Geosil® – ready to use alkali silicates for Geopolymers

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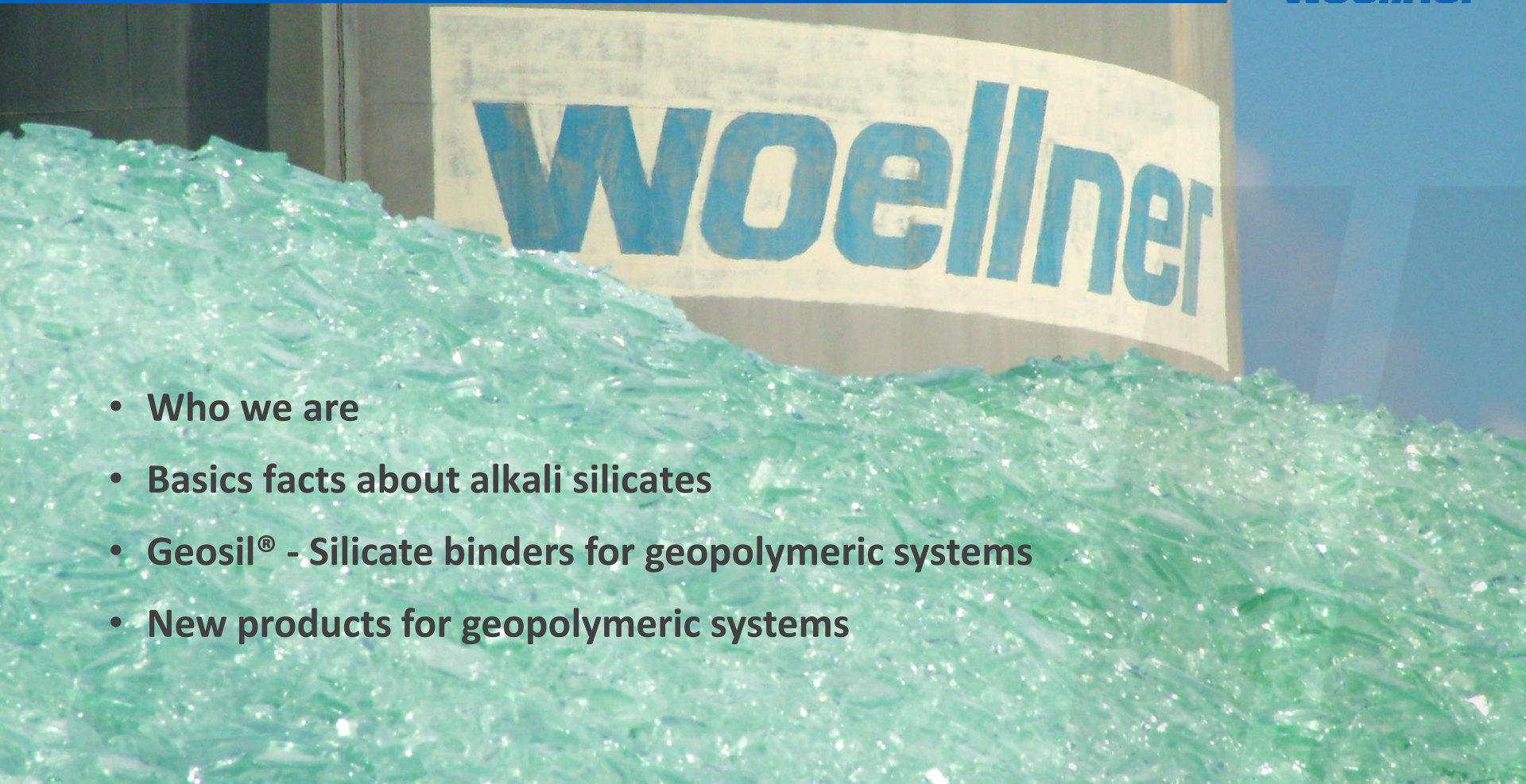


