



A path to a Standard for the family of Roman cements

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Natural cements in European cultural heritage
Les ciments naturels dans le patrimoine européen
PARIS – 26/27 Avril 2012

Current National Standards

France – NF P15-314

Spain – UNE 80309

A Pathway

ROCARE Standard
(work in progress)

European Norme

Constraints – production scale



Artisan



Industrial

Constraints – end use



Constraints – each cement is unique

Principally **setting time**

<1 minute >1 hour

Also **water demand**

Cements

Loss on Ignition

Insoluble Residue

Sulfate

Fineness

Soundness

Setting time

Loss on Ignition

Cementos naturele (UNE 80309)	Ciment prompt naturel (NF P 15-314)	ROCEM/ROCARE data
d16%	d14%	<p>Sheppey – 5.96%; Harwich – 3.79%; Whitby – 3.67%; Speeton – 7.44%; Prompt – 7.7%; Lilienfeld – 6.65%; Folwark – 11%</p>

ROCARE Standard - e2% d16%

Insoluble Residue

Cementos naturele (UNE 80309)	Ciment prompt naturel (NF P 15-314)	ROCEM/ROCARE data
d10%	d6%	<p>Sheppey – 5.69%; Harwich – 12.30%; Whitby – 5.59%; Speeton – 6.71%; Prompt – 4.0%; Lilienfeld – 11.1%; Folwark – 6.9%</p>

ROCARE Standard - d12%

Sulfate – SO₃

Cementos naturale (UNE 80309)	Ciment prompt naturel (NF P 15-314)	ROCEM/ROCARE data
d4%	d4%	<p>Sheppey – 2.4%; Harwich – 0.9%; Whitby – 3.8%; Speeton – 5.0%; Prompt - 3.7%; Lilienfeld – 0.1%; Folwark – 0.8%; Vassy – 2.8%; Pouilly – 2.5 - 4%; Rosendale - <1.4%</p>

ROCARE Standard - d4%

Fineness

Cementos naturele (UNE 80309)	Ciment prompt naturel (NF P 15-314)	ROCEM/ROCARE data
<u>Sieve residue</u> 160µm d17% 80µm d35%	<u>Blaine</u> >5000 cm ² /g	

ROCARE Standard – test technique required

Soundness

Cementos naturale (UNE 80309)	Ciment prompt naturel (NF P 15-314)	ROCEM/ROCARE data
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d15 mm

ROCARE Standard - tbd

Setting

Cementos naturale (UNE 80309)	Ciment prompt naturel (NF P 15-314)	ROCEM/ROCARE data
<u>Rapido</u> Initial >1 min Final <8 min	Initial set <4 min	Final set Sheppey – 2.5 min; Harwich – 9 min;
<u>Lento</u> Initial >10 min Final <120 min		Prompt – 2-3 min; Folwark – 3 min; Lilienfeld – 3 min; Whitby <2 min

ROCARE Standard – mixing technique required

Mortars

Strength

Shrinkage

Strength - 1:3 mortar, w/c = 0.6 (EN 196-1)

Water added to cement and
mixed 30 seconds @ 62 rpm then
Add sand and
mixed 30 seconds @ 62 rpm then
Mixed 30 seconds @ 125 rpm then
Stop mixer and scrape contents for 30
seconds then
Mixed 60 seconds @ 125 rpm

