The manufacture and uses of expanded clay aggregate

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SCI HQ, London

Xavier Kestemont, Argex

ARGEX expanded clay

Manufacture - sourcing

LWA's properties & Normative references

Typical end uses

Concrete LAC/LWAC

SCC

Location in BE

Kruibeke

Argex 1965….

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Source material – EN13055

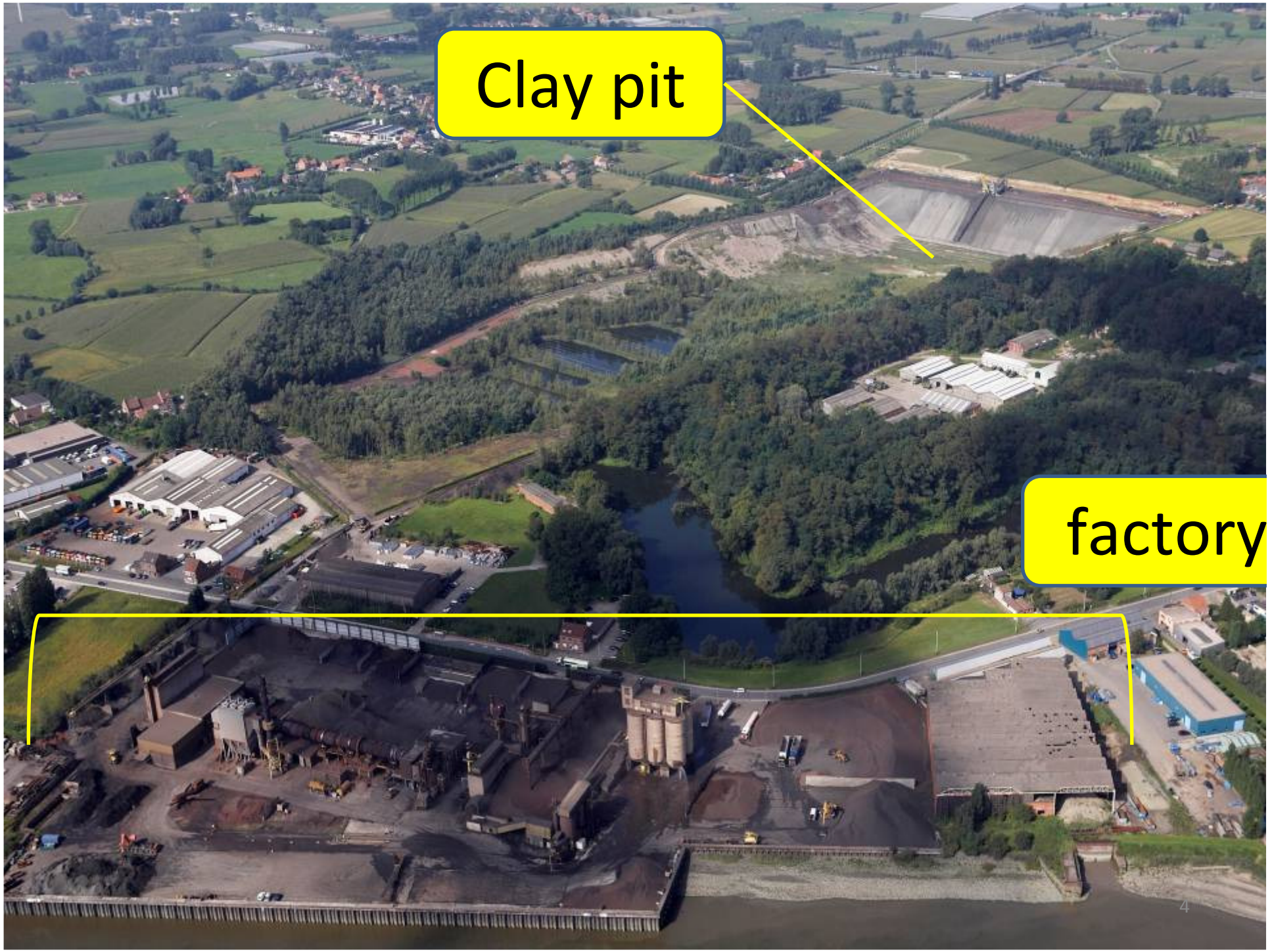
"lightweight aggregates manufactured from natural source materials"

Specific LWA material

= Expanded clay

Argex = **Arg**ile **ex**pansée

Argex is made from clay, which is expanded at high temperature to create individual granules, each of which has a hard ceramic shell that surrounds a perfect honeycomb core


Clay pit
factory

Production process

Extraction & clay preparation

1000 tons clay / day

Expansion – rotary kiln

75 m – 5 m Ø– 1100 °C

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ARGEX expanded clay

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Sieving & storage (silo & outside)

450.000 m³ / year

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Aggregates / CE

Types	SIZE (d/D - mm)	LOOSE BULK DENSITY (kg/m³)	PARTICLE DENSITY (ρrd) (kg/m³)
Normal Rounded	AR 0/2-800	**800**	1240
	AR 1/5 - 580	**580**	990
	AR 0/4 - 650	**650**	1010
	AR 0/4 - 700 Coating	**700**	1150
	AR 4/10 - 430	**430**	750
	AR 8/16 - 340	**340**	600
Normal Crushed	AG 0/2 - 580	**580**	1045
	AG 0/4 - 500 Normal	**500**	950
	AG 0/4 - 500 Special	**500**	950
	AG 1/5 - 390	**390**	780
	AG 4/8 - 320	**320**	670

ARGEX expanded clay

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Types	SIZE (d/D - mm)	LOOSE BULK DENSITY (kg/m³)	PARTICLE DENSITY (ρrd) (kg/m³)
Light Mix	AM 4/10 - 350	**350**	620
Semi-Normal Rounded	AR 3/8 - 500	**500**	875
Structural Mix	AM 4/8 - 650	**650**	1130
	AM 4/8 - 650 Coating	**650**	1130
	AM 4/8 - 750	**750**	1300
Hydroculture	AR 4/10 - 550	**550**	970
	AH 8/16 - 480	**480**	835

23 different aggregates / CE !

