22.5	26.6	31.4	36.7	43.4	52.6	62.5	73.4	84.2	92.7	97.1	98.7	99.2	99.4	99.5	99.8	100.0	100.0
120	Alpine														96.5	98.4	99.3	99.6	99.8				
120	Laser	6.4	10.5	16.2	20.0	23.9	28.5	34.0	39.7	46.9	56.2	65.4	75.0	84.0	91.7	96.5	99.3						
121	Laser	5.3	9.3	15.2	19.5	24.5	30.2	35.9	42.5	50.0	59.6	68.7	77.5	86.4	92.6	95.6	97.5	98.5	99.0	99.3	99.8	99.9	100.0
122	Alpine															97.8							
122	Laser	7.3	12.5	18.8	22.7	26.6	31.1	36.4	42.0	48.7	57.5	66.1	75.2	84.1	91.7	96.5	99.3	100.0	100.0	100.0	100.0	100.0	100.0
123	Laser	7.0	12.0	18.6	22.8	27.1	32.0	37.6	43.7	50.6	59.4	68.2	77.1	85.6	92.6	97.1	99.6	100.0	100.0	100.0	100.0	100.0	100.0
124	Laser		5.9	14.6	19.1	23.3	28.2	34.2	40.6	48.0	57.5	66.9	76.5	85.4	92.2	96.4	98.8	99.9	100.0	100.0	100.0	100.0	100.0
126	Laser	4.8	8.4	14.0	17.9	22.1	27.0	32.8	38.8	45.9	55.0	64.3	74.0	83.4	91.2	96.1	98.8	99.9	100.0	100.0	100.0	100.0	100.0
127	Alpine														96.1	98.3	99.3	99.7	99.7				
127	Laser	5.7	9.8	15.4	19.1	23.1	27.9	33.8	40.3	47.9	57.4	66.8	76.2	85.0	92.3	96.9	99.4	100.0					
128	Laser	7.8	12.0	17.3	19.8	23.1	29.2	41.6	46.7	51.8	62.4	72.0	81.6	90.3	94.8	98.8	99.3	99.8	100.0	100.0	100.0	100.0	100.0
129	Alpine															97.9	98.5	99.3	99.7	99.7	99.8	99.9	99.9
130	Alpine																99.3	99.7	99.9	99.9	100.0	100.0	100.0
130	Laser	2.7	6.4	12.4	16.4	20.6	25.3	30.6	36.9	43.5	52.4	62.2	72.0	82.0	89.8	96.1	99.4	99.8	99.9	100.0	100.0	100.0	
133	Alpine															98.4	98.9	99.5	99.8				
134	Laser			16.3	23.2	29.7	36.3	43.2	49.6	56.1	63.2	69.6	76.1	82.7	90.7	94.5	98.5	99.5	100.0	100.0	100.0	100.0	100.0
136	Alpine														96.2	98.3	99.3	99.6	99.8	99.8	99.8	99.9	99.9
137	Alpine																99.3	99.5	99.6				
138	Laser	5.4	9.0	14.0	17.8	21.7	26.5	31.6	37.5	45.0	54.0	64.0	74.0	83.5	92.0	97.1	99.7	100.0	100.0	100.0	100.0	100.0	100.0
139	Alpine											73.3	82.4	91.9	97.0	98.2	99.4	99.7	99.8				
139	Laser	6.1	10.2	15.9	20.0	22.9	27.5	32.5	39.5	44.4	54.6	63.9	35.2	81.8	92.0	96.1	99.3	100.0					
141	Alpine														97.2	98.4	99.6	99.9	100.0				
142	Laser	5.4	8.9	14.0	17.4	21.0	25.2	30.3	36.1	43.2	52.5	62.0	71.8	81.5	89.8	95.3	98.6	99.9	100.0	100.0	100.0	100.0	100.0
