global gypsum
CONFERENCE, EXHIBITION & AWARDS

IMPROVING THE WATER RESISTANCE OF GYPSUM DRYMIX APPLICATIONS

Dr. Daniel Schildbach
Wacker Chemie AG

WACKER

IMPROVING THE WATER RESISTANCE OF GYPSUM DRYMIX APPLICATIONS

Dr. Daniel Schildbach, Global Gypsum Conference, Istanbul, October 17, 2012

CREATING TOMORROW'S SOLUTIONS

IMPROVING THE WATER RESISTANCE OF GYPSUM DRYMIX APPLICATIONS

- INTRODUCTION – A NEW CONCEPT
- WATER ABSORPTION: EXISTING MARKET PRODUCTS
- WACKER‘S NEW DEVELOPMENT
- CONCLUSIONS

IMPROVING THE WATER RESISTANCE OF GYPSUM DRYMIX APPLICATIONS

- **INTRODUCTION – A NEW CONCEPT**
- WATER ABSORPTION: EXISTING MARKET PRODUCTS
- WACKER‘S NEW DEVELOPMENT
- CONCLUSIONS

A MORE SUSTAINABLE FUTURE WITH GYPSUM MATERIALS

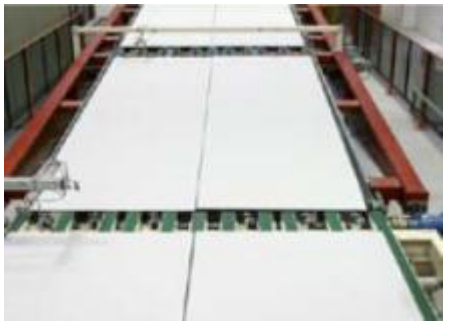
Low carbon footprint:
Gypsum is **the** construction material for a **sustainable future**.

But to really compete with cementitious systems, its **water resistance must be improved.**

Discover and extend the possibilities of gypsum construction materials.





REPRISE – WHAT ARE DRYMIX FORMULATIONS AND WHERE ARE THEY USED TODAY?

Main gypsum-based drymix products:

- plasters
- joint fillers
- adhesives
- flooring screeds
- modelling compounds

WHY EQUIP THESE APPLICATIONS WITH WATER REPELLENCY?

- Multi-purpose application of **indoor plasters** including all moist areas like bathrooms, kitchens, basements, garages, mudrooms or breezeways
- **Joint fillers** and **finishes** for moisture-resistant wallboards in all humid areas
- More durable **adhesives**, **screeds** and all kinds of **gypsum-based dry mortars** for potentially moist areas or after flooding
- Balancing of uneven or strong water absorption levels for optimal **decorative top coats**
- Outdoor applications (in selected regions)

FOR MOST GYPSUM APPLICATIONS, VERY EFFICIENT LIQUID SILICONE WATER REPELLANTS ARE AVAILABLE, ...

Application	Wallboards	Blocks	Fiberboards
Active substance	Polymethyl-hydrogen-siloxane	Polymethyl-hydrogen-siloxane	Potassium methyl-siliconate
SILRES®	BS 94	BS 46	BS 16

Above **liquid** silicone products
are **not suitable for drymix** formulations

... BUT FOR POWDER PRODUCTS POWDER ADDITIVES ARE REQUIRED

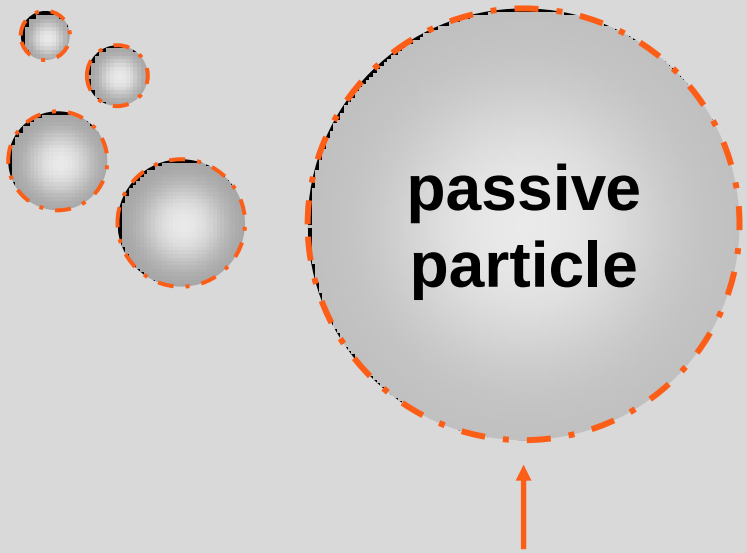
Outdated technologies available on the market:
carrier-based or encapsulated systems

Drawbacks of these technologies:

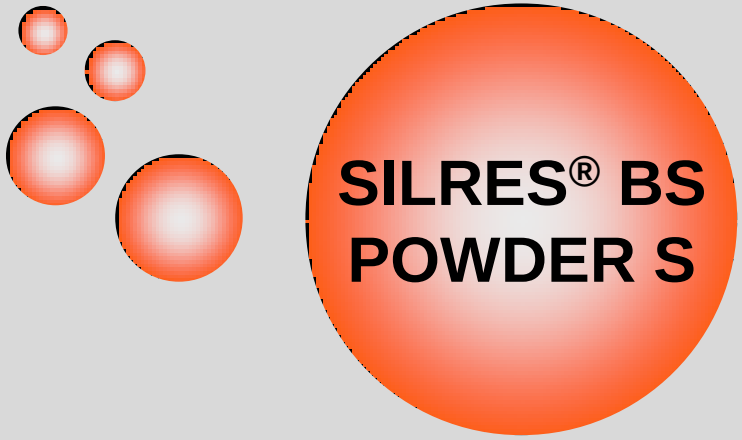
- only around 30 % active substance
- low efficiency
- too expensive, especially for plasters
- VOC release
- mixing problems and dust formation at the construction site due to poor wetting properties of finished drymix formulations

A NEW CONCEPT FOR SILICONES IN POWDER FORM

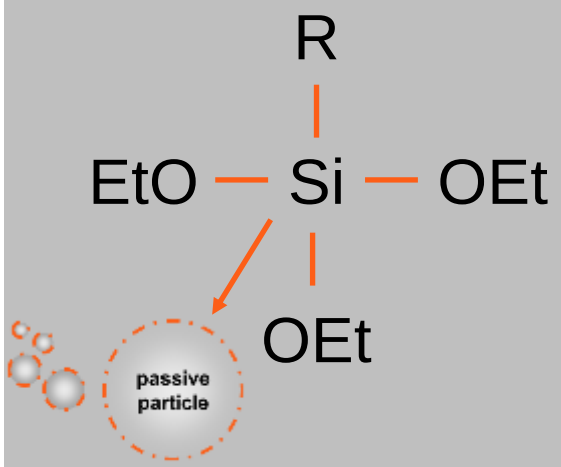
Outdated:
Carrier-based or encapsulated



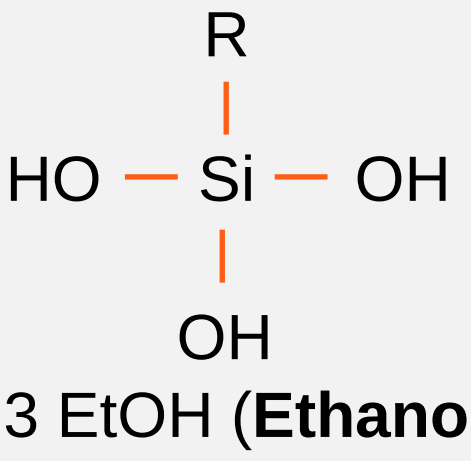
New:
Pure active substance



CARRIER-BASED OR ENCAPSULATED SYSTEMS USE ALKOXY SILANES OR SILOXANES AS ACTIVE SUBSTANCE



$$\xrightarrow[OH^- \text{ (\textbf{alkalinity})}]{3\ H_2O}$$



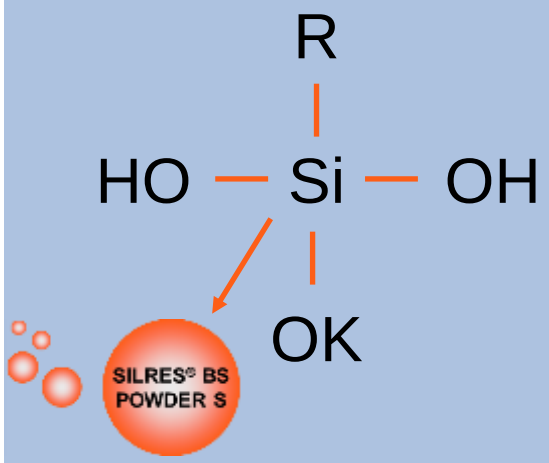
+ 3 EtOH (**Ethanol**)

- Not the active ingredient
- Hydrophobic precursor
- Volatile liquid, migration onto powder
- Mixing issues, dusting

- Reaction takes time (delayed performance)
- Depending on alkalinity

- Active ingredient
- Ethanol is a VOC

POTASSIUM SILICONATES CIRCUMVENT ALL THESE ISSUES: NO VOC BEATS LOW VOC

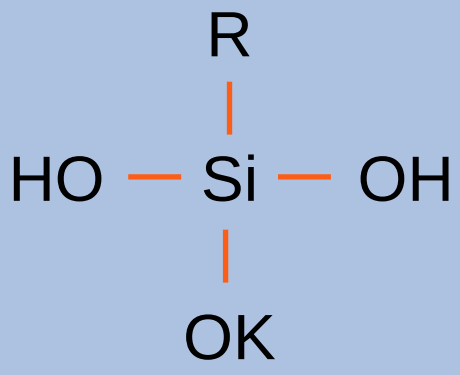


- Active ingredient
- Hydrophilic
- Solid, non-volatile, no migration
- No mixing issues, no dusting