Strength – mortar specification

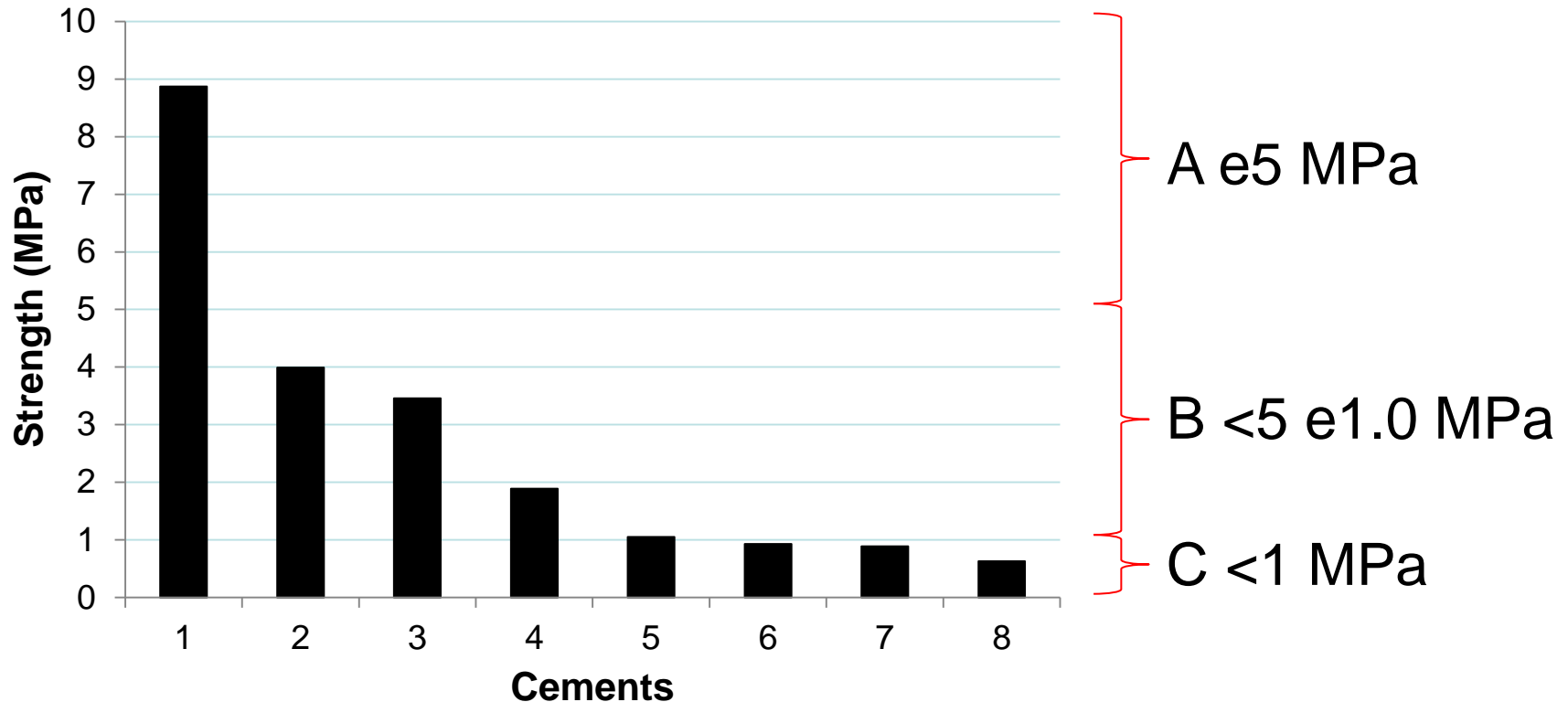
Free choice of retarder (e.g. citric acid, sodium citrate, potassium citrate)