143	Alpine														95.0	97.5	98.5	98.8	99.0	99.0	99.2	99.3	99.4
144	Laser	6.1	9.8	15.5	19.6	23.9	29.3	34.8	40.7	47.5	56.0	64.6	73.6	82.6	90.5	95.7	98.9	100.0					
145	Alpine														95.9	97.9	98.5	99.1	99.4				
146	Alpine														95.5	97.7	98.4	99.1	99.5	99.5	99.6	99.7	99.8
150	Alpine												86.3	92.7	95.1	97.2	99.5	99.7	99.8	99.8	99.9	99.9	99.9
150	Laser	8.9	12.7	19.1	23.2	27.3	31.7	36.7	41.9	47.8	55.1	63.0	72.5	83.3	92.8	97.9	99.8	100.0					
152	Alpine														97.3	98.0	98.7	99.4	99.8	99.8	99.9	99.9	100.0
153	Alpine																		99.6				
154	Alpine														96.9	98.4	99.2						
156	Alpine															98.3	99.8						
157	Alpine																99.6	99.7	99.8	99.8	99.9	99.9	100.0
157	Laser	6.4	10.1	15.8	19.8	23.9	28.7	34.2	39.9	46.6	55.3	64.2	73.5	82.7	90.5	95.5	98.5	99.7	99.9	100.0	100.0	100.0	100.0
159	Laser	6.7	9.7	14.3	18.0	22.4	27.9	34.7	41.9	49.7	59.0	68.1	77.4	86.0	92.7	97.2	99.3	99.9	100.0	100.0	100.0	100.0	100.0
200	Alpine															98.4	99.4	99.7	99.8				
203	Laser	5.6	8.6	13.6	17.4	21.8	27.2	33.6	40.4	47.9	57.0	66.1	75.5	84.5	92.1	97.0	99.7	100.0	100.0	100.0	100.0	100.0	100.0
204	Alpine														96.9	98.3	98.9	99.5	99.8				
204	Laser	1.7	5.2	11.9	16.6	21.2	29.6	37.2	44.1	56.2	66.4	74.8	85.9	86.4	96.7	99.5	99.5	100.0	100.0	100.0	100.0	100.0	
205	Alpine														96.7								
206	Alpine														97.5	98.6	99.0	99.5	99.7				
209	Alpine														95.2	96.5	97.9	98.9	99.5				
210	Alpine															97.8							
210	Laser	6.1	9.3	14.3	17.9	21.9	26.8	32.5	38.8	46.2	55.8	65.4	75.3	84.6	92.2	96.9	99.3	100.0	100.0	100.0	100.0	100.0	100.0
211	Alpine								36.1	46.6	58.2	68.2	78.1	88.4									
212	Alpine															98.3							
212	Laser	4.7	9.7	15.3	18.6	22.1	26.4	31.7	37.9	45.3	55.1	64.8	74.8	84.3	92.2	97.1	99.7	100.0	100.0	100.0	100.0	100.0	100.0
214	Laser	5.2	9.3	15.4	19.5	23.9	29.0	34.7	40.8	47.9	57.5	67.6	78.6	89.0	96.6	99.5	100.0	100.0	100.0	100.0	100.0	100.0	100.0
216	Alpine														96.6	97.9	98.6	99.3	99.7				
216	Laser	4.8	8.0	13.0	16.6	20.6	25.4	31.1	37.4	44.8	54.2	63.7	73.5	82.9	90.8	95.9	98.9	99.0	100.0	100.0	100.0	100.0	100.0