- No reaction, no delay
- No need for alkaline activation

- No VOC

POTASSIUM SILICONATES CIRCUMVENT ALL THESE ISSUES: NO VOC BEATS LOW VOC



available by

- direct drying
- azeotropic drying
- spray drying

SILRES® BS POWDER S

OUR NEW TECHNOLOGY* IS NEITHER CARRIER- NOR ENCAPSULANT-BASED, BUT PURE ACTIVE SUBSTANCE

SILRES® BS POWDER S

- silicone hydrophobizing powder additive for drymix
- optimized for gypsum-based construction materials
- highly efficient in water absorption reduction
- excellent mixing properties
- supports dust suppression during mixing

*patents pending



WETTING, MIXING AND DUST SUPRESSION ARE GREATLY IMPROVED FOR HYDROPHOBIZED GYPSUM DRY MORTARS

Outdated technology:
Carrier-based system

mixing time 3 min 30 sec

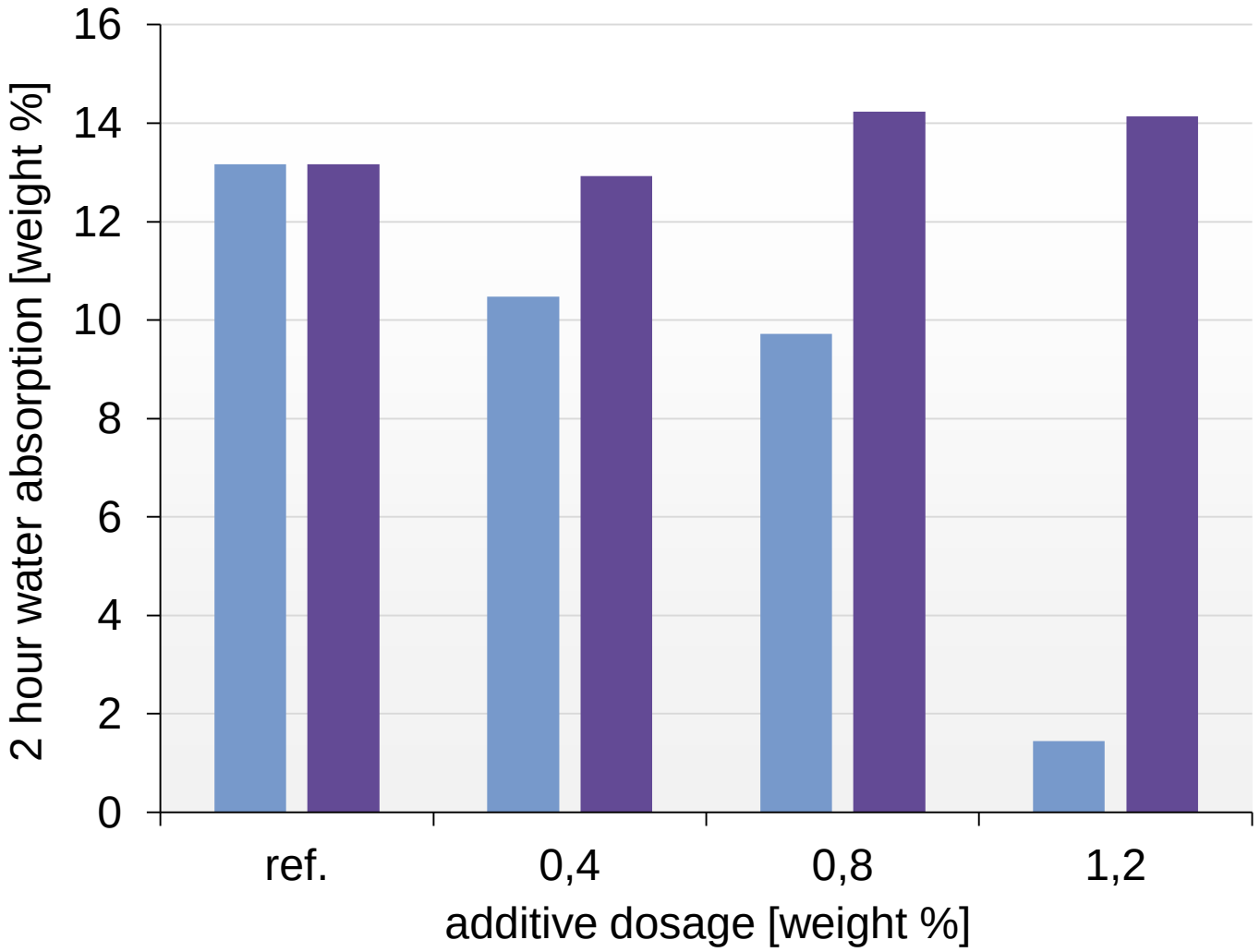
New technology:
SILRES® BS POWDER S

mixing time 1 min 45 sec

IMPROVING THE WATER RESISTANCE OF GYPSUM DRYMIX APPLICATIONS

- INTRODUCTION – A NEW CONCEPT
- **WATER ABSORPTION: EXISTING MARKET PRODUCTS**
- WACKER‘S NEW DEVELOPMENT
- CONCLUSIONS