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- Particle shape : R / C / Mix R&C
- Aggregate size : 0/2 – 0/4 – 1/5 - 4/8 – 8/16… mm
- Loose Bulk density : 300 to 750 kg/m³
- Particle density : 620 to 1300 kg/m³

- Porosity between grains : 37 - 50 % - drainage/permeability !
- Water absorption (5') : 7 - 35 % weight from dry LWA's
- Fines (< 63 µm) : 10-12 % (0/2 mm)

- LA (4/6,3) : ≤ 25 - AR4/10-650 or AM4/8-650 bitume !
- PSV : ≥ 70 - bitume !
- Compressive strength : 320 to 620 kPa (2% deformation)
- Angle of friction : 35 to 42 °

Internal

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- Acid-soluble sulfate (% SO3) : < 0,8%
- Total Sulfur (% S) : < 0,8%
- Chloride (% Cl) : < 0,02%
- Loss on ignition : - 0,18%
- Volume Stability : < 0,1%
- Freezing & Thawing Resistance : 0,5 to 2 %
- Release of Dangerous Substances : NL certif.

- Alpha Sabine (acoustical absorption) : 0,81 - 500 Hz (10 cm - AR 8/16 340)
- Lambda : 0,104 (W/mK) - AR8/16-340
- WSH : < 50 mm AR8/16-340 - Reaction to Fire : Euroclass A1

= material with unique combination of sustainable properties ! Light, re-usable, trp-handling, inflammable, 100% natural clay … + **Choices vs** applications

Normative References / CE

- **EN 13055** : *Lightweight Aggregates*

- **EN 14063-1/-2** : *Thermal insulation materials and products - In-situ formed expanded clay LWA*

- **EN 15732** : *Light weight fill and thermal insulation products for civil engineering applications (CEA) - Expanded clay LWA*

-Others : **BBK NL (RDS) – Komo NL – RAL (Hydro) ….**
ISO/CE

Applications ++++

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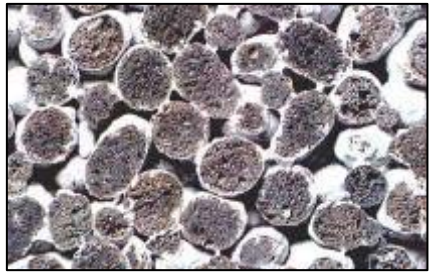
Concrete : LAC/LWAC for ready mix, prefab, blocks, light mortar…

ARGEX concrete

Open-structure concrete = LAC according to EN 1520

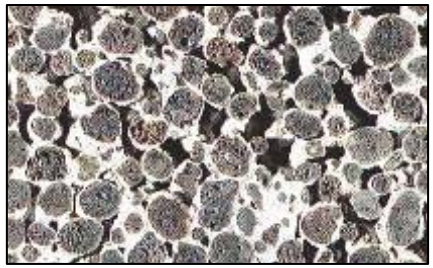
Open : 500 -1100 kg/m³

1 - 9 MPa



Half-open : 700 - 1200 kg/m³

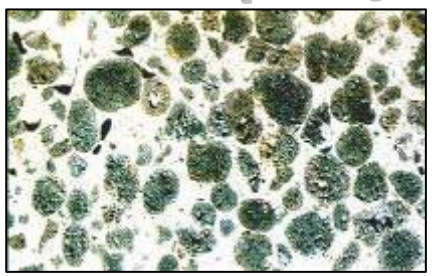
5 - 20 MPa



Compact concrete = LWAC according to EN 206-1 (LC / D…)

1200 – 2000 kg/m³

12 – 85 MPa



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LAC – Blocks

Argex blocks in EUR. – EN 771-3

650 to 1600 kg/m³ - 3 – 15 MPa

Fine texture
Paint block – AG 0/4-500

Split blocks
AR4/10-430

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LAC – prefab

Precast
R or Crushed
LWA's

Noise barrier
AR1/5-580

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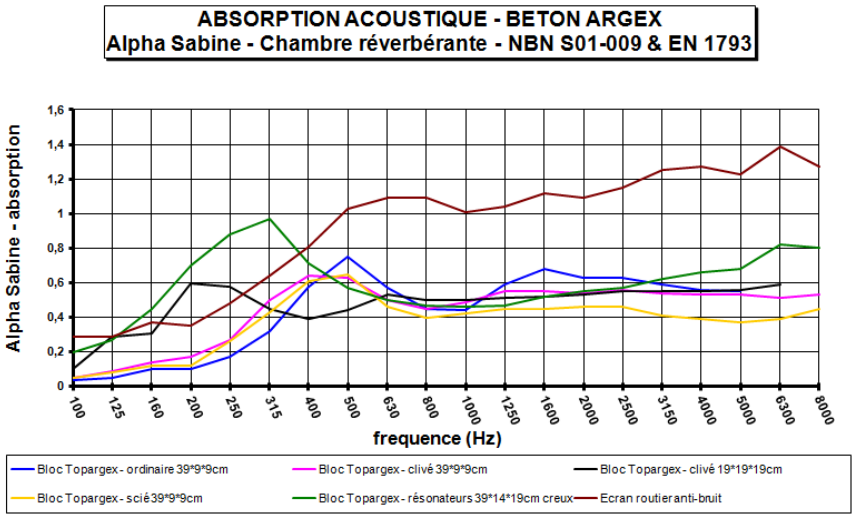
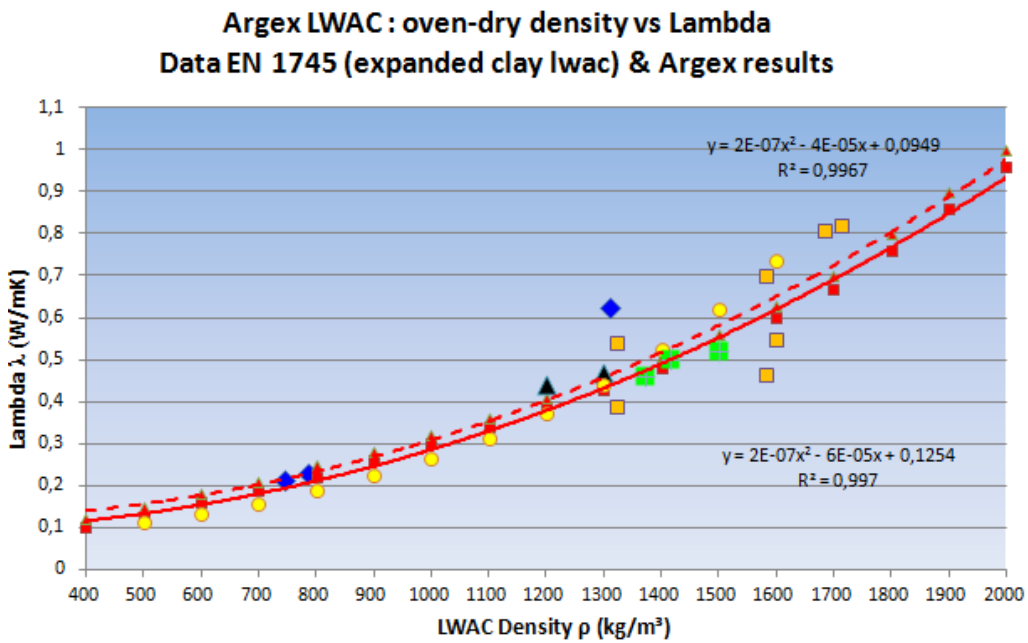
- ✓ ratio compressive vs low density!
- ✓ sound absorption,
- ✓ thermal insulation
- ✓ frost resistance,
- ✓ high fire resistance (1 to 6 h. - 9 to 19 cm LAC 1100 kg/m³)…