217	Alpine														95.7	97.0	98.3	99.7					
219	Alpine																	99.7					
221	Alpine														96.4	97.4	98.3	99.4					
222	Alpine														93.9	96.6	99.3	99.6	99.8				
222	Laser	9.3	13.3	19.2	22.9	26.7	31.3	36.7	42.7	49.7	58.6	67.4	76.7	85.8	93.2	97.5	99.6	100.0	100.0	100.0	100.0	100.0	100.0
223	Alpine														96.7	98.1	98.8	99.2	99.4	99.5	99.6	99.8	100.0
223	Laser	6.3	10.1	15.9	19.9	24.2	19.2	34.8	40.7	47.4	55.9	64.5	73.6	82.5	90.2	95.4	98.5	99.8	100.0	100.0	100.0	100.0	100.0
224	Alpine														97.2	98.7	99.4	99.8	99.8	99.8	99.9	99.9	100.0
225	Alpine														96.0	97.0	98.0	99.1	99.6	99.7	99.8	99.9	100.0
229	Alpine																	99.6					
231	Alpine														96.6	98.5	99.0	99.6	99.9	99.9	99.9	100.0	100.0
231	Laser		14.2	21.9	26.4	30.8	35.6	41.0	46.5	52.9	61.5	70.9	82.1	92.7	99.1	100.0							
233	Laser		10.2	16.0	19.8	24.0	28.5	33.8	40.0	46.5	55.1	64.3	73.3	82.5	89.5	95.2	98.4	99.5	100.0				
240	Laser	6.2	9.3	14.4	18.1	22.6	27.9	33.5	39.6	46.9	55.2	63.9	72.7	81.5	91.5	98.1	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Labs	Mass on demoulding (g)	Bending 1d (MPa)	Bending 2d (MPa)	Bending 7d (MPa)	Bending 28d (MPa)	Compressive 1d (MPa)	Compressive 2d (MPa)	Compressive 7d (MPa)	Compressive 28d (MPa)
1	580.6					A 21.5	A 34.6	A 49.6	A 64.6
1						D 22.2	D 35.6	D 53.6	D 71.5
2	594.9					A 24.4	A 36.0	A 51.9	A 66.6
2a	592.4					A 22.8	A 36.1	A 48.0	A 67.0
3	580.0	4.2	6.2	7.1	9.2	A 22.4	A 34.7	A 51.1	A 65.6
3a						A 22.0	A 33.2	A 50.0	A 65.2
4	579.0	4.0	5.4	7.3	8.9	A 23.1	A 33.6	A 51.3	A 66.6
4a						A 23.1	A 36.2	A 52.5	A 70.2
5	595.0	4.7	6.3	8.3	9.8	A 22.3	A 34.2	A 52.6	A 68.1
5						D 22.5	D 36.9	D 53.3	D 74.1
6	589.5	4.7	6.3	8.7	9.9	D 23.1	D 35.3	D 53.9	D 74.4
7	583.8	4.7	5.6	7.5	8.9	A 23.4	A 35.2	A 51.0	A 65.7
7a	565.8	4.7	5.6	7.0	8.3	D 23.0	D 34.5	D 50.6	D 63.5
8						A 22.0	A 33.0	A 50.0	A 64.8
9	578.7	4.4	5.7	7.9	8.8	A 22.6	A 34.4	A 51.7	A 68.9
10	587.0	4.8	6.2	7.8	8.3	A 25.3	A 37.2	A 53.0	A 67.1
11		4.6	6.1	7.0	8.2	A 21.6	A 34.3	A 50.4	A 63.8
12	587.0					A 22.5	A 35.9	A 48.3	A 71.9
13		4.9	7.2	8.3	9.9	A 24.0	A 35.8	A 52.7	A 68.8