- Who we are
- Basics facts about alkali silicates
- Geosil® - Silicate binders for geopolymeric systems
- New products for geopolymeric systems

COMPANY INTRODUCTION

Owned by Dr. Eduard Wöllner family foundation

Founded in 1896 – 125 years of experience

Head office in Ludwigshafen / Germany

Main product groups:

- industrial silicates
- raw materials and additives for paints, plasters and construction materials
- process chemicals for industrial water circuits

Approx. 150 employees

Annual turnover approx. 50M€

Sites in Germany & Austria

Basic facts about alkali silicates

Basic facts about alkali silicates

- Glasses soluble in water, consisting of a combinations of alkali metal oxide (Na_2O, K_2O, Li_2O) & silica (SiO_2) in varying proportions
- Alkali silicates are generally not distinct stoichiometric chemical substances

- No specific chemical formula for each product
- Trivial name = Waterglass
- Products available as solution and powder

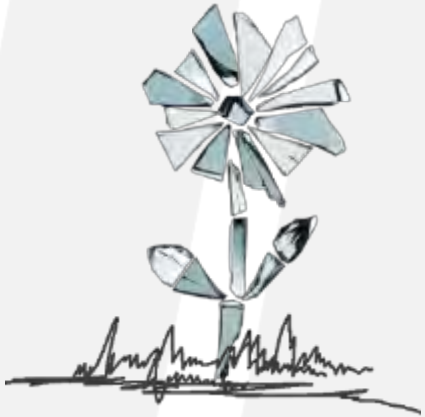
Molar and weight ratio

$$Molar\ ratio: \frac{n\ SiO_2\ [mol]}{n\ Me_2O\ [mol]} = MR\ [-]$$

$$Weight\ ratio: \frac{w\ SiO_2\ [\%]}{w\ Me_2O\ [\%]} = WR\ [-]$$

Technical significant liquid Na, K & Li-silicates and mixtures thereof:

- Sodium silicate $MR = 1{,}7 - 4{,}0$
- Potassium silicate $MR = 1{,}0 - 4{,}0$
- Lithium silicate $MR = 2{,}5 - 5{,}0$



Geosil® - Silicate binders for geopolymeric systems

Geosil® - Silicate binders for geopolymeric systems

- Geosils are not blends of standard alkali silicates with hydroxide
- New production technology
- Highest possible solid content & optimal Q-structure distribution

Pros

+ Ready-to-use solutions
+ Many variations are possible
+ Userfriendly - no hydroxide handling
+ High purity of raw materials
+ Reproducible & controlled production process
+ Storage stable solution

Cons

– Limitation: dangerous goods (ADR) for some molar ratios
– Molar ratio < 1,7 for sodium based products are not possible due to limited shelf life / spontaneous crystalisation

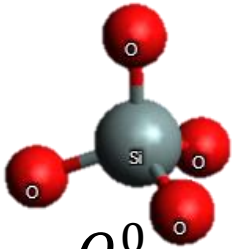
Geosil® - Types

Product	Geosil® 14515	Geosil® 14517	Geosil® 34417
Alkali metal	potassium	potassium	sodium
Viscosity	20 [mPa·s]	20 [mPa·s]	430 [mPa·s]
CLP - classification	H290 / H314 (1B) / H318	H315 / H318	H315 / H318
CLP - label			
ADR - classification	Class 8 / packaging group II	non	non

