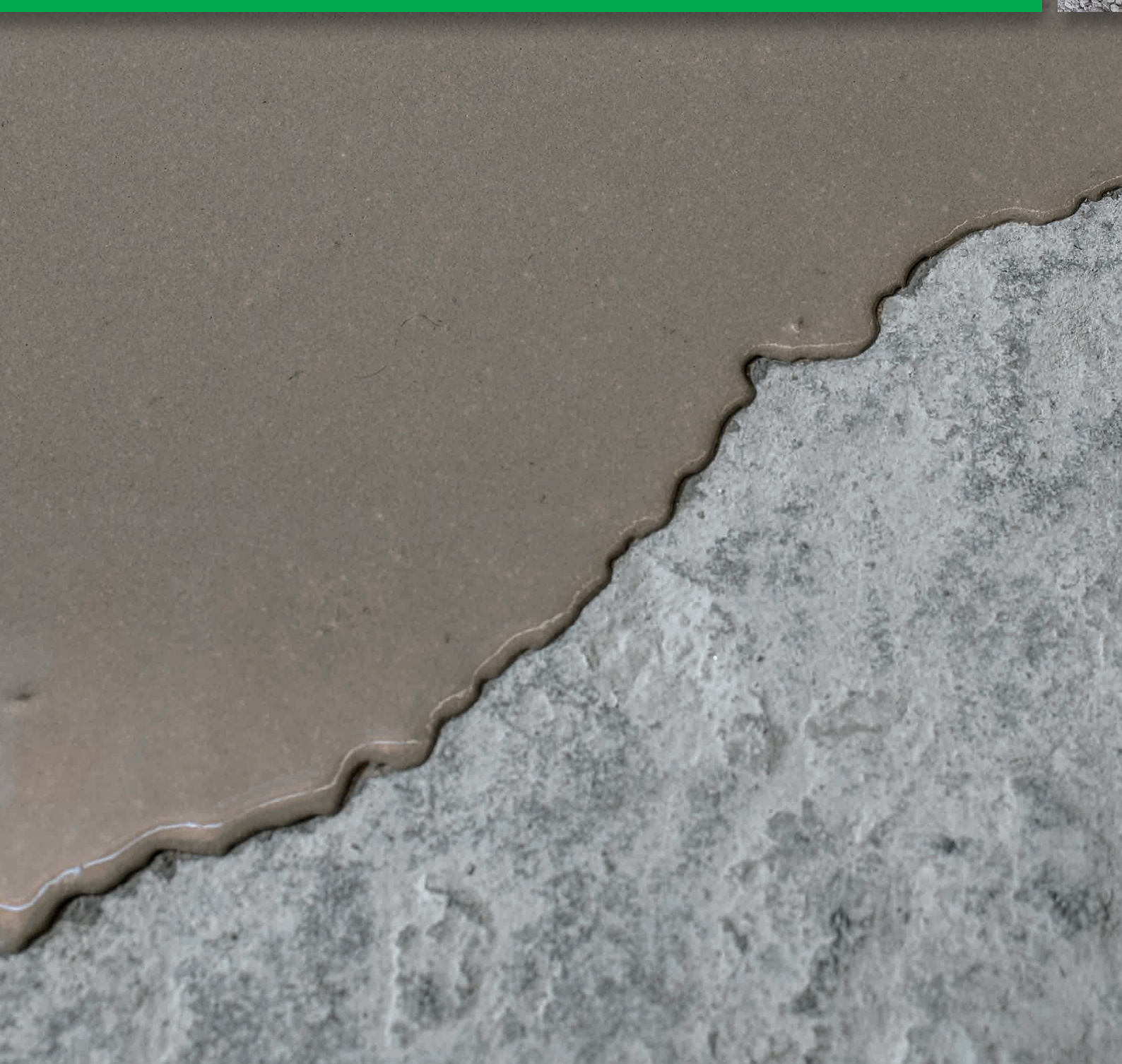



i.tech[®] ALI PRE
i.tech[®] ALI CEM

Calcium Sulfoaluminate
(CSA) Cements

HEIDELBERGCEMENT



More flexibility by managing
the important properties.
Our CSA cements offer
many advantages.