BENCHMARKING OF EXISTING MARKET PRODUCTS: WATER ABSORPTION / LOW-PH JOINT FILLER



carrier
encapsulated

Joint filler

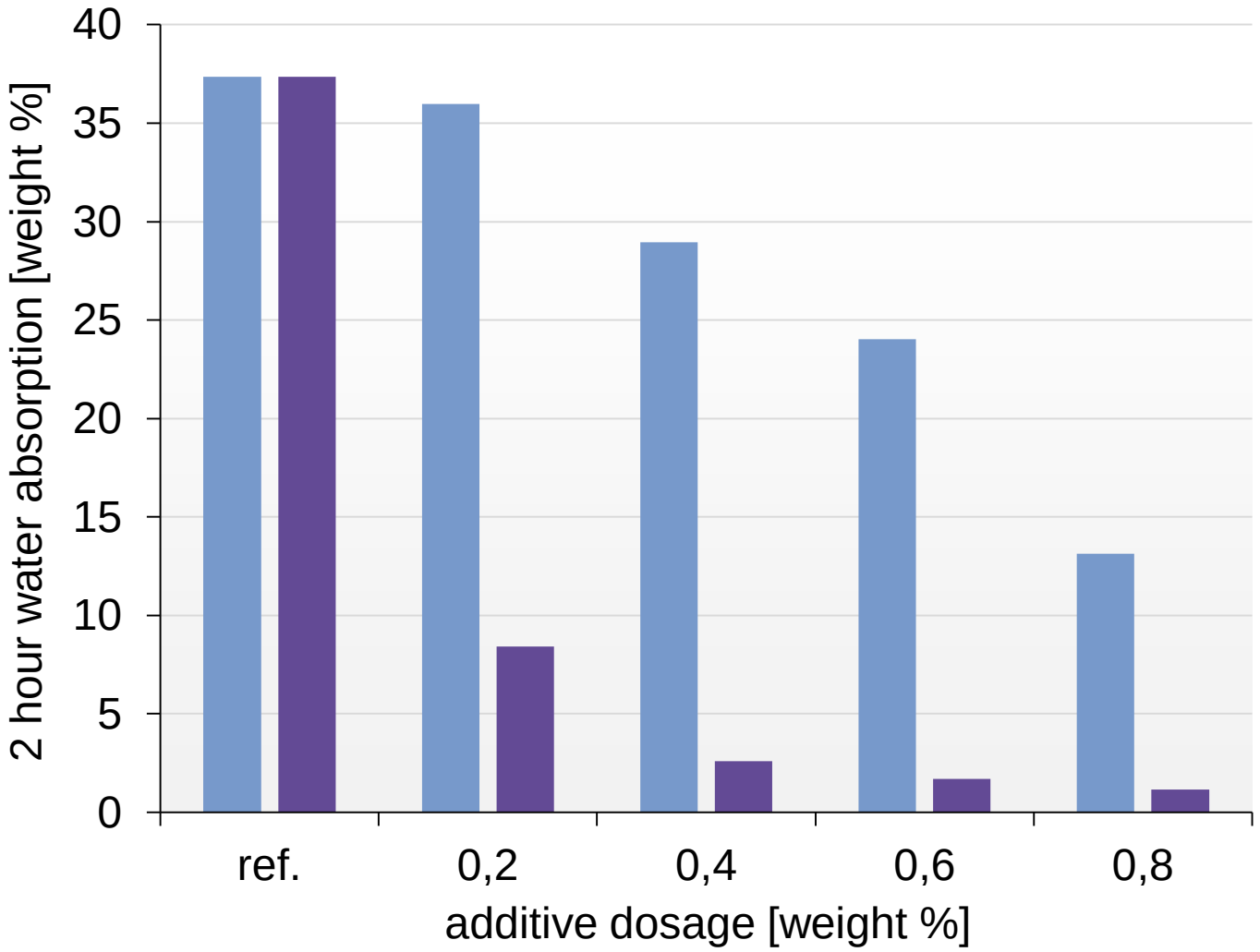
pH 9

Water/solids = 0,50

prep: EN 196-1

water absorption: EN 520

BENCHMARKING OF EXISTING MARKET PRODUCTS: WATER ABSORPTION / GYPSUM LIME HAND PLASTER



carrier
encapsulated

Hand plaster

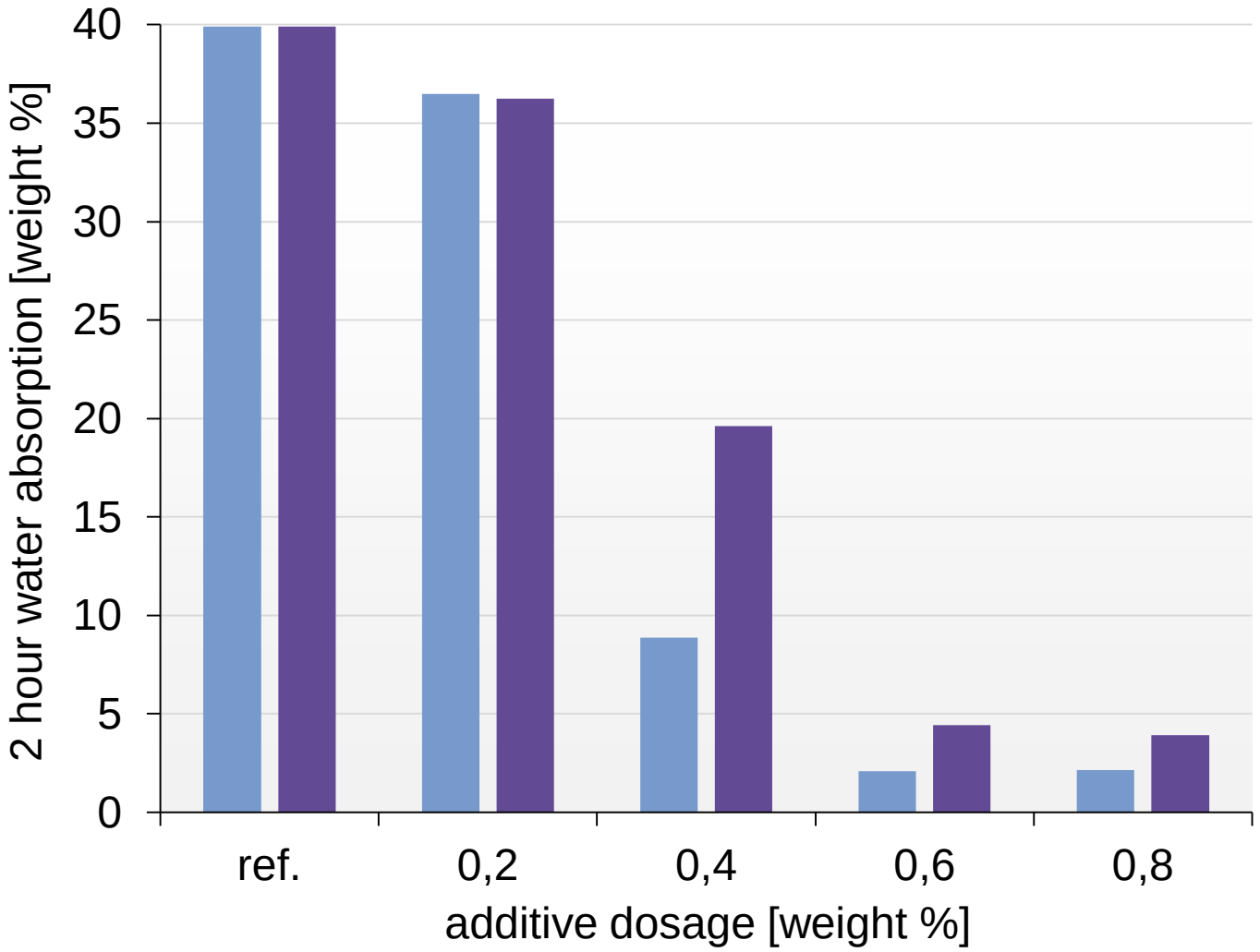
pH 12

Water/solids = 0,67

prep: EN 196-1

water absorption: EN 520

BENCHMARKING OF EXISTING MARKET PRODUCTS: WATER ABSORPTION / GYPSUM LIME MACHINE PLASTER



carrier
encapsulated

Machine plaster

pH 12

Water/solids = 0,60

prep: EN 196-1

water absorption: EN 520

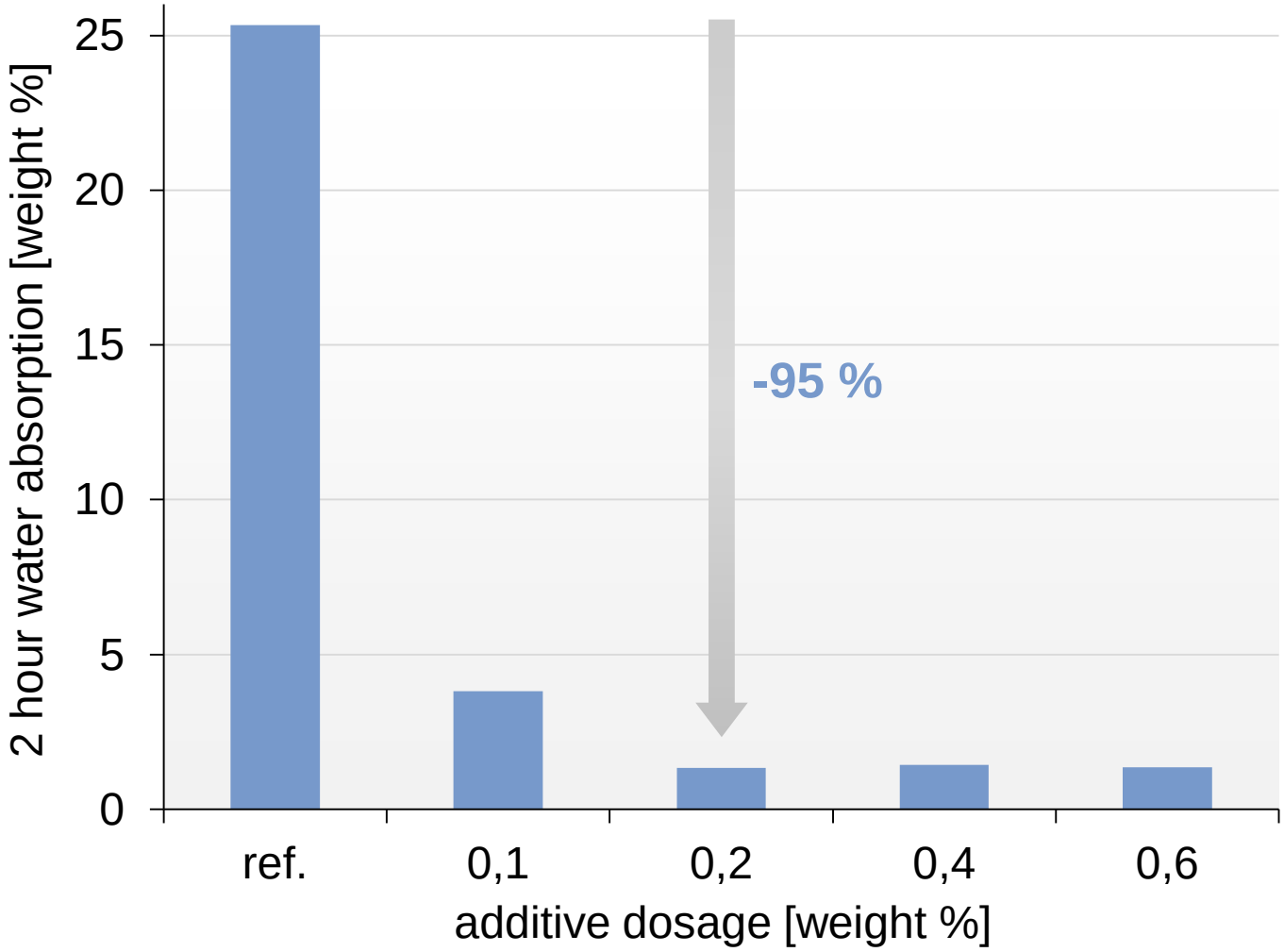
GYPSUM MANUFACTURERS EXPRESSED VERY PRECISELY WHAT THEY WERE LOOKING FOR

Customer requests	
Water absorption	**< 5 %**
Dosage level	**< 0,5 %**
Mixing properties	**Excellent**
Dusting	None
VOC	None

IMPROVING THE WATER RESISTANCE OF GYPSUM DRYMIX APPLICATIONS

- INTRODUCTION – A NEW CONCEPT
- WATER ABSORPTION: EXISTING MARKET PRODUCTS
- **WACKER‘S NEW DEVELOPMENT: SILRES® BS POWDER S**
- CONCLUSIONS