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Concrete L

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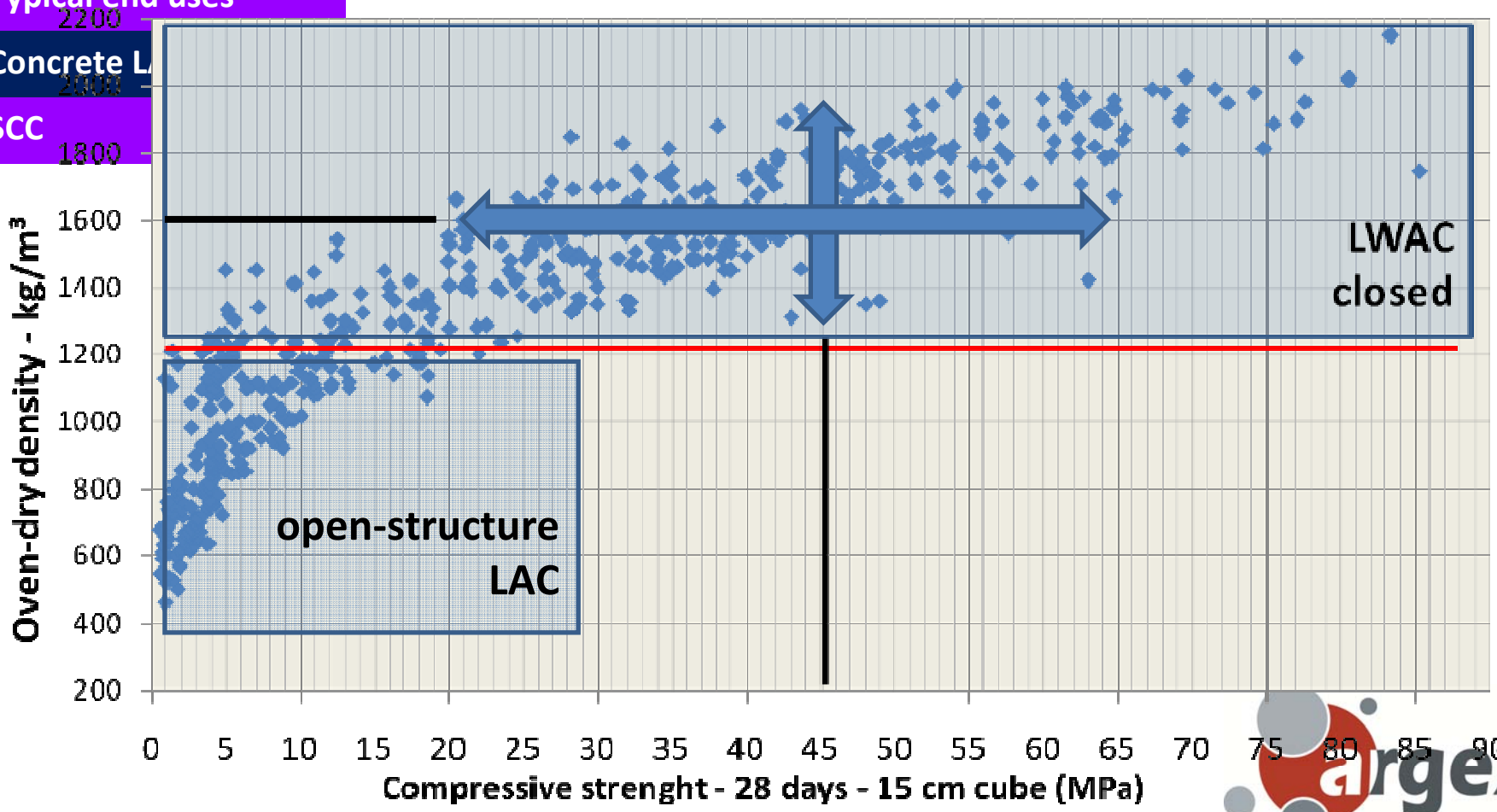
LWAC – properties