The next generation of Geosil®

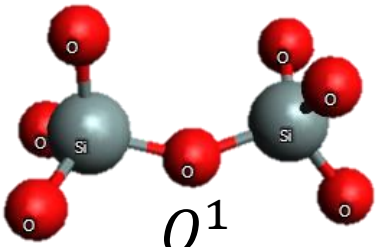
Q-Structure

Index = numbers of nearby silicon atoms



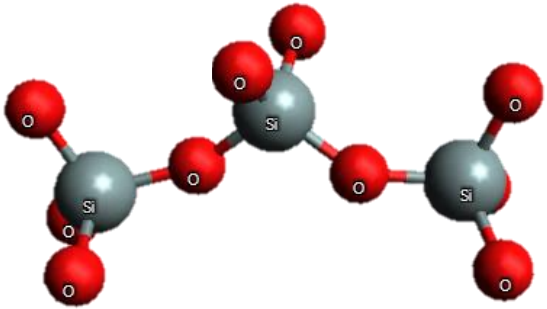
Q^0

monosilicates



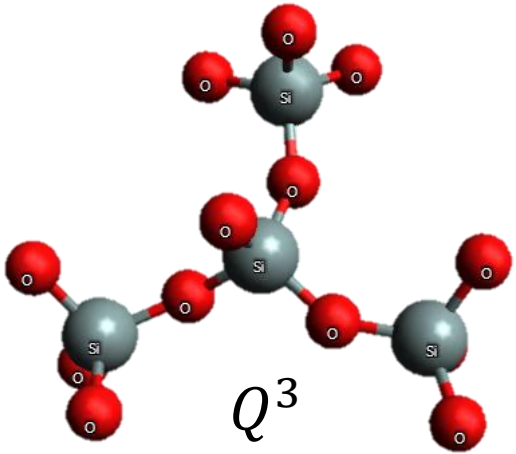
Q^1

disilicates and chains



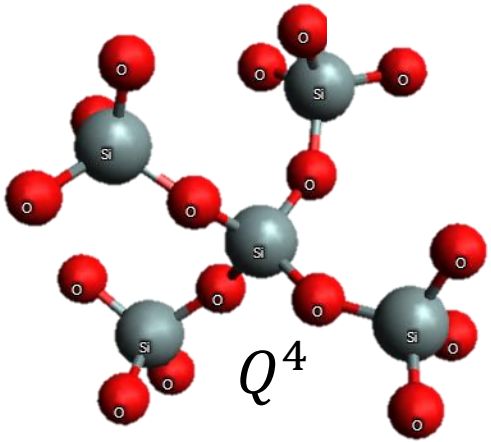
Q^2

chains and rings



Q^3

rings and branches

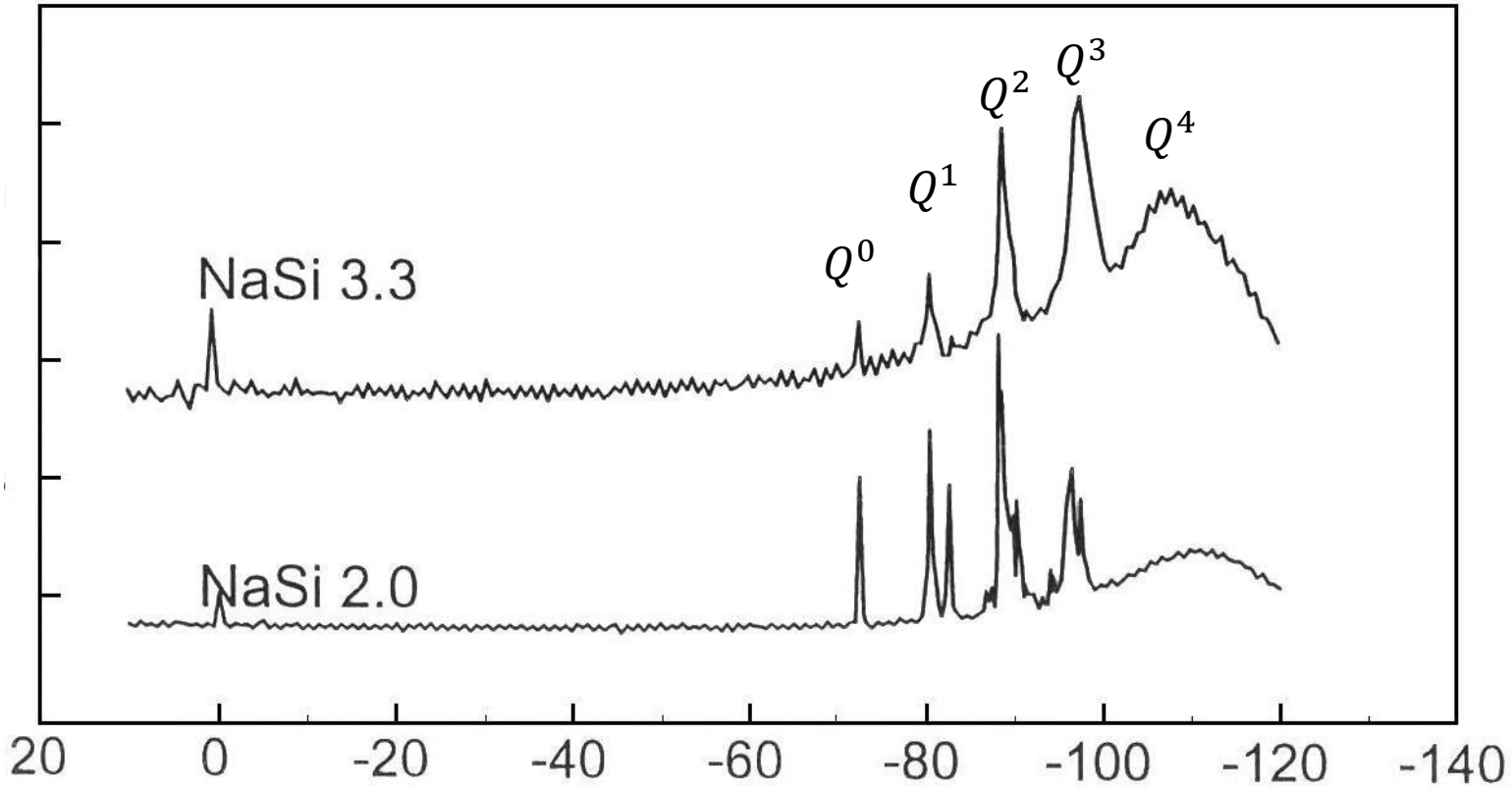