13a	569.1					A 23.8	A 34.7	A 51.2	A 68.5
14	583.0	5.1	6.0	7.7	8.9	A 22.8	A 35.6	A 54.3	A 70.9
14a						A 22.4	A 35.5	A 54.9	A 70.9
15	586.1					A 21.7	A 33.9	A 50.8	A 69.4
16	584.5	4.1	5.8	8.2	9.4	A 23.3	A 37.4	A 55.3	A 71.1
17	588.0					A 25.6	A 39.6	A 56.3	A 74.2
17a						A 24.9	A 38.2	A 57.5	A 75.7
20	593.0					A 24.6	A 37.0	A 51.7	A 68.3
21	588.4					A 23.0	A 37.7	A 51.0	A 68.7
21a	588.4					A 23.5	A 30.2	A 54.8	A 71.0
22	578.5						A 35.7	A 50.4	A 64.2
23	584.8					A 23.1	A 34.6	A 51.1	A 67.9
23a	584.8					A 23.4	A 34.3	A 52.2	A 68.1
25	589.9					A 22.8	A 34.9	A 52.1	A 68.3
26	586.1					D 21.5	D 34.7	D 52.6	D 71.4
27	592.8					A 21.7	A 32.1	A 47.5	A 63.7
28	576.0					A 22.0	A 34.1	A 52.1	A 65.3
29	584.8					A 22.3	A 34.8	A 51.5	A 66.7
31	591.3					A 23.9	A 35.7	A 54.2	A 69.9
31a						A 23.8	A 35.3	A 51.5	A 68.9
32	574.0					A 21.9	A 31.4	A 50.3	A 67.5
34						A 21.9	A 32.6	A 47.5	A 68.0
35	580.7					A 23.3	A 35.1	A 52.2	A 67.8
36	587.0					A 23.1	A 35.3	A 51.6	A 67.8
36a						A 22.9	A 34.8	A 51.7	A 67.5
38	587.2					A 24.5	A 36.2	A 53.6	A 68.5
38a						A 24.8	A 36.1	A 52.3	A 68.7
39	584.0		7.4	9.1	10.4		A 36.7	A 56.0	A 70.8
40	579.0					A 22.3	A 34.3	A 49.5	A 64.0
41	584.9					A 22.9	A 34.7	A 51.6	A 67.8
42	589.4					A 25.3	A 36.1	A 53.0	A 68.5
43	575.4					A 24.5	A 34.7	A 49.9	A 64.9
44	576.5					A 21.9	A 37.1	A 52.0	A 67.4
45						A 23.1	A 36.4	A 53.5	A 69.4
46	586.0					A 23.3	A 35.1	A 52.8	A 68.2
46a						A 23.8	A 35.8	A 51.6	A 67.7
47	587.4					A 23.6	A 34.6	A 51.3	A 68.2
47a						A 22.9	A 35.0	A 52.4	A 69.0
48	583.2					A 24.9	A 36.7	A 54.1	A 69.2
48a						A 24.1	A 35.8	A 52.9	A 67.7
49	580.0					A 25.2	A 35.7	A 55.1	A 72.1
50						A 25.2	A 37.0	A 52.5	A 67.1
50a						A 24.0	A 38.6	A 53.6	A 68.2
51	595.0					A 22.7	A 38.2	A 51.7	A 74.9
51a						A 24.5	A 38.2	A 53.2	A 74.5
52	591.8					A 23.8	A 35.5	A 52.2	A 68.3
52a							A 34.9		

Labs	Mass on demoulding (g)	Bending 1d (MPa)	Bending 2d (MPa)	Bending 7d (MPa)	Bending 28d (MPa)	Compressive 1d (MPa)	Compressive 2d (MPa)	Compressive 7d (MPa)	Compressive 28d (MPa)
53						A 24.6	A 36.4	A 54.2	A 70.8
54	585.3					A 26.2	A 36.3	A 52.6	A 77.1