SILRES® BS POWDER S:
WATER ABSORPTION / LOW-PH JOINT FILLER



■ SILRES® BS POWDER S

Joint filler

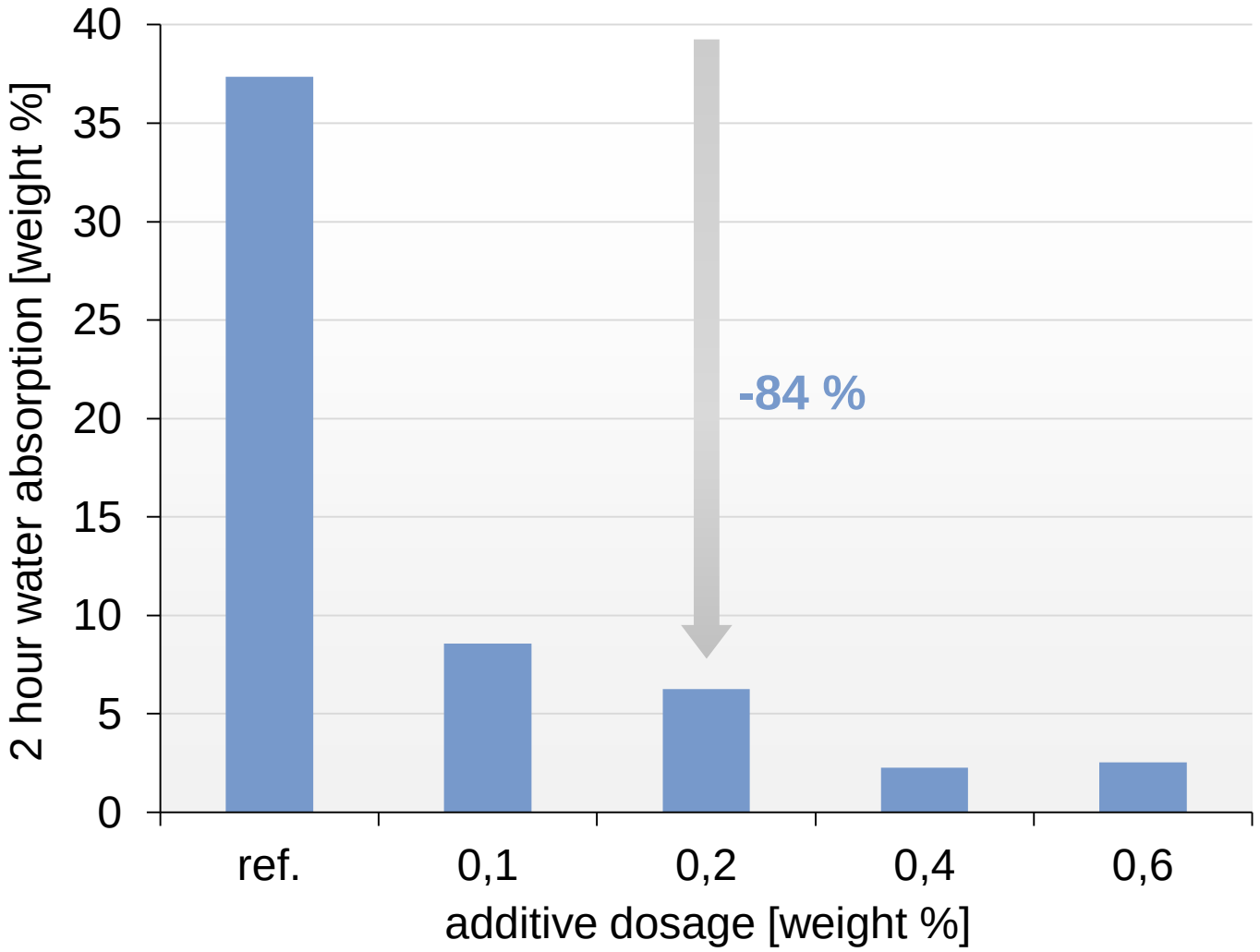
pH 9

Water/solids = 0,50

prep: EN 196-1

water absorption: EN 520

SILRES® BS POWDER S:
WATER ABSORPTION / GYPSUM LIME HAND PLASTER



SILRES® BS POWDER S

Hand plaster

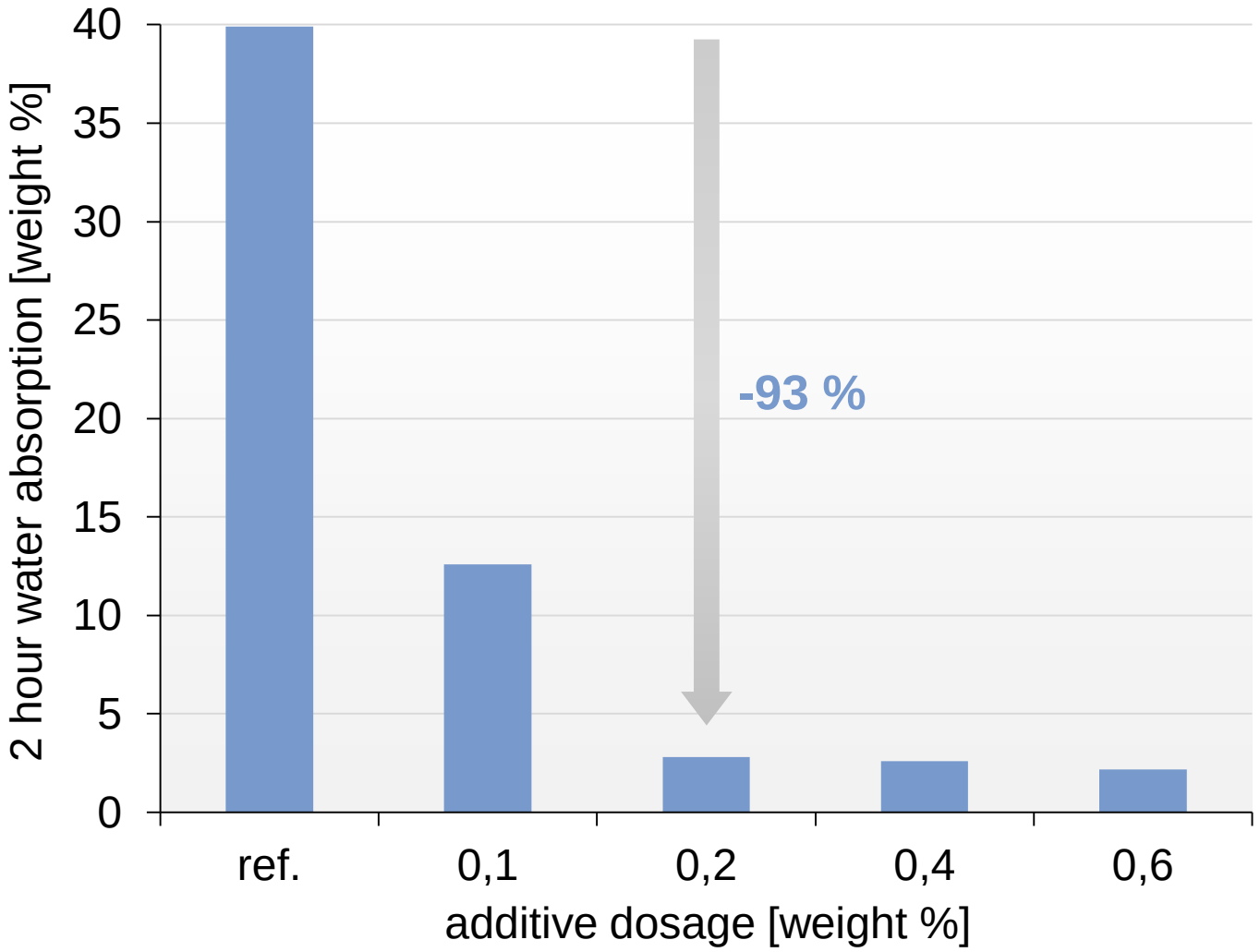
pH 12

Water/solids = 0,67

prep: EN 196-1

water absorption: EN 520

SILRES® BS POWDER S:
WATER ABSORPTION / GYPSUM LIME MACHINE PLASTER



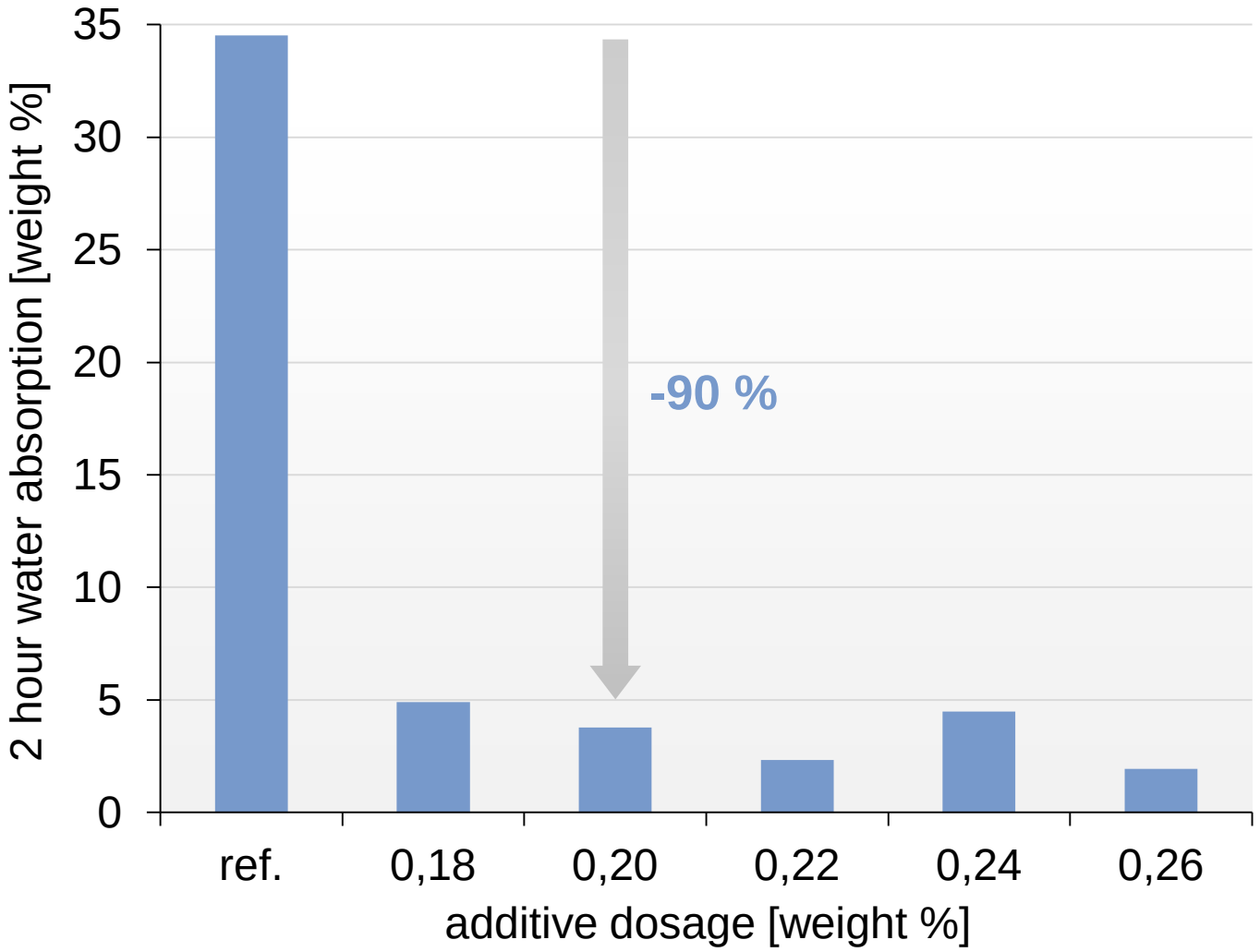
SILRES® BS POWDER S

Machine plaster
pH 12
Water/solids = 0,60

prep: EN 196-1

water absorption: EN 520

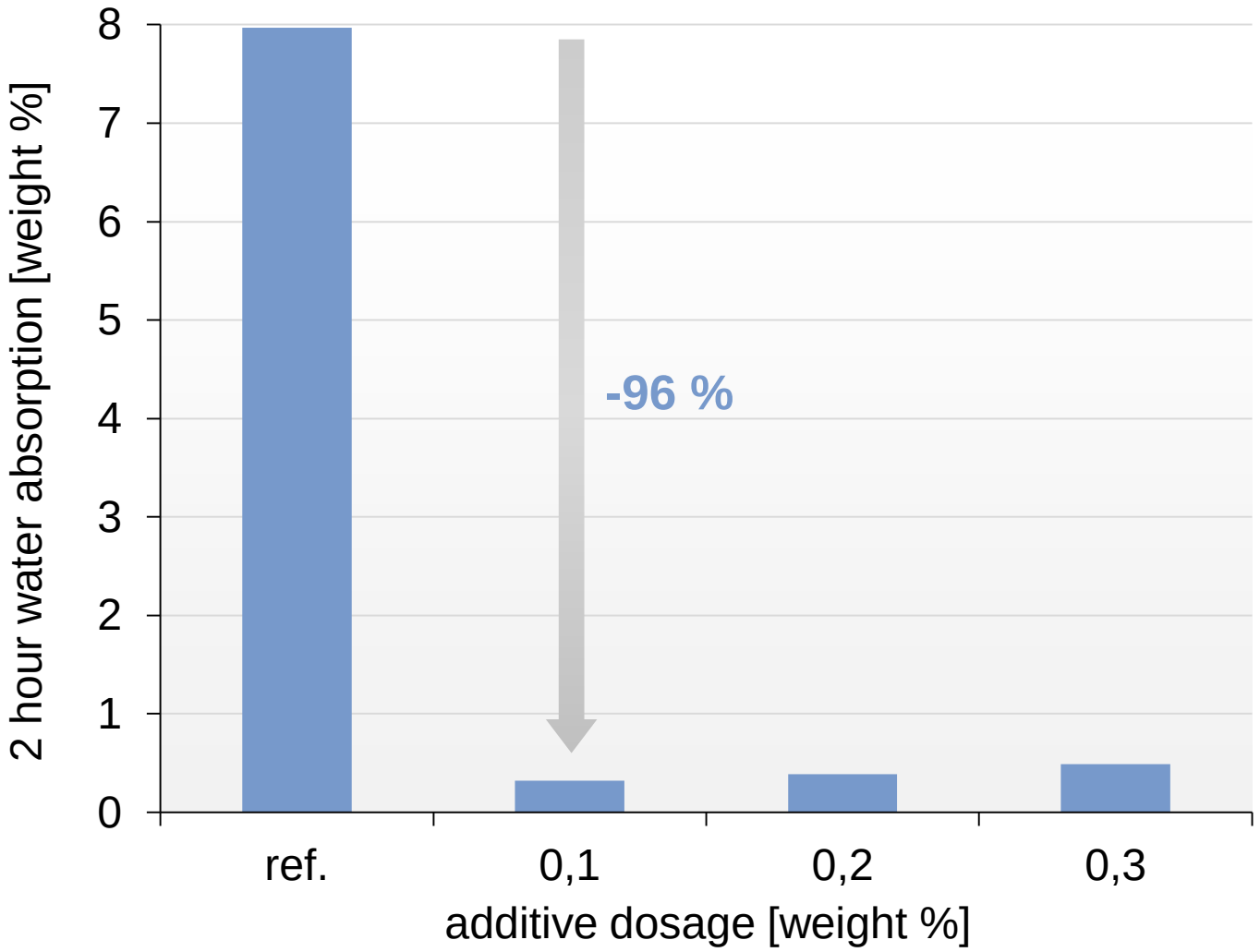
SILRES® BS POWDER S:
WATER ABSORPTION / GYPSUM LIME MACHINE PLASTER



SILRES® BS POWDER S

Machine plaster
30 % stucco 70 % carbonate filler
pH 12
Water/solids = 0,35

SILRES® BS POWDER S:
WATER ABSORPTION / SELF-LEVELLING SCREED



SILRES® BS POWDER S

Flooring screed

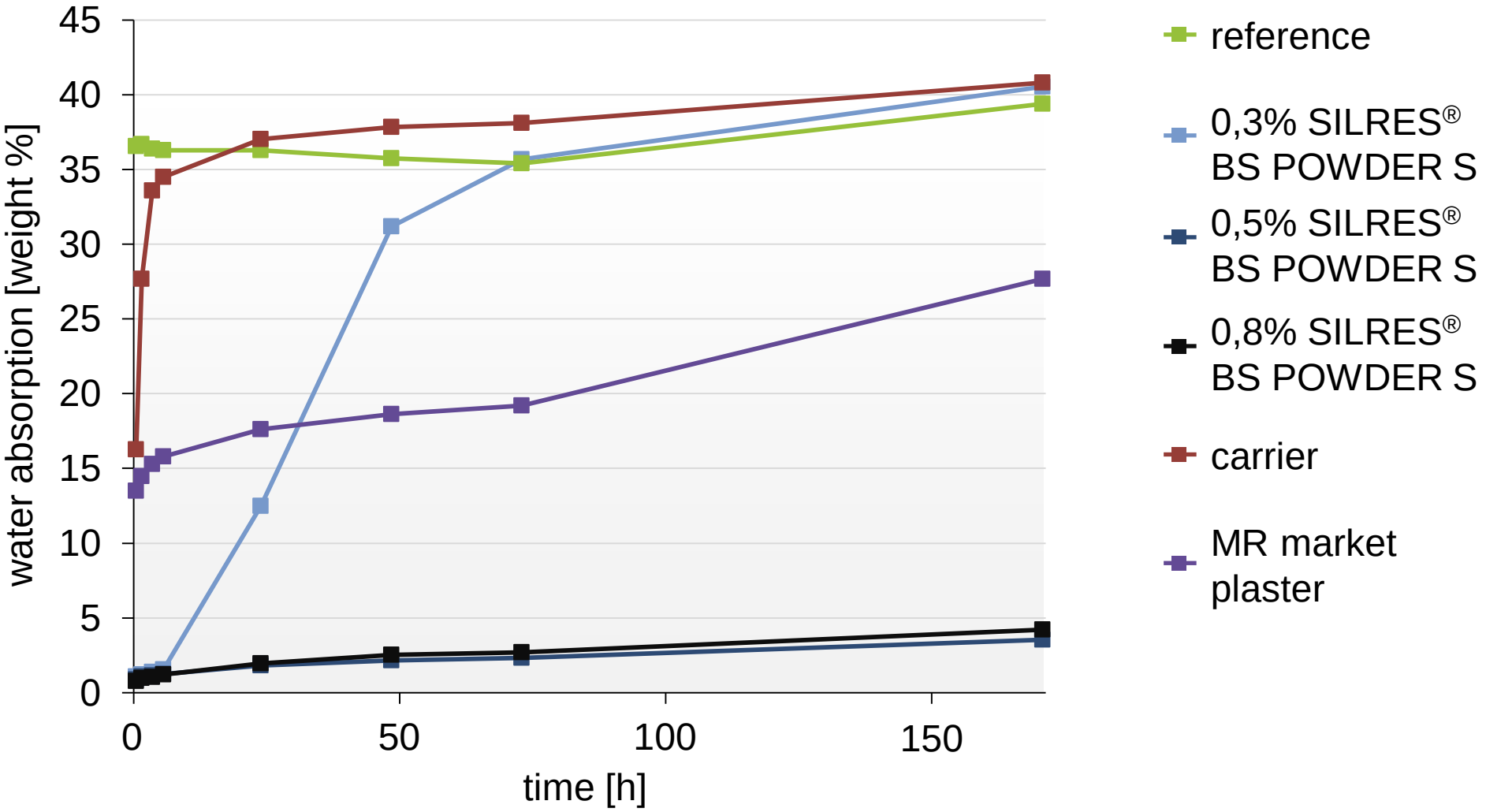
pH 11

Water/solids = 0,17

prep: EN 196-1

water absorption: EN 520

LONG-TERM WATER RESISTANCE AFTER 7 DAYS ON A GYPSUM HAND PLASTER FROM THE MARKET