Q^4

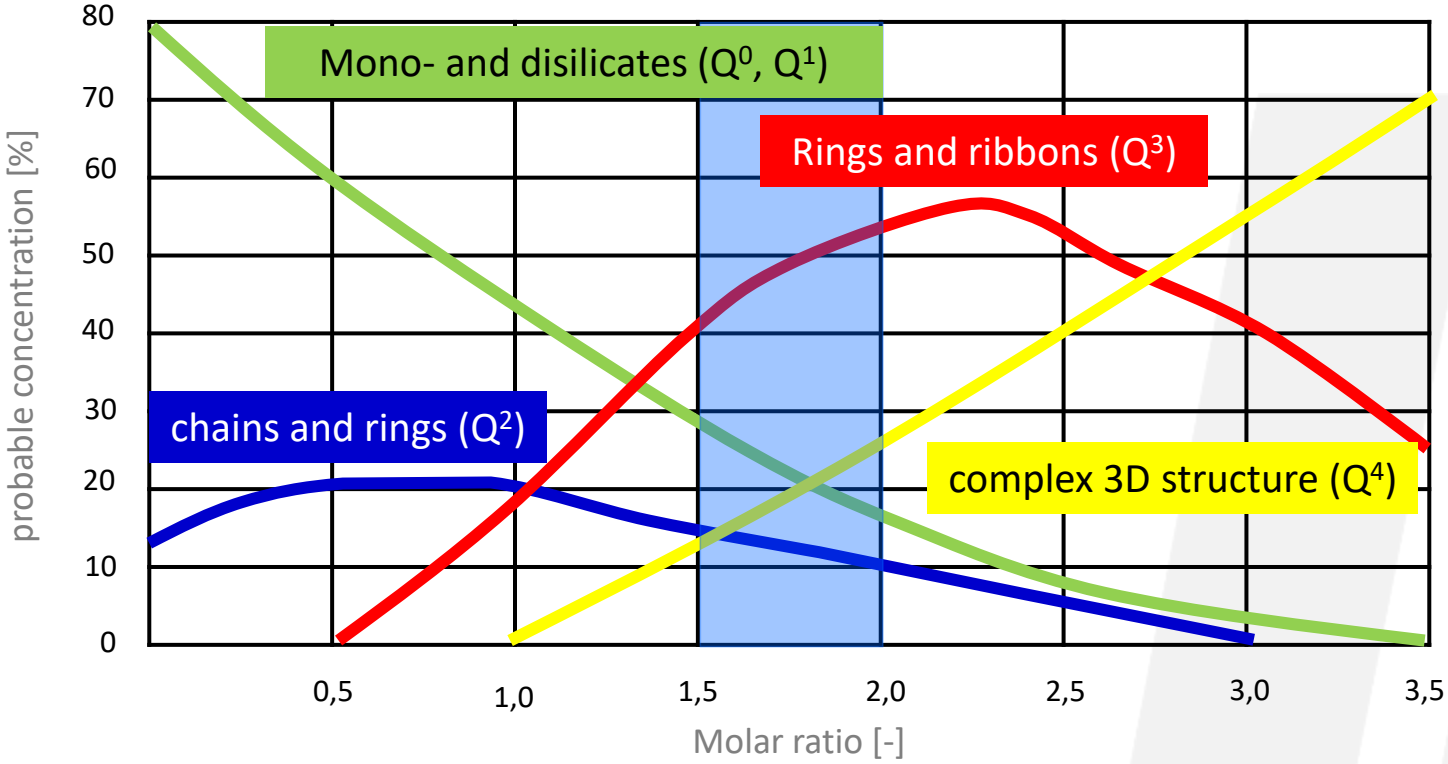
complex 3D structure

Avogadro: an open-source molecular builder and visualization tool. Version 1.20. http://avogadro.cc/

Molar ratio and the silicate structure



Preferred range for molar ratio



Geosil® VP 6918 - Geosil® VP 6923

- The next generation of Geosil®

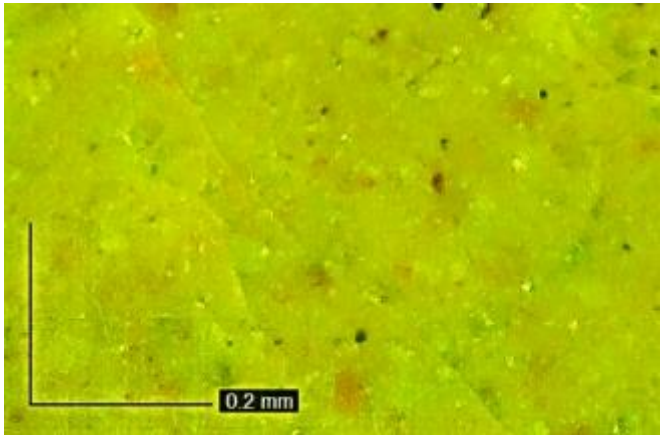
Pros