CSA CEMENT

i.tech® ALI PRE:

**Ground Calcium Sulfoaluminate
clinker (CSA)**

i.tech® ALI CEM:

**Blend of Calcium Sulfoaluminate (CSA)
cement with micronized Calcium Sulfate**



ENTS





Properties

Shrinkage

With the addition of **i.tech ALI PRE** or **i.tech ALI CEM** to Portland cement, shrinkage can be considerably reduced.

Setting time, workability

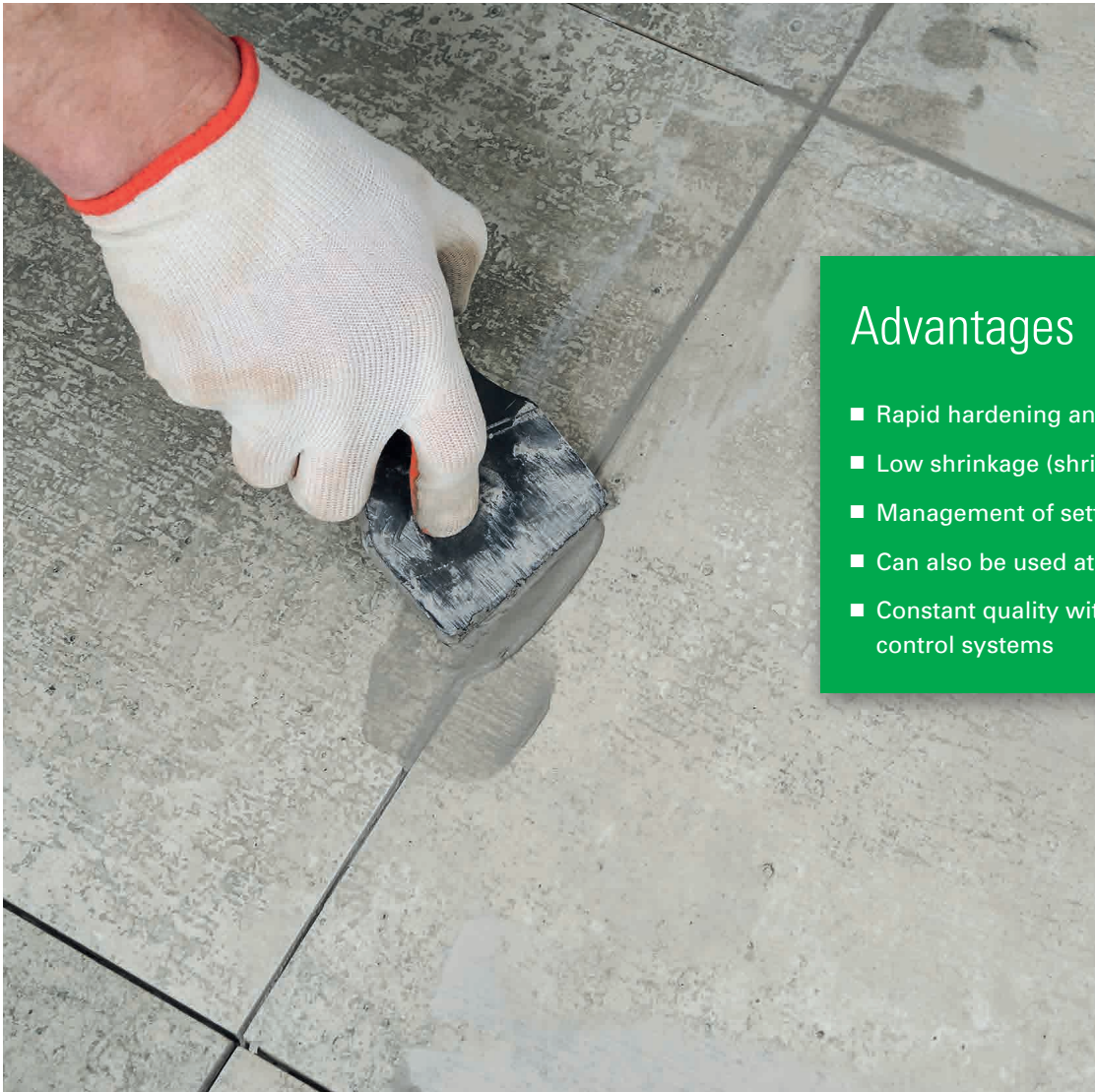
The addition of **i.tech ALI PRE** or **i.tech ALI CEM** leads to a substantial decrease in setting time with stable workability.