SILRES® BS POWDER S WITH STRONG BEADING IN ADDITION TO LOW WATER ABSORPTION

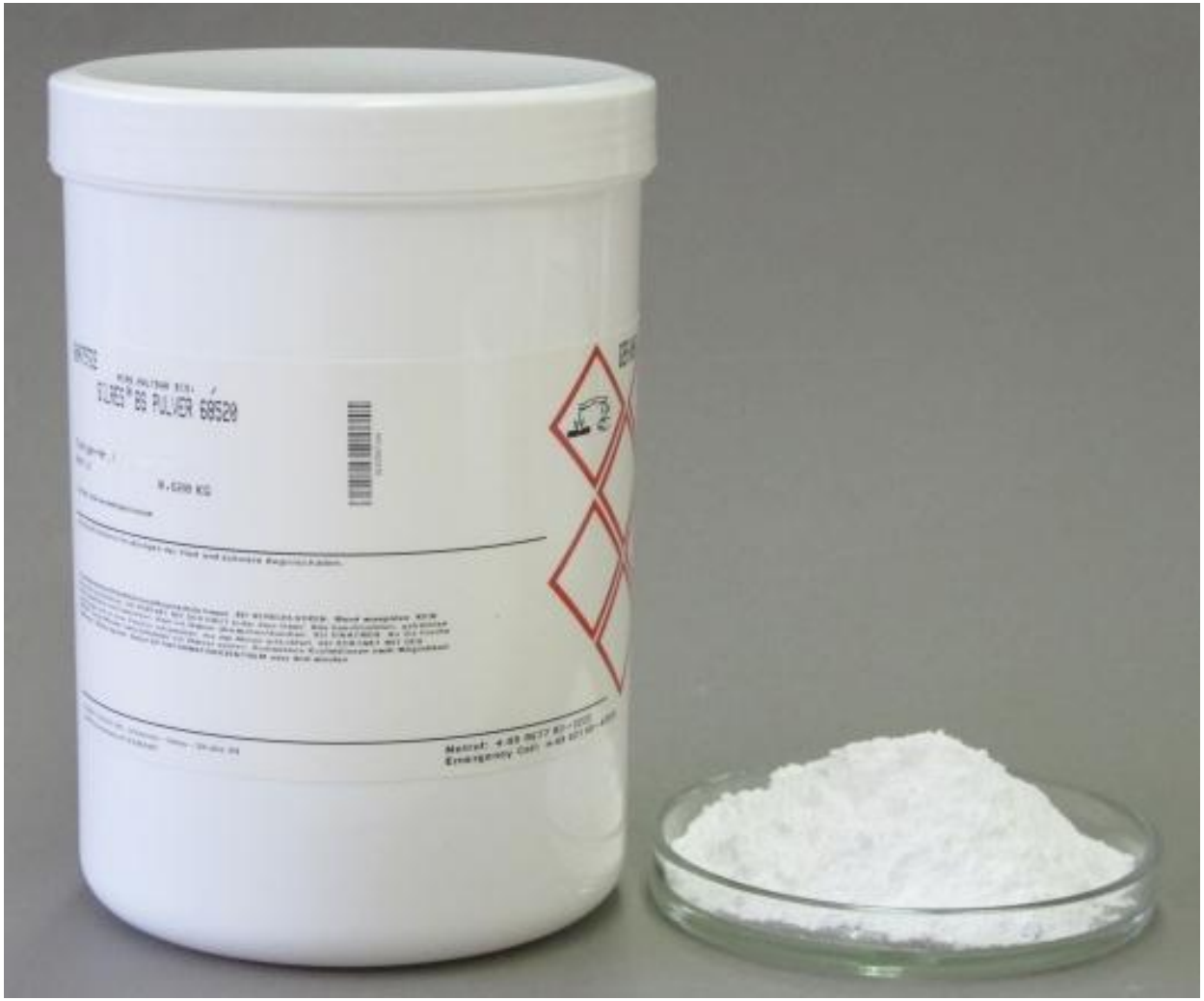
Untreated gypsum plaster	+0,3 % POWDER S

droplet test	**Gypsum hand plaster**			**Gypsum machine plaster**		
	Ref.	**0,2 %**	0,5 %	Ref.	**0,2 %**	0,5 %
time (min)	0	253	280	0	215	209

THE MECHANICAL PROPERTIES OF TEST SPECIMEN WERE INVESTIGATED USING 4×4×16 PRISMS (EN 196-1)

plaster	gypsum hand plaster			gypsum machine plaster		
POWDER S dosage	Ref.	**0,2 %**	0,5 %	Ref.	**0,2 %**	0,5 %
	relative values (%)					
air content (%) DIN EN 1015-7	0	0	-29	0	-41	-62
slump (cm) DIN EN 1015-3	0	0	-5	0	0	-5
tensile strength (N/mm^2) DIN EN 1015-12	0	-13	-11	0	-19	-19
bending strength (N/mm^2) DIN EN 1015-11	0	-6	+4	0	-11	23
compressive strength (N/mm^2) 1015-11	0	-5	+9	0	-14	29

SILRES® BS POWDER S IS A FREE FLOWING WHITE POWDER OF HIGH ALKALINITY



Currently available:

- 0,4 kg sample
- 5 kg drum
- 80 kg drum

IMPROVING THE WATER RESISTANCE OF GYPSUM DRYMIX APPLICATIONS

- INTRODUCTION – A NEW CONCEPT
- WATER ABSORPTION: EXISTING MARKET PRODUCTS
- WACKER‘S NEW DEVELOPMENT
- **CONCLUSIONS**

CONCLUSIONS