closed structure

Obvious correlation but …. = advantages



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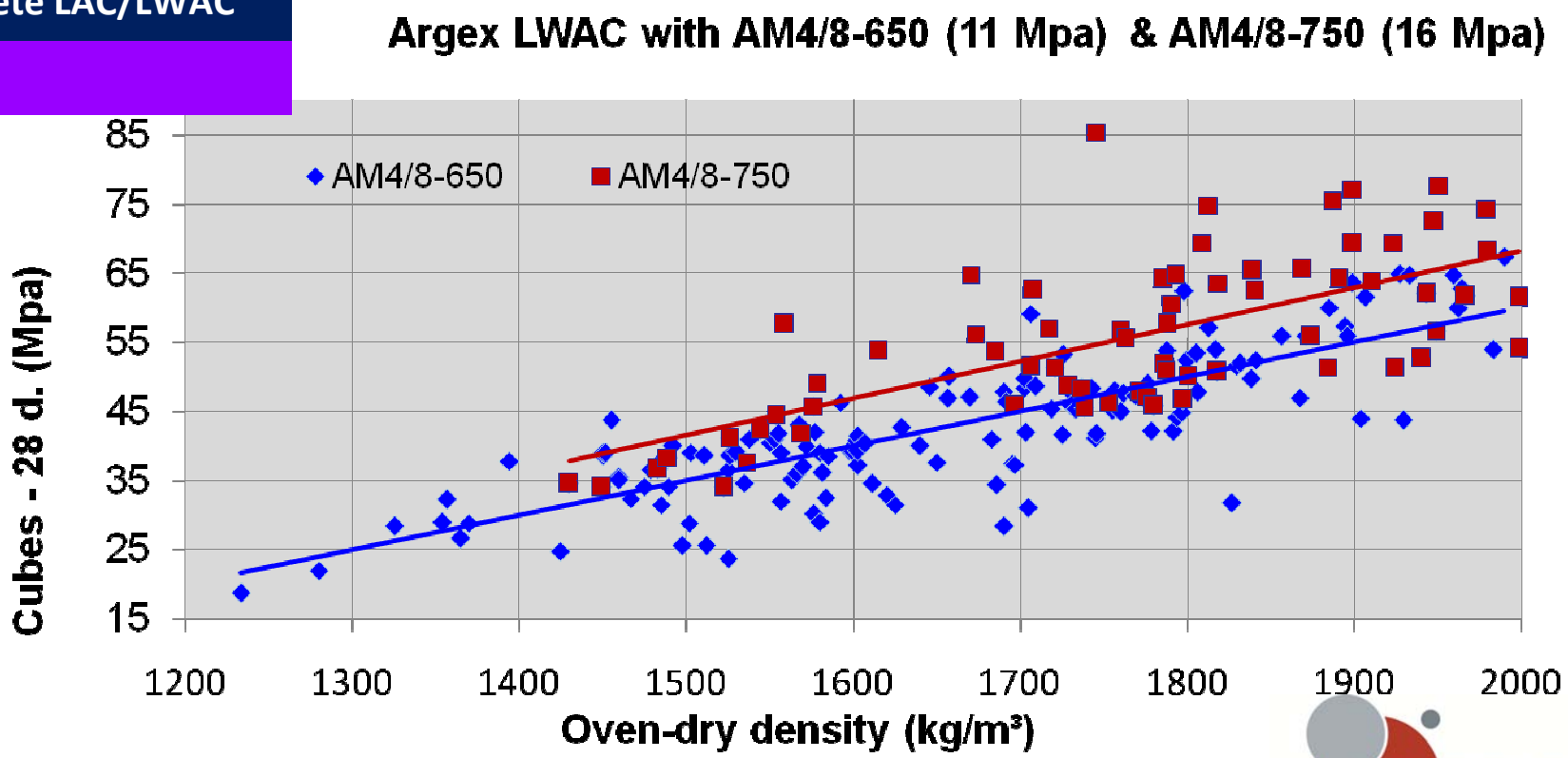
LWAC – properties

influence of LWA resistance



Broad range – variations – trend !

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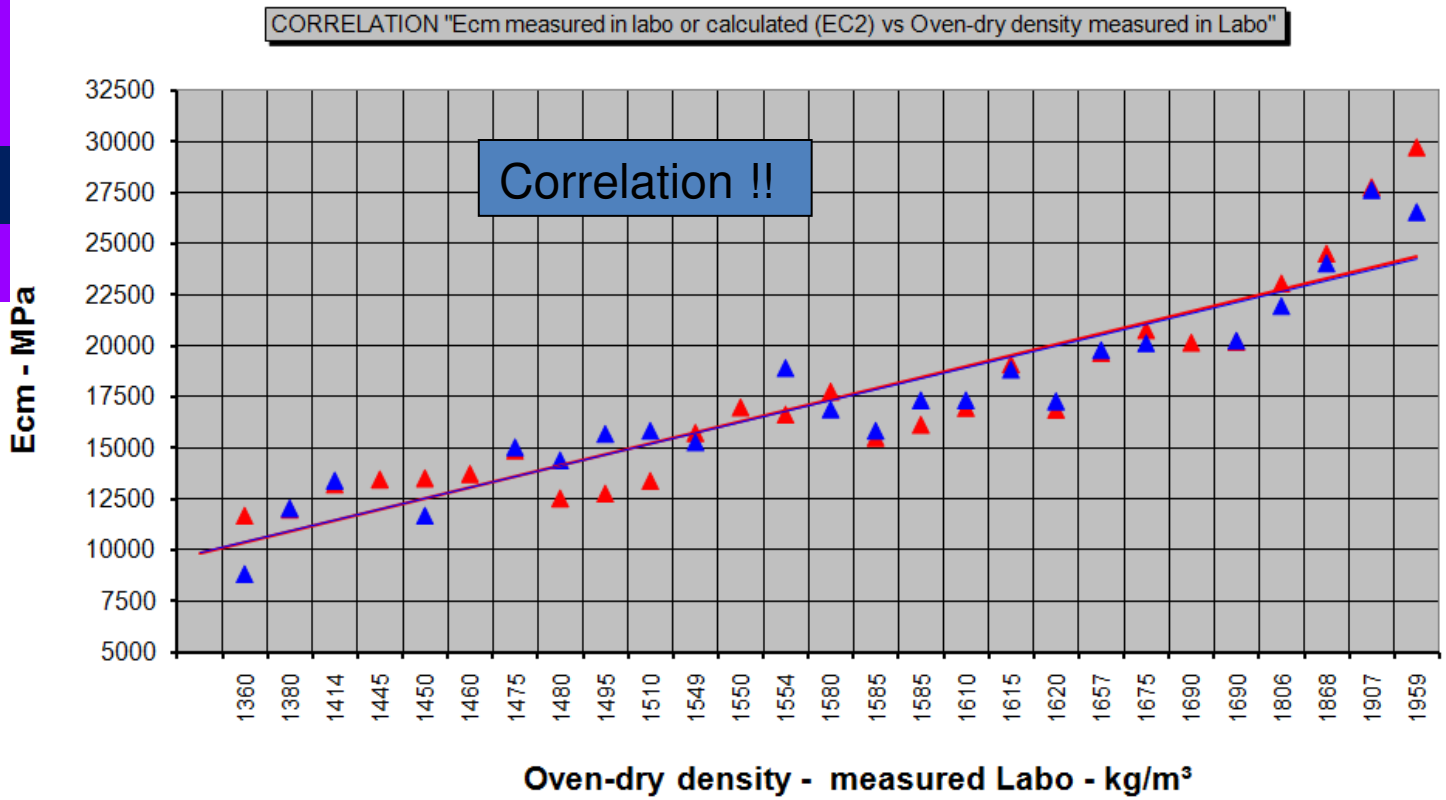
LWAC – properties