54a						A 24.9	A 34.6	A 55.6	A 70.5
55	590.0					A 24.7	A 35.8	A 52.9	A 68.8
55a						A 24.4	A 35.6	A 52.7	A 69.2
56						A 24.3	A 38.9	A 53.9	
56a						A 25.7	A 36.5	A 54.5	A 69.2
57	588.0					A 23.7	A 35.4	A 51.5	A 69.0
57a						A 23.4	A 34.2	A 51.1	A 65.5
57b	586.6					A 23.0	A 37.0	A 52.1	A 65.4
58	589.0						A 35.5	A 51.3	A 67.3
59	588.0					A 23.9	A 36.2	A 54.3	A 69.5
60	580.0					A 22.0	A 34.4	A 51.6	A 67.1
60a						A 21.8	A 34.0	A 52.8	A 66.5
61	580.5						A 35.1	A 51.6	A 67.7
62						A 23.4	A 35.0	A 51.9	A 68.0
63	578.3					A 24.5	A 37.6	A 52.7	A 66.4
63a						A 24.9	A 37.5	A 52.5	A 65.2
64						A 25.5	A 35.3	A 51.4	A 67.8
65	578.8					A 23.5	A 33.5	A 48.3	A 64.7
70		3.3	6.1	7.4	9.1	A 17.8	A 34.5	A 49.1	A 68.4
71	588.2	5.9	7.2	9.4	10.9	A 25.5	A 37.0	A 54.1	A 68.9
71a									A 69.6
72	585.1	4.3	5.8	7.8	9.1	A 24.5	A 35.1	A 50.6	A 66.8
73	577.0	5.3	6.0	8.6	9.8	A 24.9	A 36.6	A 50.6	A 65.8
75	593.4				8.6				A 65.9
76	583.9					A 22.0	A 34.3	A 50.3	A 63.9
76a						A 22.0	A 41.3	A 55.2	A 66.4
77	582.8	4.9	6.4	8.7	9.3	A 21.9	A 33.6	A 46.4	A 61.7
78	590.4	4.4	5.7	8.8	9.7	A 22.6	A 34.8	A 54.0	A 67.3
78a						A 23.6	A 34.7	A 53.0	A 71.1
79	582.0	5.0	5.9	7.7	8.9	A 25.1	A 36.2	A 52.7	A 66.4
79a						A 24.9	A 36.5	A 52.2	A 66.4
80	585.4	5.3	6.3	8.0	9.0	A 23.5	A 36.2	A 51.1	A 67.9
80d	581.0	4.8	5.9	8.4	8.8	A 22.9	A 34.6	A 54.0	A 68.2
80e	586.5	4.8	6.2	8.6	9.6	A 22.3	A 36.0	A 54.4	A 68.6
82	588.1	4.5	5.7	8.0	8.5	A 23.9	A 34.3	A 55.5	A 64.0
83	581.7	4.4	6.2	8.2	8.6	A 21.5	A 33.6	A 49.8	A 67.2
84	589.4					A 24.2	A 36.4	A 53.2	A 69.3
84a						A 24.2	A 36.2	A 53.5	A 69.7
86		4.4	5.8	7.3	8.7	A 21.1	A 32.9	A 53.9	A 70.1
87	592.2	4.7	6.5	8.0	9.2	A 23.4	A 36.7	A 51.4	A 71.1
88	580.9	4.5	6.2	8.5	10.5	A 18.7	A 30.6	A 47.4	A 57.0
100	595.0						A 33.8	A 47.3	A 65.3
101	575.0						A 33.9	A 50.7	A 68.2
102	581.0	4.9	6.1	8.0	9.4	A 23.8	A 35.2	A 51.0	A 68.2
102a						A 25.0	A 36.1	A 53.6	A 72.1
103		4.1	5.3	7.1	8.2	D 24.6	D 35.6	D 52.0	D 69.0
104	588.0					A 21.4	A 32.0	A 48.0	A 63.9
104						D 22.4	D 33.5	D 50.5	D 68.9
105	590.5						A 36.7		A 68.4
105							D 36.2		
106	591.0					D 20.6	D 36.8	D 53.2	D 67.6