Compressive Strength

The addition of **i.tech ALI PRE** and **i.tech ALI CEM** ensures quick strength development and leads to high early strength. Already after just a few hours, compressive strengths are achieved, which would only be achieved later on with a pure Portland cement.

Areas of use

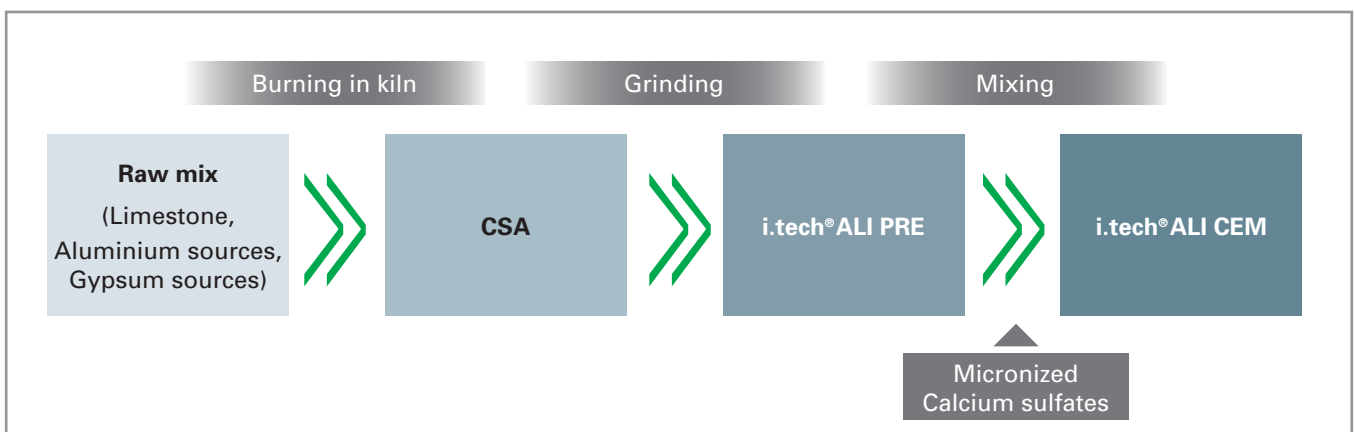
- Rapid hardening, self-levelling flooring compounds
- Rapid hardening repair mortars and fillers
- Quick-binding repairing mortar for fixing and anchorage work
- Grouting and injection mortar
- Grout
- Tiling / repairing adhesive
- Anchor mortar



Advantages

- Rapid hardening and high early strength
- Low shrinkage (shrinkage control)
- Management of setting times
- Can also be used at low temperatures
- Constant quality with the most recent control systems

Overview of the manufacturing steps of our CSA cements



i.tech® ALI PRE – more flexibility

i.tech ALI PRE offers more flexibility as the setting time can be managed over a very wide time period. Even the strength development can be controlled very flexibly by adjusting the mixing ratio with Portland cement and calcium sulfate.

Main phases		Main chemical components	
$C_4A_3\bar{S}$	≥ 58 %	CaO	36 – 41 %
$C_2\bar{S}$	≤ 25 %	SiO ₂	≤ 9 %
$C\bar{S}$	≤ 5 %	Al ₂ O ₃	27 – 33 %
		Fe ₂ O ₃	≤ 1.5 %
		SO ₃	10 – 14 %
		MgO	≤ 5 %

Specific surface area (Blaine value):
4750 ± 250 cm²/g

i.tech® ALI CEM – simple processing

i.tech ALI CEM guarantees simple, secure processing. The advantage is the lower dose outlay, as it is already a dual component system.