- SILRES® BS POWDER S: Well-suited for all gypsum-based powder products requiring drymix hydrophobizing
- More effective, more efficient than current technologies on the market – works instantly without delays
- No release of organic substances (VOC)
- Processing and workability remain unchanged within the recommended dosage ranges
- Mixing problems caused by the water repellant belong to the past

CLICK FOR FURTHER INFORMATION:
WWW.WACKER.COM/POWDER-S

THANK YOU FOR YOUR KIND ATTENTION!
PLEASE VISIT US AT BOOTH 29

SILRES® VINNAPAS®

Durability	Workability	Water resistance	Adhesion	Flexibility

WACKER

CREATING TOMORROW'S SOLUTIONS

global gypsum
CONFERENCE, EXHIBITION & AWARDS

IMPROVING THE WATER RESISTANCE OF GYPSUM DRYMIX APPLICATIONS

Dr. Daniel Schildbach
Wacker Chemie AG

IMPROVING THE WATER RESISTANCE OF GYPSUM DRYMIX APPLICATIONS

- INTRODUCTION – A NEW CONCEPT
- WATER ABSORPTION: EXISTING MARKET PRODUCTS
- WACKER‘S NEW DEVELOPMENT
- CONCLUSIONS
- **BACKUP**

ADVANTAGES AND OTHER PROPERTIES OF SILRES® BS POWDER 68520

Appearance	Powder
Color	White
Odor	Odorless
Active substance	> 99 %
Bulk density	Approx. 640 kg/m^3
pH Value	12 (20 °C, 50 g/l H_2O)
Minimum ignition energy	> 10000 mJ