107	597.9	4.9	6.3	8.3	9.1	A 22.9	A 35.8	A 53.1	A 71.8
107						N 23.8	N 38.0	N 56.2	N 74.9
108	592.0	4.8	6.2	8.4	9.2	A 21.3	A 33.2	A 51.0	A 64.8
108						D 21.5	D 33.3	D 51.0	D 65.9
109						A 24.1	A 35.3	A 50.0	A 66.3
109						D 24.2	D 36.0	D 53.3	D 68.8
110	592.5					A 23.1	A 35.7	A 52.0	A 66.8
111	578.9					A 21.9	A 33.6	A 49.5	A 68.1
112	581.2	5.2	6.0	8.1	9.5	A 27.4	A 35.4	A 51.7	A 65.1
112						D 28.0	D 36.8	D 54.9	D 68.7
113	591.0					N 20.6	N 36.8	N 53.2	N 67.6
114	577.0							A 45.3	A 59.4
115						A 23.8	A 34.1	A 47.6	A 65.4
115						D 25.0	D 36.5	D 53.5	D 68.5

Labs	Mass on demoulding (g)	Bending 1d (MPa)	Bending 2d (MPa)	Bending 7d (MPa)	Bending 28d (MPa)	Compressive 1d (MPa)	Compressive 2d (MPa)	Compressive 7d (MPa)	Compressive 28d (MPa)
116	595.4	4.9	6.2	7.7	8.9	D 21.8	D 32.8	D 48.5	D 64.9
117	580.3	4.7	6.2	7.4	8.4	A 23.5	A 35.3	A 51.8	A 66.1
117						D 24.6	D 35.5	D 55.1	D 71.1
118						A 22.2	A 37.3	A 52.0	A 66.4
118						D 25.7	D 40.2	D 51.9	D 72.1
119	590.5					A 23.3	A 34.1	A 51.7	A 68.7
120							A 34.1	A 47.2	A 68.0
120							D 35.2	D 50.8	D 66.3
121	567.3	5.1	5.8	7.5	8.7	A 23.3	A 33.7	A 49.2	A 65.4
121a	569.4	5.0	6.3	7.6	9.2	D 23.3	D 35.4	D 52.8	D 70.2
122	583.0	4.7	6.0	8.1		A 21.9	A 33.4	A 50.5	
123	595.7	4.8	6.6	8.8	9.5	D 24.0	D 37.5	D 56.1	D 73.8
124	583.4	4.7	5.9	8.2	9.5	A 22.7	A 33.2	A 48.9	A 65.0
125		5.0	6.0	7.9	8.9	N 25.3	N 36.6	N 53.0	N 67.4
126	584.0	5.1	6.0	8.1	9.5	A 22.8	A 33.8	A 49.2	A 62.9
126						D 22.6	D 34.1	D 51.9	D 67.8
127	578.9					A 23.1	A 33.5	A 51.6	A 64.8
127a						A 22.9	A 33.8	A 51.5	A 64.7
128	584.7	3.4	4.2	5.0	6.2	A 23.8	A 34.5	A 55.6	A 67.8
128						D 24.4	D 35.2	D 48.8	D 65.9
129	589.0					A 23.4	A 36.0	A 49.5	A 67.7
130	578.8					D 21.4	D 32.7	D 49.3	D 66.8
130a						D 20.9	D 33.0	D 48.6	D 65.7
131						N 21.3	N 33.8	N 49.7	N 64.4
132		4.4	5.9	7.8	8.9	A 23.3	A 36.3	A 52.3	A 67.3
133	591.0					A 23.3	A 36.5	A 53.2	A 68.0
134	587.0					A 20.8	A 32.9	A 48.5	A 65.9
134						D 21.5	D 35.2	D 52.2	D 67.3
136	579.6					A 22.6	A 36.0	A 48.5	A 65.1
136a	579.6					A 23.1	A 35.5	A 48.7	A 68.3
137	576.8					N 23.1	N 34.7	N 49.4	N 62.9
137a						N 22.9	N 32.2	N 50.2	N 63.3