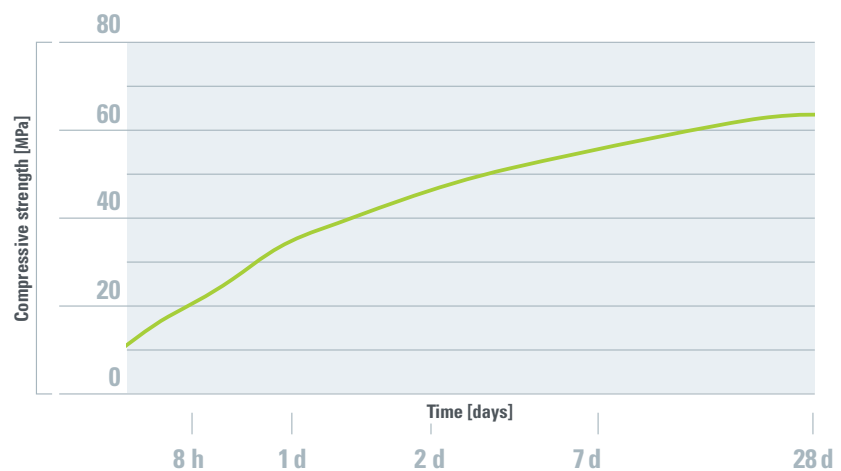
PHYSICAL & MECHANICAL PROPERTIES

Specific surface area (Blaine value):
5000 ± 500 cm²/g

Soundness (Strain measurement):
≤ 10 mm

Initial set:
≤ 25 min

The initial setting time test was carried out according to EN 196-3, but with a different w/c ratio (w/c = 0.33 ± 0.02).



The strength measurement test was carried out on standard mortars according to EN 196-1.

Packaging

i.tech ALI PRE and i.tech ALI CEM are available in bulk, big bags and 25 kg bags. The bags are stacked on pallets (i.tech ALI PRE 1.000 kg or i.tech ALI CEM 1.600 kg) and protected with stretch film. Store in fresh and dry place.

ENVIRONMENTAL PRODUCT DECLARATION

The EPD (Environmental Production Declaration) of i.tech ALI PRE and i.tech ALI CEM are available under the International EPD System (www.environdec.com) and the Institut Bauen und Umwelt e. V. (www.ibu-epd.com). An EPD is a standardized type III environmental claim (ISO 14025), based on a Life Cycle Assessment (ISO 14040).

i.tech® ALI PRE

	Cradle to gate ¹	Core process ²
Global warming potential	721 kg CO ₂ eq/ton	480 kg/ton
Use of recycled materials	599 kg/ton	599 kg/ton
Recycled material content	54 %	50 %



i.tech® ALI CEM

	Cradle to gate ¹	Core process ²
Global warming potential	599 kg CO ₂ eq/ton	380 kg/ton
Use of recycled materials	475 kg/ton	475 kg/ton
Recycled material content	43 %	40 %



¹ raw materials and fuels, electricity, transportation to and in plant, handling of secondary raw materials

² manufacturing process in plant, handling of secondary raw materials

i.tech® ALI PRE
i.tech® ALI CEM

TECHNICAL REPORT

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Introduction

i.tech ALI PRE technology is the result of advanced research that has led to the development of a dedicated production process. Its peculiar sulphoaluminous nature makes the cements coming from **i.tech ALI PRE** and **i.tech ALI CEM** – the ideal constituents to manufacture rapid, chemically resistant and particularly durable products. This Technical Report is intended to:

- A.** give basic information about the behaviour of **i.tech ALI CEM** in simple systems, in order to gain confidence with the potential advantages deriving from **i.tech ALI PRE**;
- B.** propose some example of formulation for the most common applications of **i.tech ALI PRE**.

In **Section A** are presented tests carried out on blends with **i.tech ALI CEM** and Portland limestone cement (CEM II/A-LL 42.5 R); test results will be described in order to give building sector professionals some information on the technical performance of **i.tech ALI PRE** based products.

The following tests have been performed:

- Shrinkage test in the plastic state
- Hygrometric shrinkage test in the hardened state
- Setting times and workability
- Compressive strength tests

The tests have been carried out without using any admixture (accelerating, retarding and/or plasticizer) and the results and conclusions has to be taken only as an indication of the possible behaviour of more complex formulations.