Amount to yield workable life of 5 – 10 minutes

Strength – mortar specification

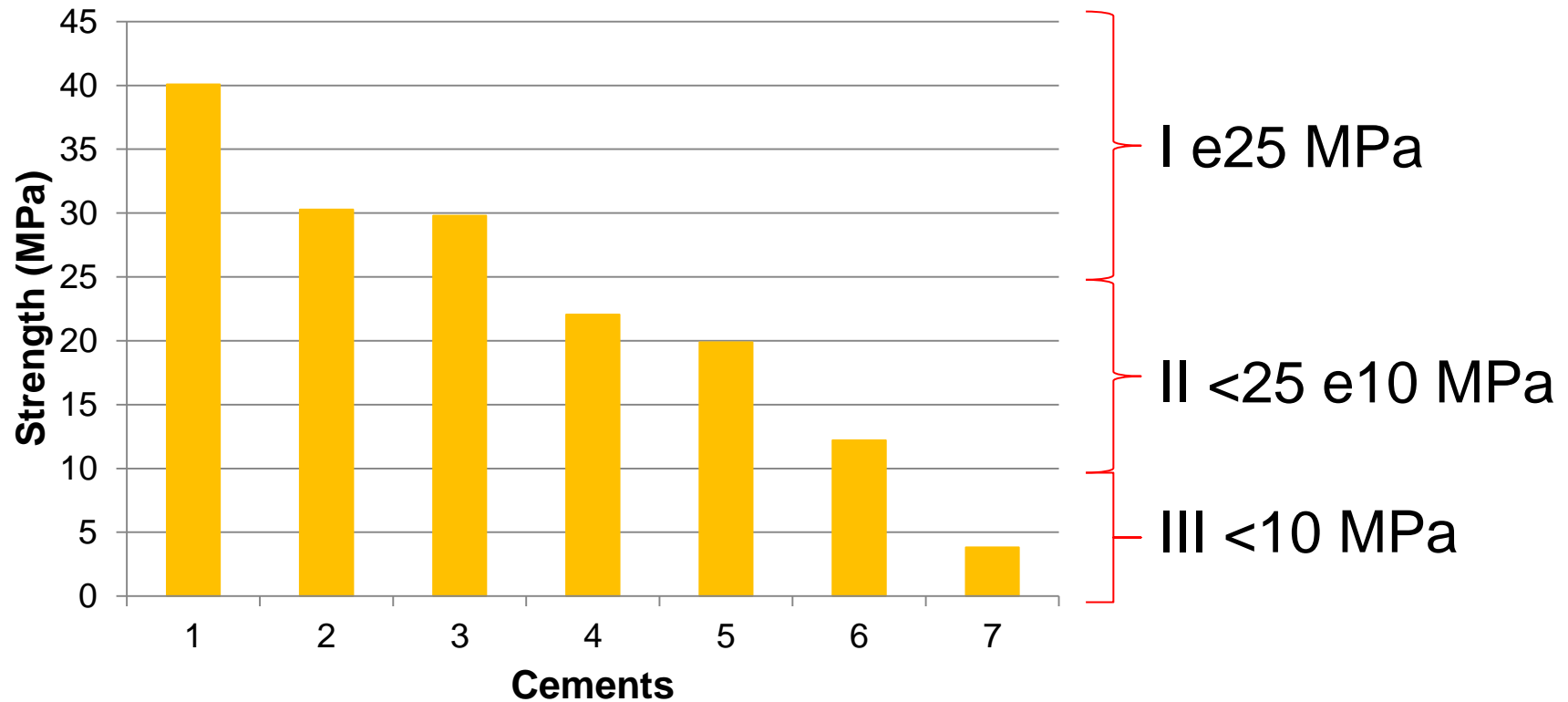
Cement	Retarder	Concentration
MBM Folwark 2011	Sodium Citrate	1%
MBM Gartenau	Sodium Citrate	0.75%
MBM Lilienfeld	Sodium Citrate	1.1%
VFB Gartenau	Sodium Citrate	0.27%
W&P Wietersdorf	Citric Acid	0.15%
MBM Rejowiec	Sodium Citrate	1.1%
Vicat Prompt	Citric Acid	0.1%
Tigre Rapido	Citric Acid	0.05%

Strength – mortar specification (3 hour) - Definitive



Strength – mortar specification (91 day)