138		4.2	5.7	7.7	8.4	A 21.1	A 33.0	A 51.1	A 69.1
139	586.3						A 33.1		A 66.9
139a							A 33.3		A 67.2
140	580.8					A 24.2	A 36.4	A 52.4	A 67.7
140						D 23.2	D 35.4	D 49.8	D 63.5
141	581.6					A 22.3	A 33.2	A 48.9	A 64.0
142	586.0	5.5	6.8	8.0	9.9	D 25.4	D 35.5	D 54.9	D 70.5
143		4.3	5.9	8.4	9.4	A 23.6	A 36.6	A 53.9	A 66.8
144	571.9	4.7	5.8	7.4	9.3	A 21.7	A 32.4	A 46.8	A 63.7
144						D 22.1	D 33.8	D 51.0	D 70.9
145	581.6	4.6	6.0	8.0	9.1	D 23.9	D 36.8	D 53.6	D 67.0
146	585.8	4.5	5.9	7.9	9.4	A 22.0	A 35.5	A 52.0	A 67.3
146a						A 23.1	A 34.5	A 50.1	A 63.9
147	586.7						A 36.6	A 53.5	A 69.1
148						A 24.7	A 36.0	A 49.7	A 69.8
148a							A 36.8	A 49.9	A 68.3
150	595.1	4.7	6.2	8.2	9.3	A 21.9	A 32.8	A 50.5	A 67.0
151						A 22.7	A 35.9	A 48.3	A 65.0
151						D 23.9	D 36.6	D 53.3	D 70.7
152	587.8				8.9				D 64.9
152a	586.6	4.6	5.8	7.9	9.5	D 21.5	D 32.7	D 50.4	D 64.5
152b	582.7	4.4	5.8	7.8	9.4	D 20.8	D 31.1	D 46.6	D 61.5
153	576.6						A 35.1	A 51.9	A 67.7
153a							A 34.5	A 51.0	A 66.7
154	587.4	5.4	7.0	8.9	10.3	A 22.3	A 35.7	A 49.5	A 67.4
154a						A 23.5	A 35.4	A 49.3	A 66.3
155	587.4	4.9	5.8	8.2	8.7	A 22.2	A 33.5	A 49.8	A 64.5
155a						A 22.7	A 33.8	A 49.2	A 64.8
156		5.1	6.6	8.6	9.9	A 22.8	A 34.7	A 50.8	A 70.4
156						D 23.2	D 36.1	D 53.7	D 65.3
158	573.2		6.0	7.5	9.0		A 33.3	A 48.6	A 60.3
158a							A 32.1	A 47.4	A 61.3
159		5.0	6.1	8.2	9.6	A 24.3	A 33.7	A 49.9	A 63.2
200	598.2					A 24.3	A 33.4	A 49.2	A 64.4
201	580.8	4.0	5.8	7.2	8.2	A 21.1	A 34.0	A 52.5	A 64.5

Labs	Mass on demoulding (g)	Bending 1d (MPa)	Bending 2d (MPa)	Bending 7d (MPa)	Bending 28d (MPa)	Compressive 1d (MPa)	Compressive 2d (MPa)	Compressive 7d (MPa)	Compressive 28d (MPa)
201a						A 21.1	A 34.1	A 52.3	A 64.6
202		6.2	6.8	8.0	9.2	A 25.5	A 38.7	A 52.0	A 68.8
203	583.3	5.0	6.6	8.4	9.1	A 24.9	A 37.1	A 52.4	A 68.7
203						D 23.1	D 36.1	D 53.9	D 68.0
204	597.5	5.3	6.4	8.0	9.4	A 23.4	A 34.8	A 48.1	A 69.1
204a						A 23.1	A 34.8	A 50.5	A 69.7
205	593.1					A 26.2	A 36.9	A 51.5	A 67.9
205a						A 24.3	A 38.4	A 54.8	A 66.1
206	601.3	5.1	6.1	7.9	9.4	A 23.4	A 35.7	A 53.0	A 68.8
207	585.9					B 25.2	B 35.1	B 52.0	B 67.4