+ Higher alkalinity possible at a comparable Q-Structure distribution
+ Variation of the Q-Structure distribution at a similar alkalinity
+ Higher reactivity
+ Curing temperature can be reduced
+ Properties of the Geopolymere can be improved

Cons

– Reduced open time due to the higher reactivity

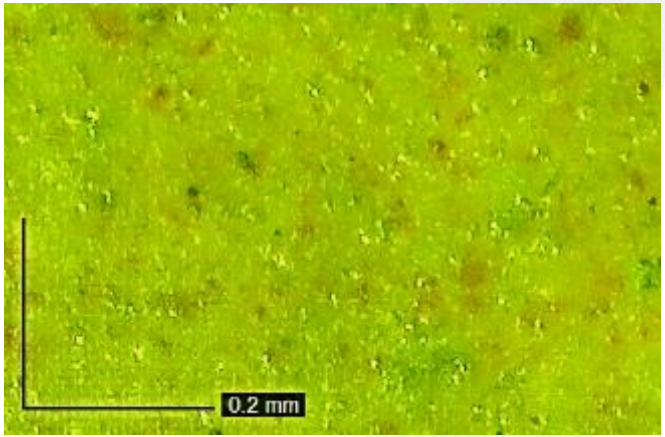
Improved crack behavior / reduced shrinkage