Elastic deformation vs dry-density

Ecm EC2
vs
Ecm lab



Broad R&D : air (ASTM vs EN) – durability (EC2 vs lab) – RAS – SCC durability – Ecm & all mechanical (EC vs lab)…

LWAC – Pompmix

Ready-mix LWAC "pumpable"

Pompmix L : LC 12/13 to LC 20/22
D 1,2 to D1,6

Pompmix S : LC 30/33 to LC 40/44 –D1,8

aggregates! – W%! – sieving concrete! – workability!....

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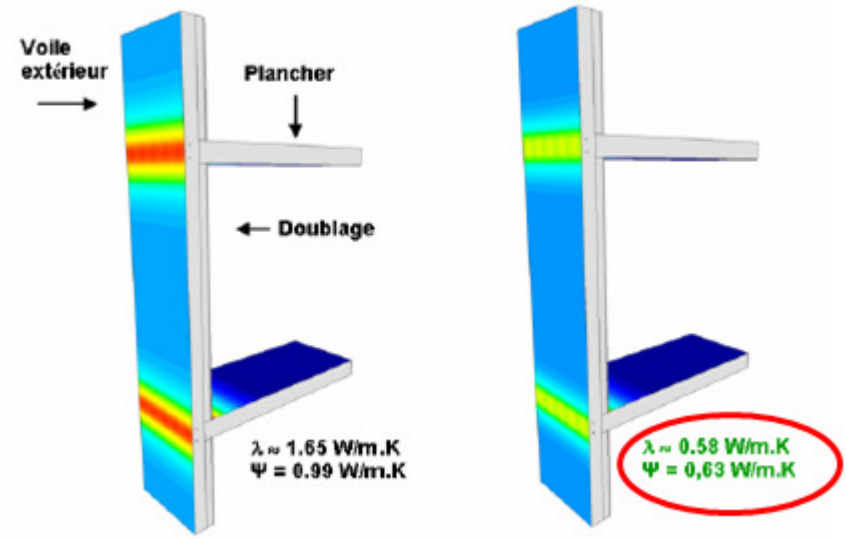
LWAC

LC 25/28 – D1,4 - λ = 0,58 W/mK

ψ = 0,63 W/mK

Against thermal bridges : 35% reduction !!

buildings



LWSCC - Combination of LWAC & SCC advantages - R&D project

1. **Flexible method for mix designs**

   (not one optimal mix)

   – Prefab industry
   – Variety of components
   – Combination strength / density (EN206-1)

2. **Software (as model for each density class)**

3. **Fresh concrete workability measurements : own limits**

slumpflow-Vfunnel-Lbox-Jring…

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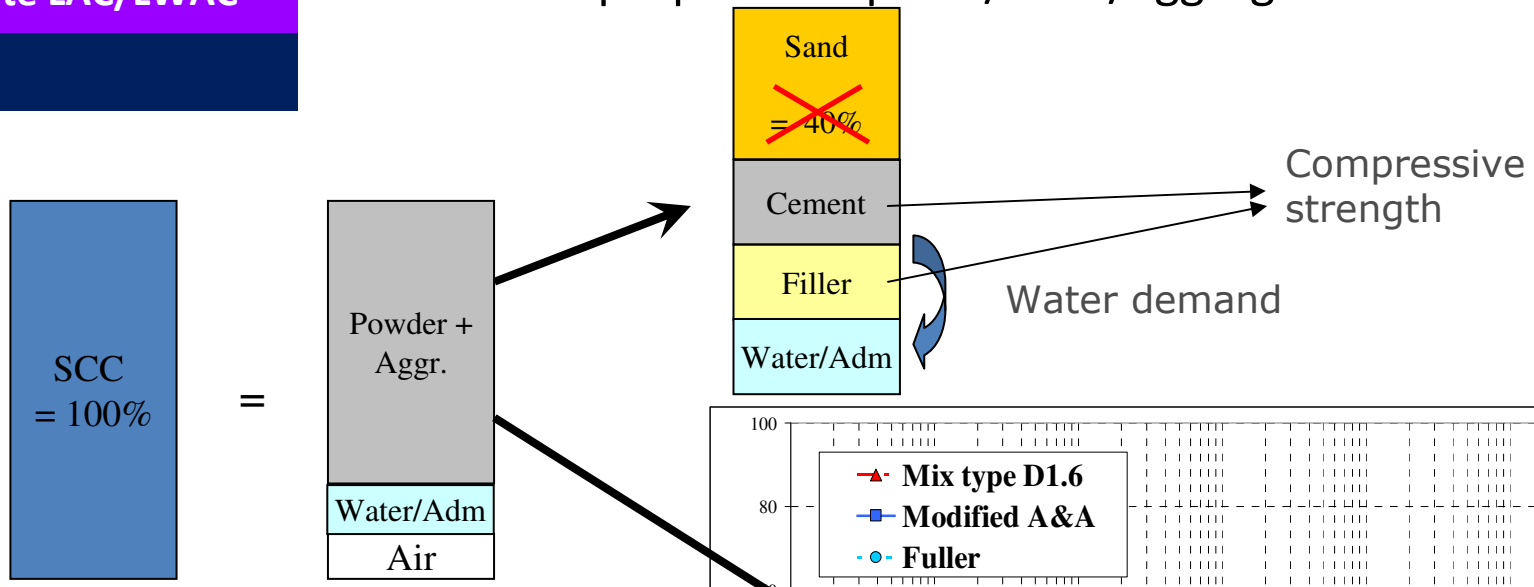
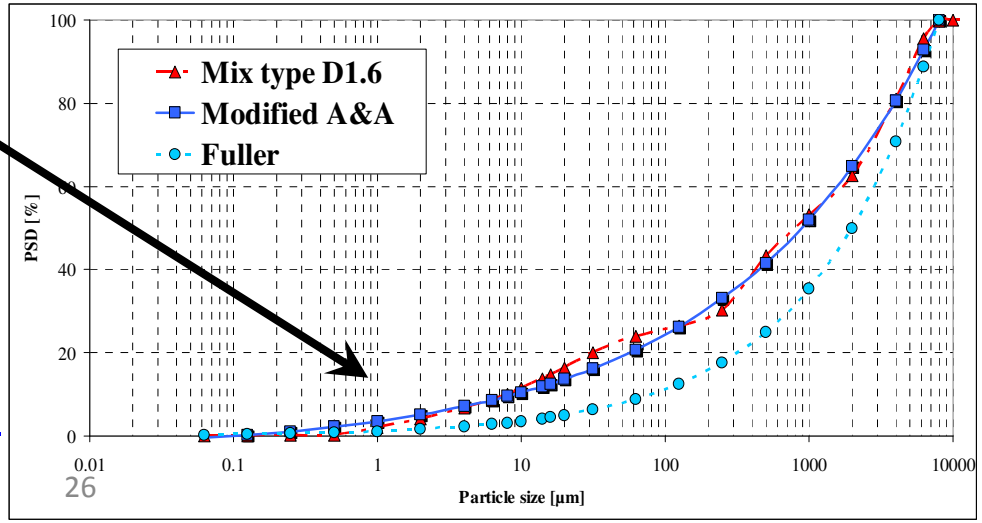
Mix design & Materials