207						C 25.3	C 37.6	C 55.2	C 72.2
208						N 23.0	N 35.4	N 51.5	N 65.1
209	574.0					D 23.4	D 35.7	D 52.3	D 66.5
209a						D 23.7	D 36.0	D 52.4	D 66.0
210	585.0					C 23.3	C 36.2	C 53.1	C 70.9
210a	585.0					C 23.6	C 36.1	C 52.6	C 70.5
211	585.0	5.2	6.9	8.7	9.4	A 22.7	A 32.5	A 47.2	A 64.5
212	588.9	4.3	9.0	11.0	12.5	A 23.4	A 34.1	A 52.5	A 70.1
212a						A 23.9	A 34.8	A 52.9	A 70.2
213	581.7	4.5	5.9	8.4	9.0	A 25.4	A 37.6	A 57.4	A 67.0
213a						A 23.2	A 37.6	A 53.2	A 67.3
214	581.6					A 21.9	A 33.5	A 51.2	A 67.1
214a						A 23.0	A 33.9	A 50.7	A 68.6
215		5.1	6.4	9.1	11.0	B 22.0	B 35.5	B 48.5	B 57.9
216	595.5	6.4	7.5	9.1	11.3	A 25.9	A 35.9	A 48.8	A 69.8
216a						A 26.4	A 36.4	A 49.6	A 70.5
217						B 23.4	B 34.5	B 50.8	B 65.1
218	584.3	5.3	6.0	7.9	8.9	A 24.6	A 37.3	A 54.2	A 64.5
219	597.1	4.3	5.5	6.7	8.2	A 23.0	A 36.6	A 55.3	A 66.8
220	601.8	5.9	5.9	8.6	9.1	A 25.3	A 35.1	A 49.0	A 59.7
221	577.3	5.0	6.2	8.1	10.2	A 21.3	A 34.8	A 50.4	A 68.0
222	594.0					A 23.4	A 34.3	A 53.5	A 66.9
223	580.0	4.5	5.7	7.3	9.4	B 22.8	B 34.5	B 50.1	B 66.2
224	576.0	4.9	6.3	8.3	9.4	B 24.2	B 35.1	B 51.1	B 66.1
225		5.0	6.0	6.8	9.4	B 25.0	B 37.1	B 51.8	B 65.1
226	584.8	5.6	6.7	7.5	8.6	A 27.0	A 39.5	A 56.3	A 72.1
228	602.8	5.0	6.2	7.3	9.0	A 22.3	A 30.9	A 41.8	A 54.1
229		5.0	6.1	7.9	9.3	A 22.6	A 34.9	A 50.9	A 68.0
230	586.9					A 23.0	A 35.2	A 50.1	A 65.1
230						D 23.2	D 35.8	D 51.1	D 66.1
231	575.0		5.0	7.6	8.7	N 25.0	N 34.2	N 48.2	N 64.2
232	584.7						B 34.2	B 50.1	B 66.7
232							C 36.7	C 53.2	C 72.1
233	584.8						B 36.3	B 51.7	B 65.6
233a	588.3						C 37.5	C 54.8	C 72.5
234	586.3						B 35.2	B 46.5	B 65.8
234							C 37.6	C 51.3	C 69.7
234a	591.0						C 37.3	C 55.1	C 73.8
235	587.6						B 34.9	B 52.2	B 66.2
235b	602.3						C 35.6	C 53.5	C 66.4
236	584.1					B 23.8	B 34.2	B 49.0	B 64.9
236						C 24.3	C 36.2	C 52.2	C 69.7
237	586.2						B 35.2	B 49.2	B 67.9
237							C 37.5	C 54.2	C 73.4
238	586.1						B 37.2	B 52.6	B 65.8
238							C 37.6	C 52.5	C 70.2
239	584.3						N 35.8	N 50.5	N 65.4
240	586.7					A 23.2	A 34.7	A 51.1	A 67.0
240						D 24.3	D 36.3	D 54.9	D 70.9

Flyleaf photo caption :

Photo : The Hall Debat-Ponsan in Bordeaux.