Informative



Shrinkage – 3 days

Same mortar as for Strength

Store at $60 \pm 10\%$ rh

Shrinkage (1:3 mortar) at 28 days in range
200 – 1500 $\mu\text{m}/\text{m}$

Shrinkage (1:1 mortar) at 28 days ~ 3200
 $\mu\text{m}/\text{m}$

Conclusions

A work in progress

Suggestions gratefully received



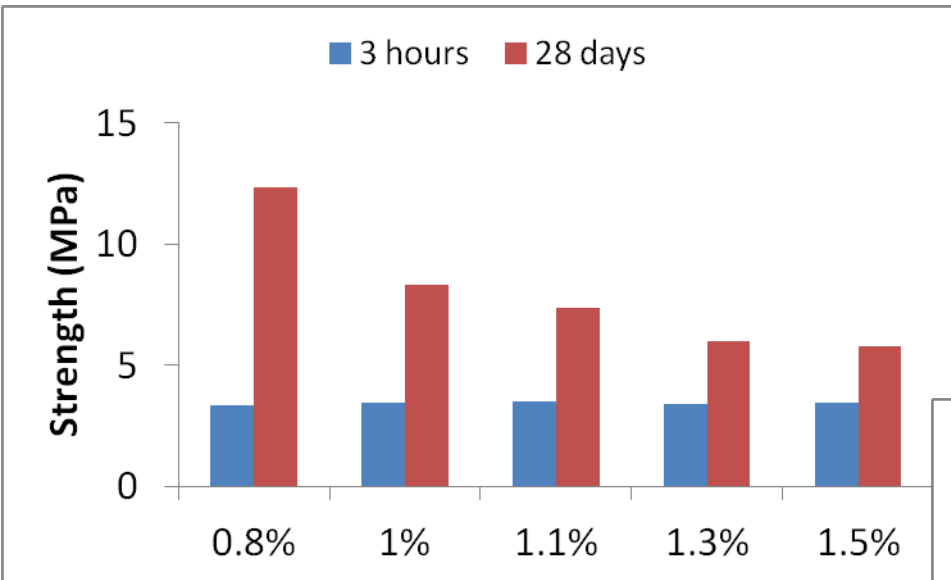
For additional information see

www.rocare.eu

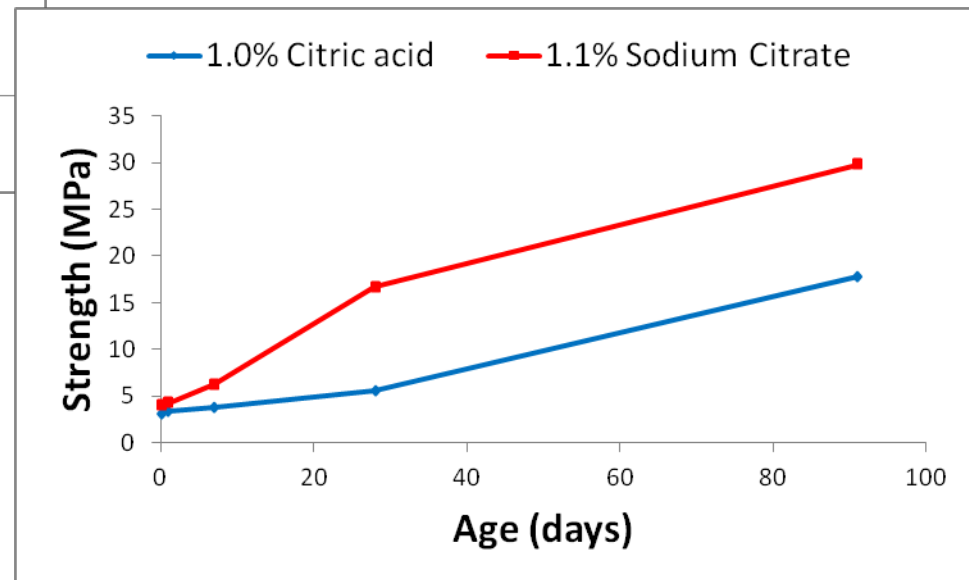
If you have any questions contact me at

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Strength – effect of retarder type and amount



MBM Lilienfeld cement



MBM Lilienfeld cement
Potassium Citrate retarder

Shrinkage – effect of retarder type (Lilienfeld cement)