Geopolymer Mortar A Geosil 14517

Slight micro cracks on the surface

Shrinkage > 10 mm/m



Geopolymer Mortar A Geosil VP 6918

No micro cracks on the surface

Shrinkage < 3 mm/m

Improved acid resistance

7d curing / 24hr Water / 24hr drying at 120°C / 48hr 10% H_2SO_4

Metakaolin + Geosil 14517

Metakaolin + Geosil VP 6919

Improved acid resistance

28d curing / 48hr 10% H_2SO_4

Geopolymer with Geosil 14517

Geopolymer with Geosil VP 6922

The next generation of Geosil® - overview

Product	Geosil® VP 6918	Geosil® VP 6919	Geosil® VP 6920	Geosil® VP 6921	Geosil® VP 6922	Geosil® VP 6923
Alkali metal	potassium	potassium	potassium	potassium	potassium	potassium
Alkalinity compared to Geosil® 14517	+	+	0	0	-	-
Increase in Q-Structure	+	++	+	++	+	++
ADR-classification	Class 8 / packaging group II	Class 8 / packaging group II	non	non	non	non

New products for geopolymeric systems

Geosil® VP 6924 - Geosil® VP 6925

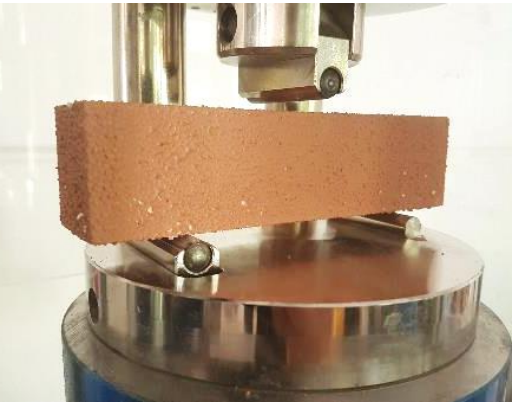
- Highly concentrated additives
- You can replace a part of the original Geosil
- Can be adapted to your needs in a ready to use product