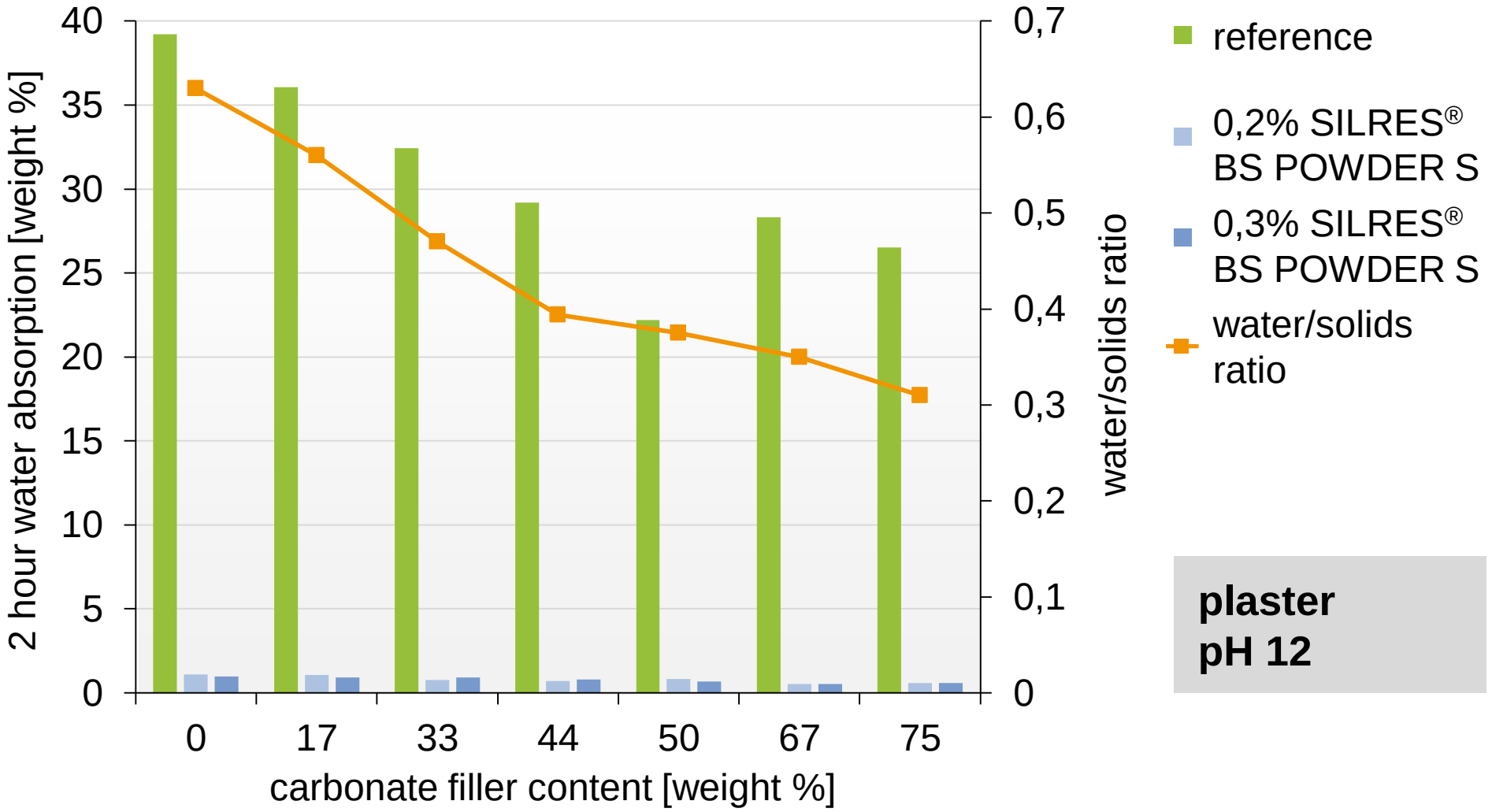
Contains / releases no VOC (no alkoxysilanes)

(Virtually) no vapor pressure

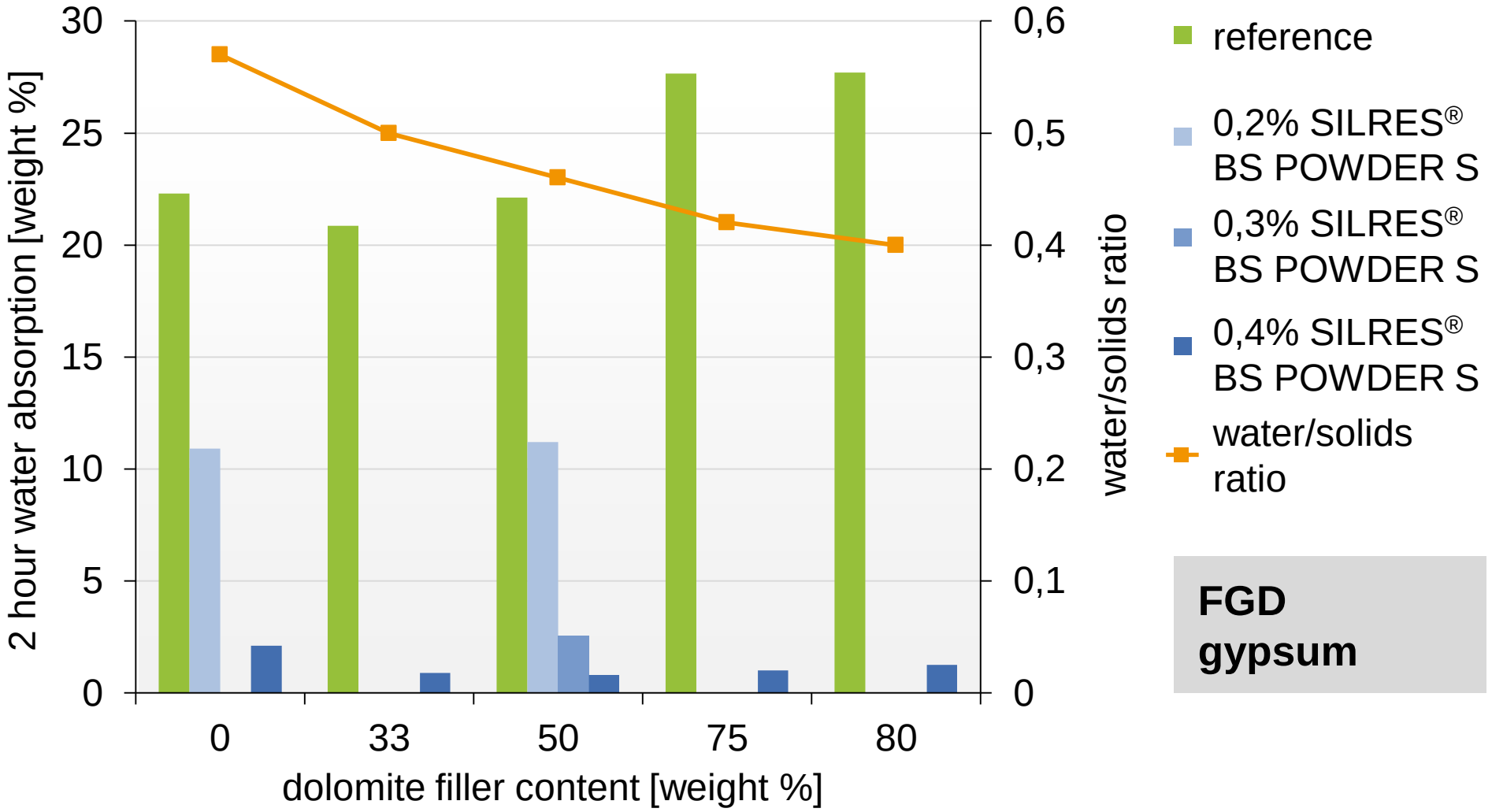
No alkaline activation (pre-hydrolysis) necessary

No nano-scale material

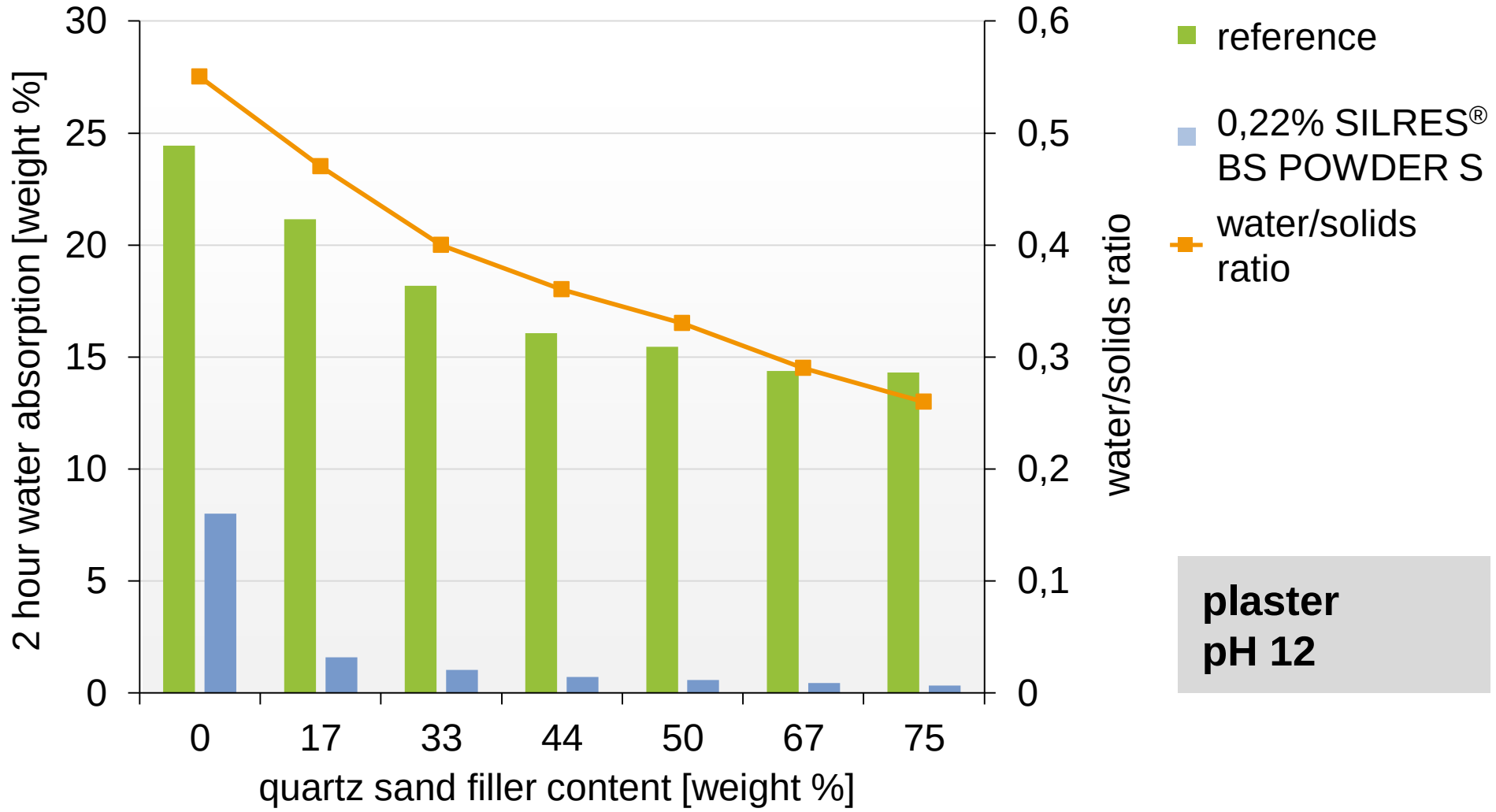
THE PERFORMANCE IS NOT AFFECTED BY LARGE AMOUNTS OF FILLERS – 500 MICRON CARBONATE FILLER