- ✓ **Evaluation of theoretical models**
- ✓ **Brouwers approach**
- Chineese method ≈ Andreasen et Andersen curves
- No fixed proportions paste/sand/aggregates





Model = Input / Output

Sieving all components & W/C, cement, filler & LC & D classes

= Composition LWSCC with estimation SP et VMA => ~~theoretical model~~ but practice

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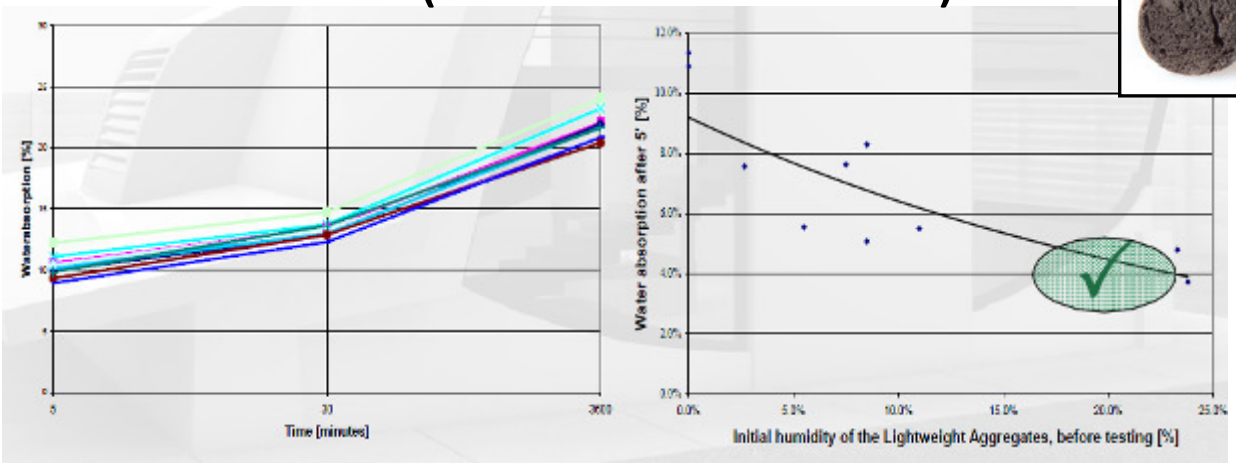
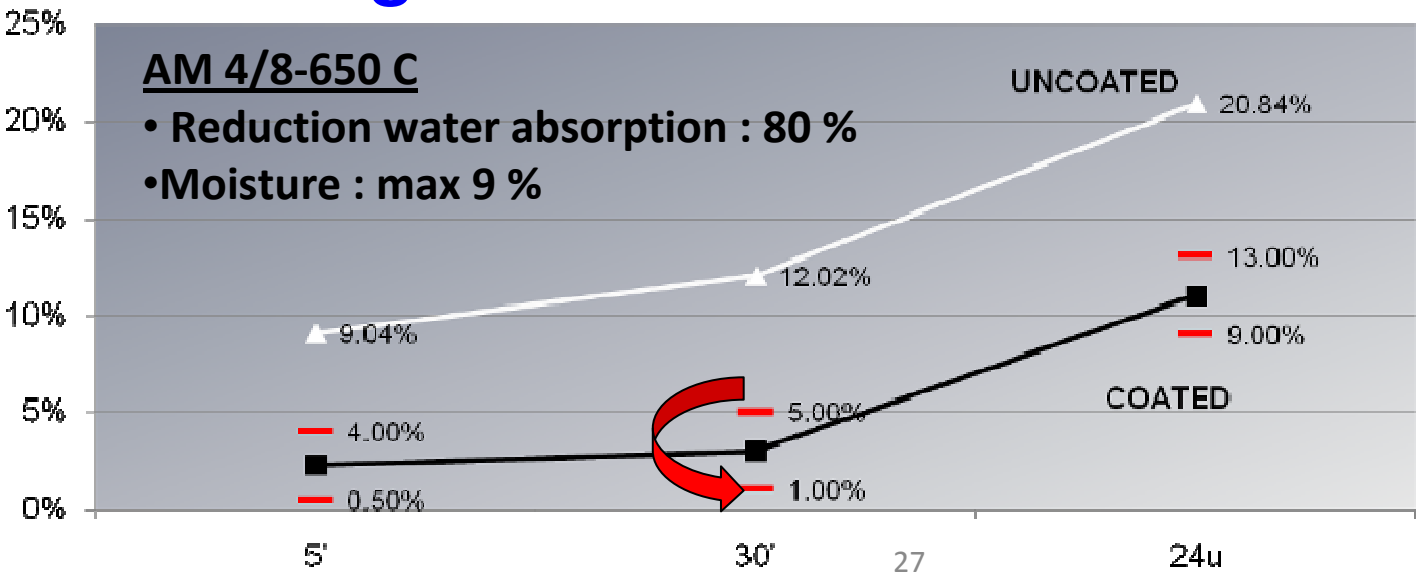
Argex aggregates = porous ! Rheology?