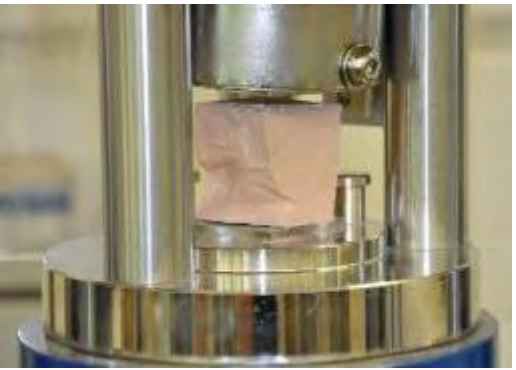
Pros

+ Improves the tensile strength
+ Improves the alkalination process

Cons

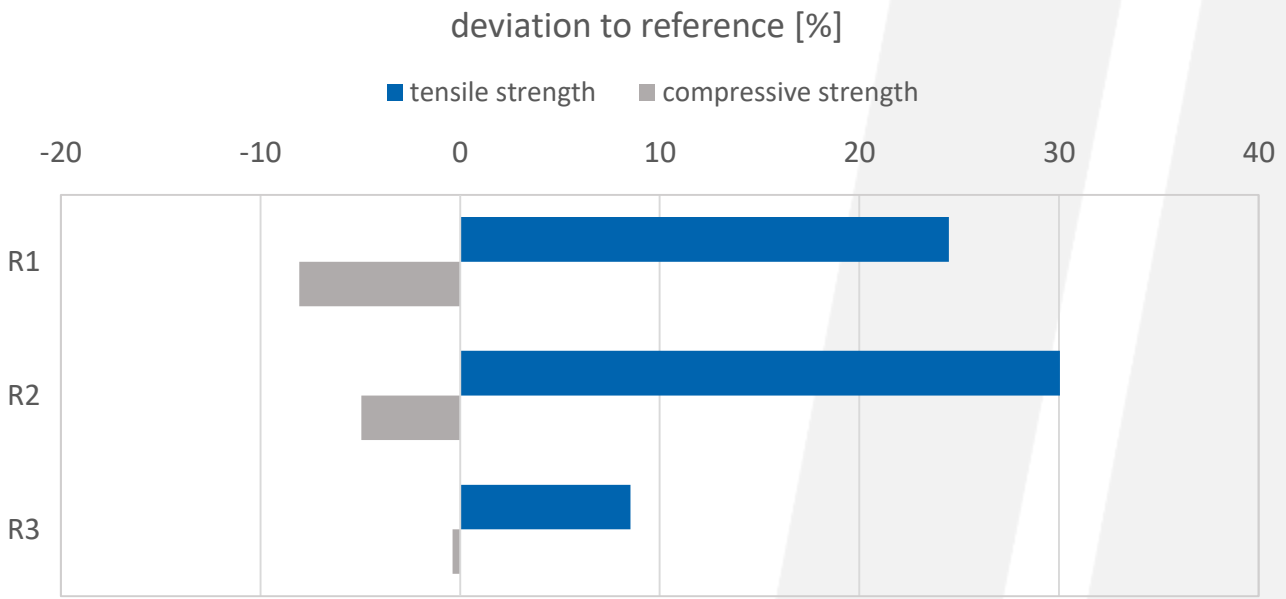
– Slight reduction of the compressive strength





Tensile strength booster Geosil® VP 6924

Strength according to DIN EN 196-1



Tensile strength booster - overview

Product	Geosil® VP 6924	Geosil® VP 6925
Suitable for	Geosil® 14515/ Geosil® 14517	Geosil® 34417
Dosage recommendation	0,5-3 %	0,5-3 %

Geosil® VP 6926 - Geosil® VP 6927

- Highly concentrated additives
- You can replace a part of the original Geosil
- Can be adapted to your needs in a ready to use product