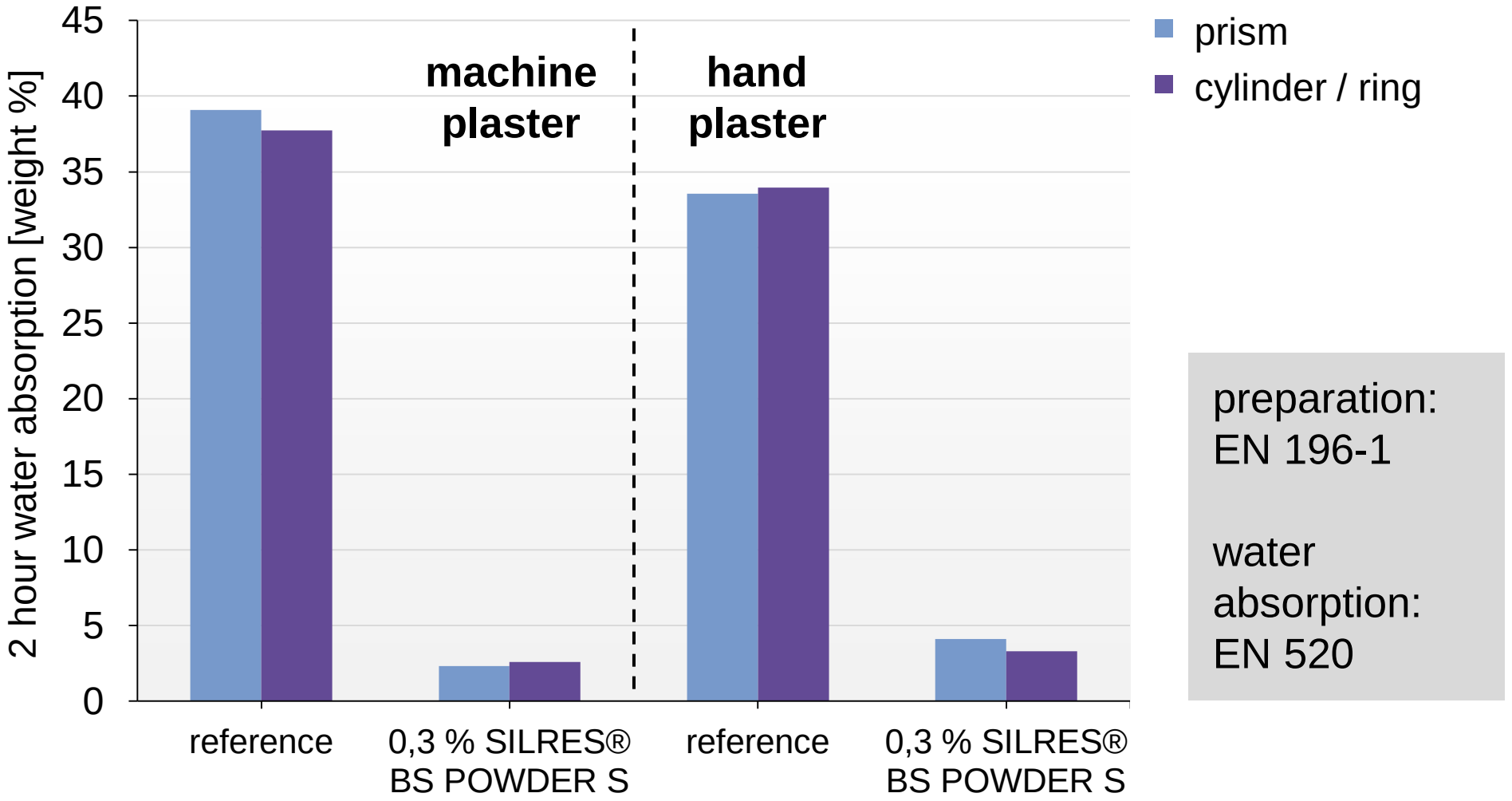
THE PERFORMANCE IS NOT AFFECTED BY LARGE AMOUNTS OF FILLERS – 80 MICRON DOLOMITE FILLER



THE PERFORMANCE IS NOT AFFECTED BY LARGE AMOUNTS OF FILLERS – QUARTZ SAND FILLER



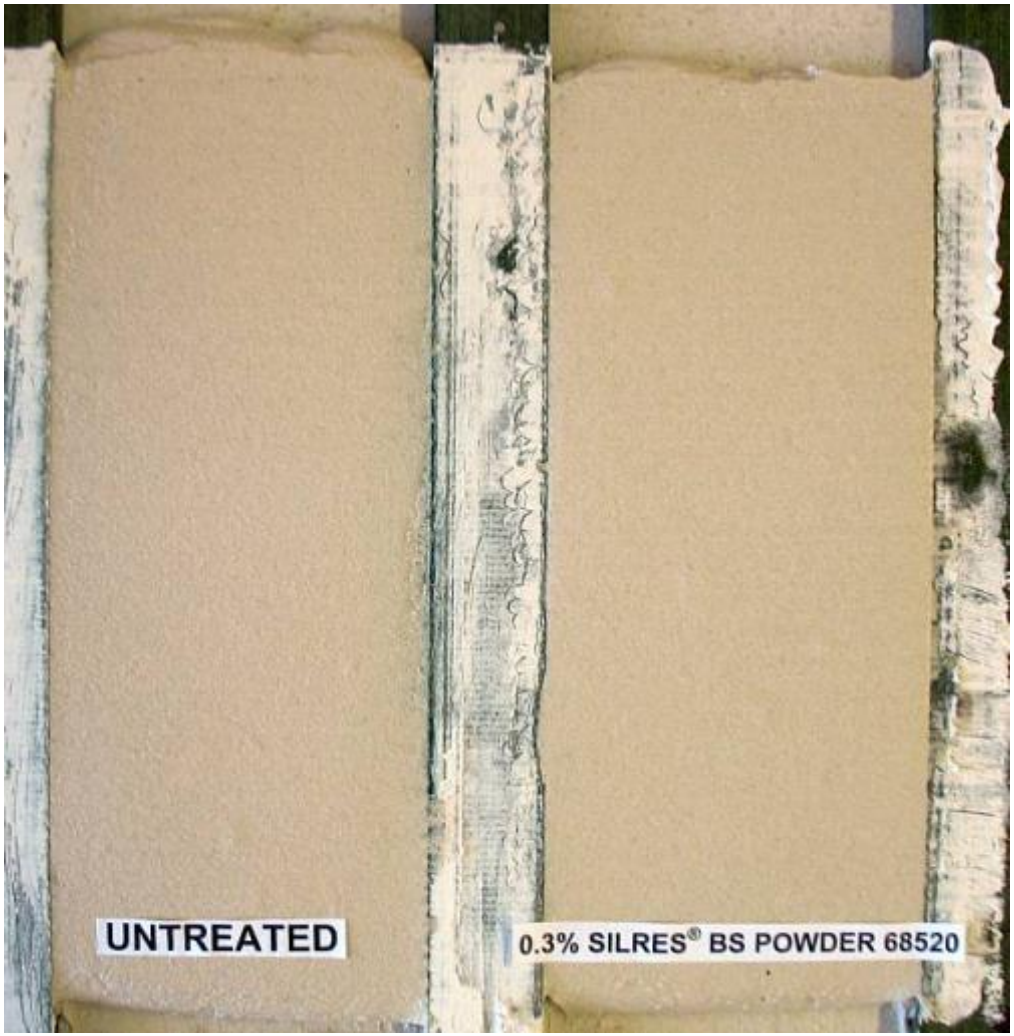
WATER ABSORPTION TEST BY PRISM OR CYLINDER? VIRTUALLY NO DIFFERENCE



preparation:
EN 196-1

water absorption:
EN 520

UNCHANGED MIXING, MODELLING AND FINISHING PROPERTIES FOR DOSAGES ≤ 0.3 %



THE DIFFERENCE IS OBVIOUS AFTER A PERIOD OF NATURAL OUTDOOR WEATHERING

6 months of natural weathering (Sep – Feb 2012) (gypsum lime hand plaster)

Reference 0,3 % 0,5 %

PREPARATION OF GYPSUM SAMPLES IN WACKER'S CONSTRUCTION CHEMISTRY LABS

WATER ABSORPTION TEST ACCORDING TO DIN EN 520

cylindrical gypsum test bodies (2 cm x 8 cm Ø) are prepared using ring-shaped standardized PVC molds.

water absorption test according to DIN EN 520 (gypsum test bodies forced under water using steel weights).