1° Saturation (min 20-25% W%)



2° "Coating" = +++



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Mix design (kg/m³)	D 1,4 - D1,6 LC 25/28 - LC 30/33	D1,6 LC30/33	D1,8 LC35/38	D2,0 LC45/50
CEM I 52,5 R (N)	380	330	350	350
Limestone filler	235	260	175	175
Sand 0/2	0	175	140	80
Sand 0/5	0	0	645	885
AR0/4-700 C	680 L	630 L	0	0
AM4/8-650 C	325 L	220 L	580 L	0
AM4/8-750 C	0	0	0	400 L
Water	195	175	170	170
SP	4	4,2	4,2	4,2
VMA	3	2,6	2,3	3,7
Density fresh (kg/m³)	1612	1625	1910	1995
W/C	0,43	0,45	0,45	0,47
W/P	0,38	0,39	0,41	0,43

SP and VMA dosage:

- stability of the mixture (water variations)
- inhibits floating of the lightweight aggregates

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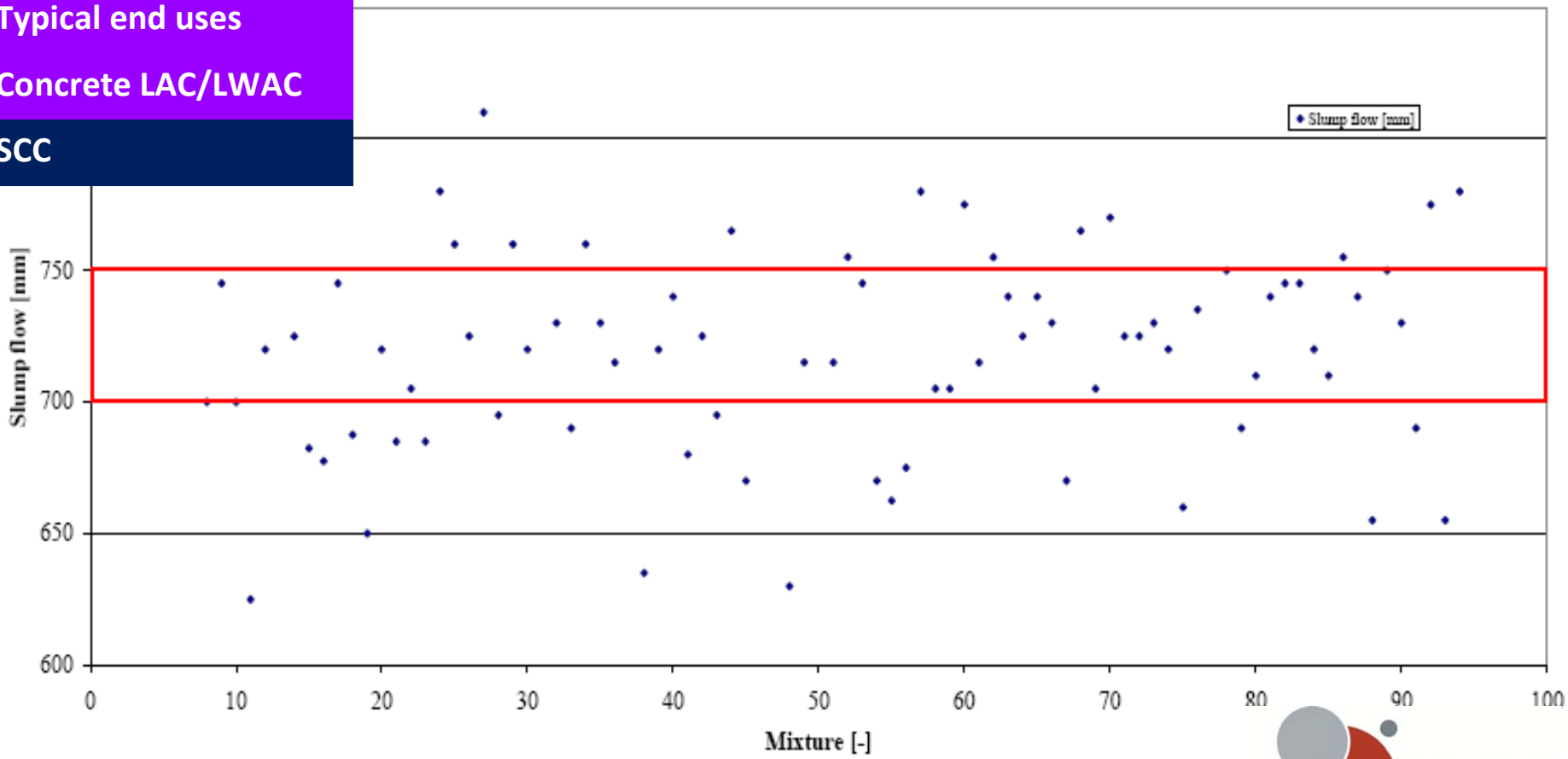
Ref. FprEN 206-9 !! – own ARGEX LWSCC limits acc. to concrete pieces

Slumpflow

Slumpflow: 700 – 750 mm (class SF2)