Pros

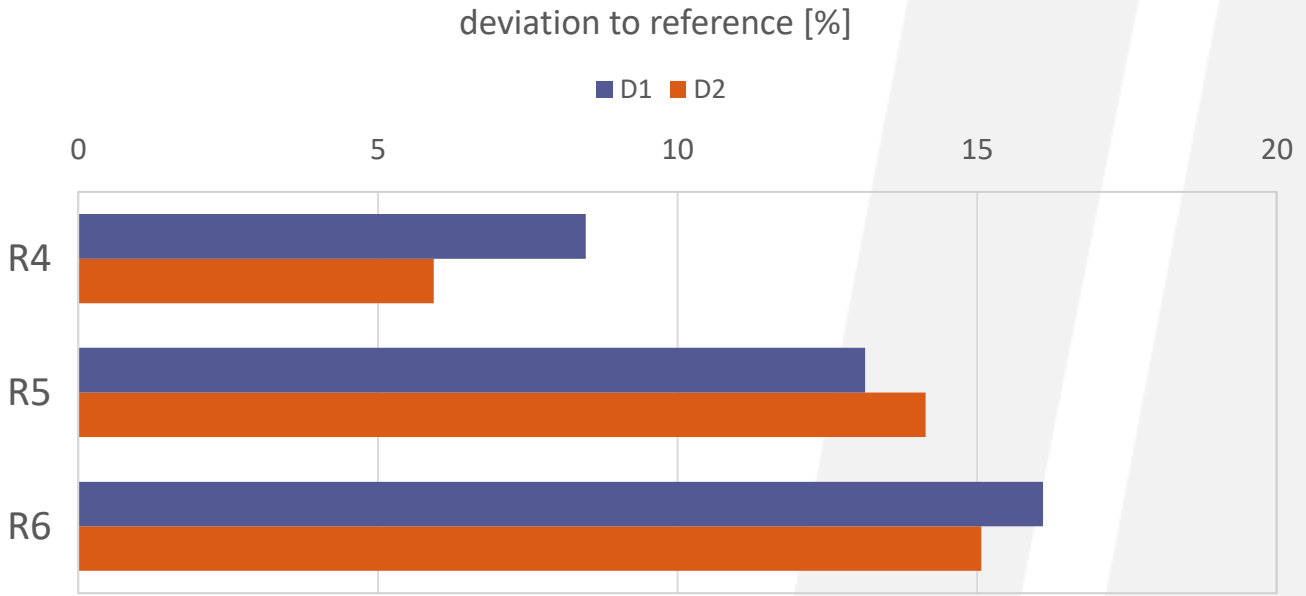
\+ Improves workability

Cons

– Reduced open time

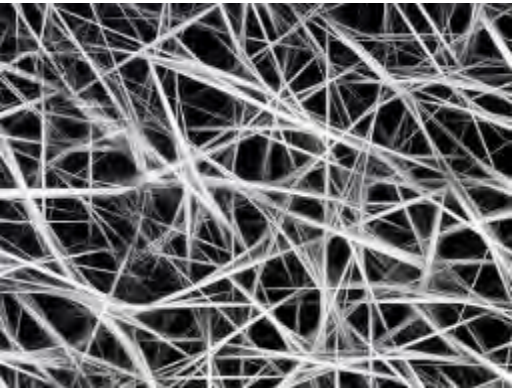
Workability booster Geosil® VP 6926

Flow spread according DIN EN 1015-3



Workability booster - overview

Product	Geosil® VP 6926	Geosil® VP 6927
Suitable for	Geosil® 14515/ Geosil® 14517	Geosil® 34417
Dosage recommendation	0,5-3 %	0,5-3 %

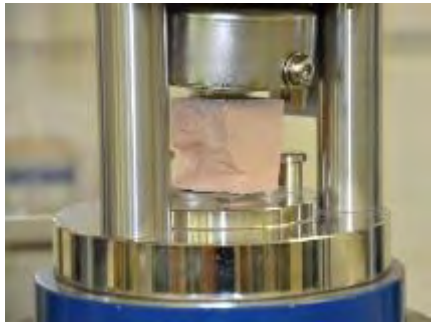
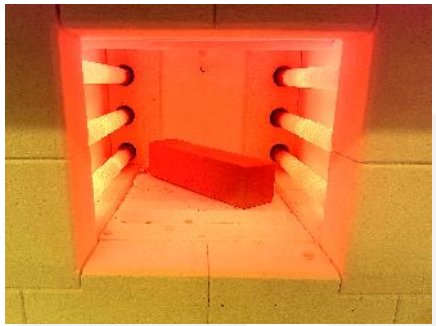


R&D work

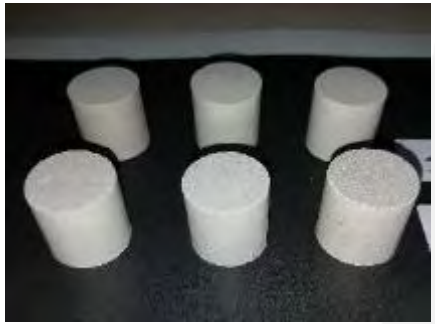
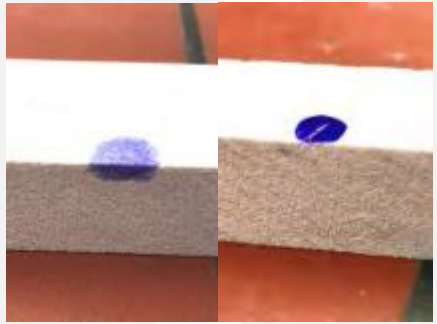
- Raw material studies
  - Reactive raw materials
  - Functional and non-functional fillers
- How to reinforce? (✓)
  - Fiber materials
  - Laminated structured materials
- Additive study
  - Liquefying ✓
  - Dispersing
  - Retarding
  - Shrinking ✓
  - Cracking ✓

Equipment



Customer-related formulation development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chemical solutions