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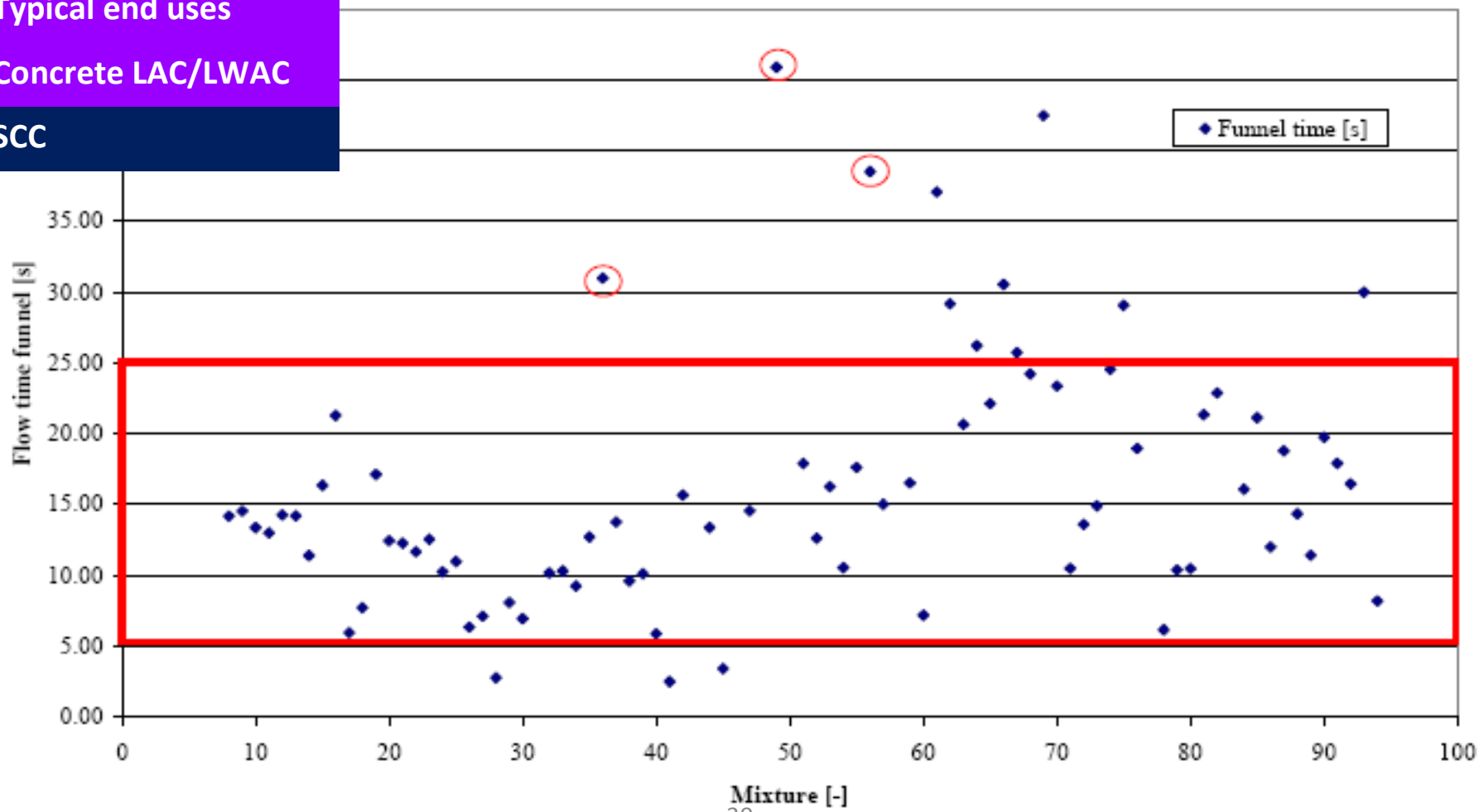
V-Funneltime

V- Funneltime: 5-25 sec (classes VF1 & VF2)



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Segregation – risks / fresh concrete

Visual Control !!

Slumpflow or J-ring

Bleeding :Yes or Not

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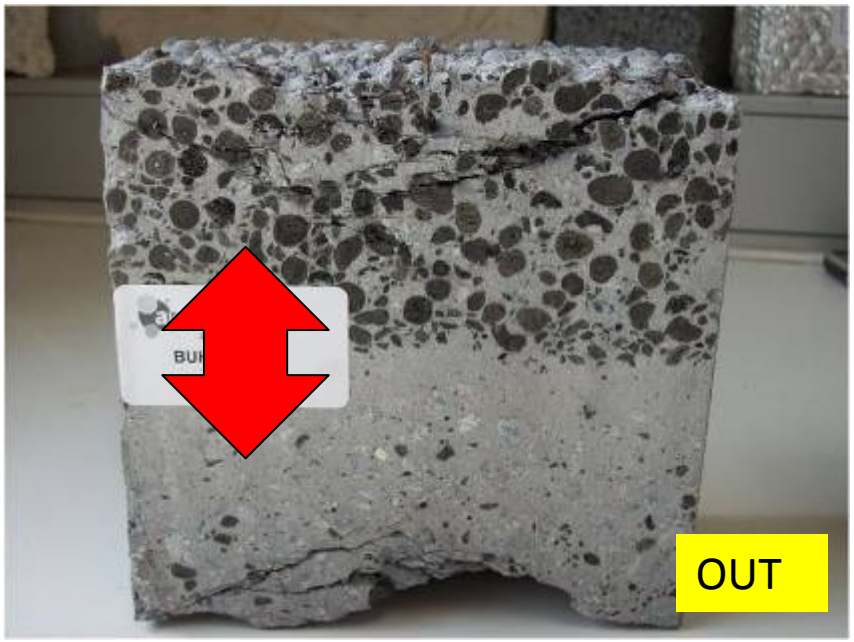
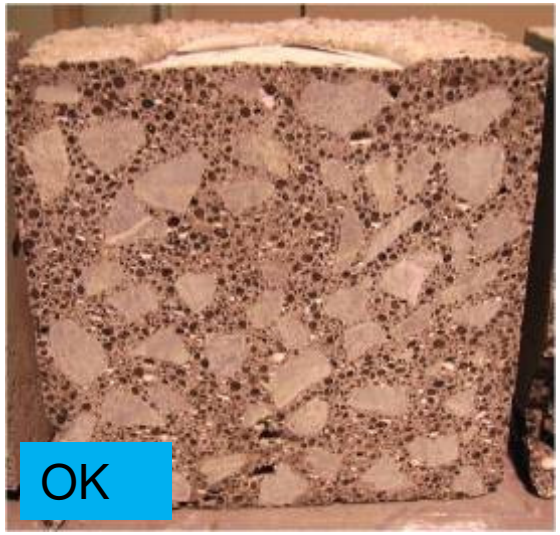
Segregation – risks / hardened concrete

Visual control

Washed LWA, quality of corners & surfaces… : OUT !



& density measurement See Eurolightcon



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Production LWSCC

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Production LWSCC

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Production LWSCC

Thank you very much for your attention!

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