In **Section B** are listed examples of formulations for the following applications:

- Self levelling floor screed
- Self levelling underlayment
- Rapid hardening mortar
- Rapid setting mortar
- Rapid hardening concrete – slump class S3

Each formulation has been developed and tested in our laboratory and is described in the document with the aim of helping our customers with useful indications in order to develop their own final formulations in a faster and easier way.



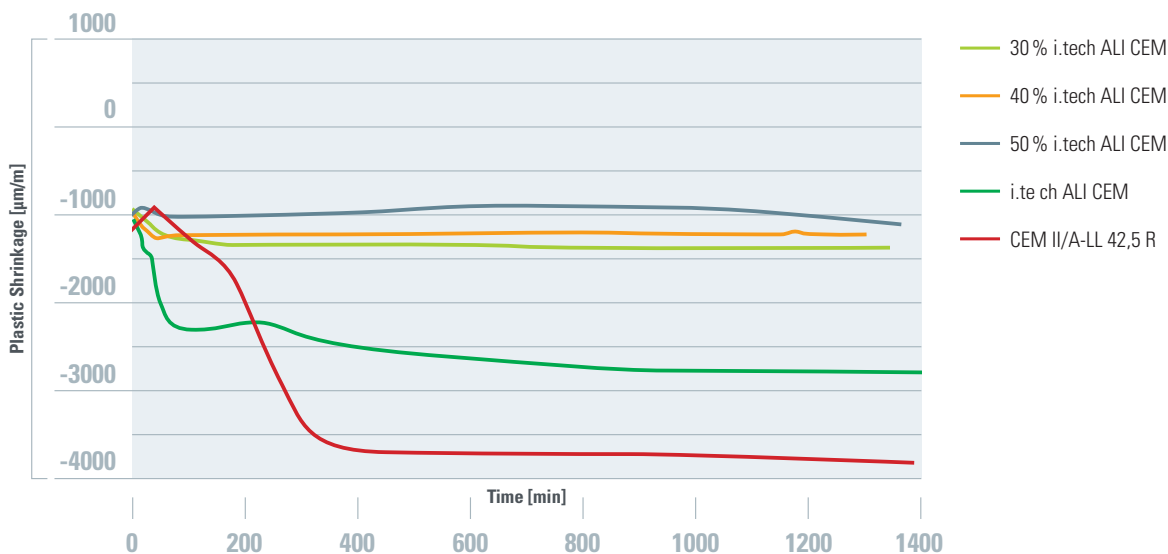
Section A – Basic performances

A1 SHRINKAGE IN THE PLASTIC STATE

The properties of **i.tech ALI CEM** - Portland limestone cement blends have been examined in the following ratios:

straight Portland limestone cement, 30 %, 40 %, 50 %, 100 % **i.tech ALI CEM**.

The graph here below show the shrinkage in the plastic state during the first 24 h period of straight Portland limestone cement (CEM II/A-LL 42.5 R), straight **i.tech ALI CEM** and various blends of Portland limestone cement and **i.tech ALI CEM**.



Comments

The addition of **i.tech ALI CEM** to Portland cement permits to drastically reduce the plastic shrinkage up to a level that reaches a practically zero-shrinkage formulation.

Both straight cements show a higher plastic shrinkage than the blended formulation.

The shrinkage compensating effect is due to the different reaction of hydration of CSA occurring in the presence of portlandite or $\text{Ca}(\text{OH})_2$ (hydration product of Portland cement and Portland limestone cement). Accordingly, in the presence of portlandite, the hydration reaction of CSA leads to the formation of 3 moles of ettringite per mole of $\text{C}_4\text{A}_3\bar{\text{S}}$.



While the reaction of the CSA without portlandite where 1 mole of ettringite is formed per 1 mole of $\text{C}_4\text{A}_3\bar{\text{S}}$.



A2 HYGROMETRIC SHRINKAGE

The properties of **i.tech ALI PRE** - Portland limestone cement blends have been examined in the following ratios:

straight Portland limestone cement (CEM II/A-LL 42.5 R), 30 %, 40 %, 50 %, 100 % **i.tech ALI CEM**.

The diagram below shows the hygrometric shrinkage of the straight cements and the blends at 1, 2, 7 and 28 days.



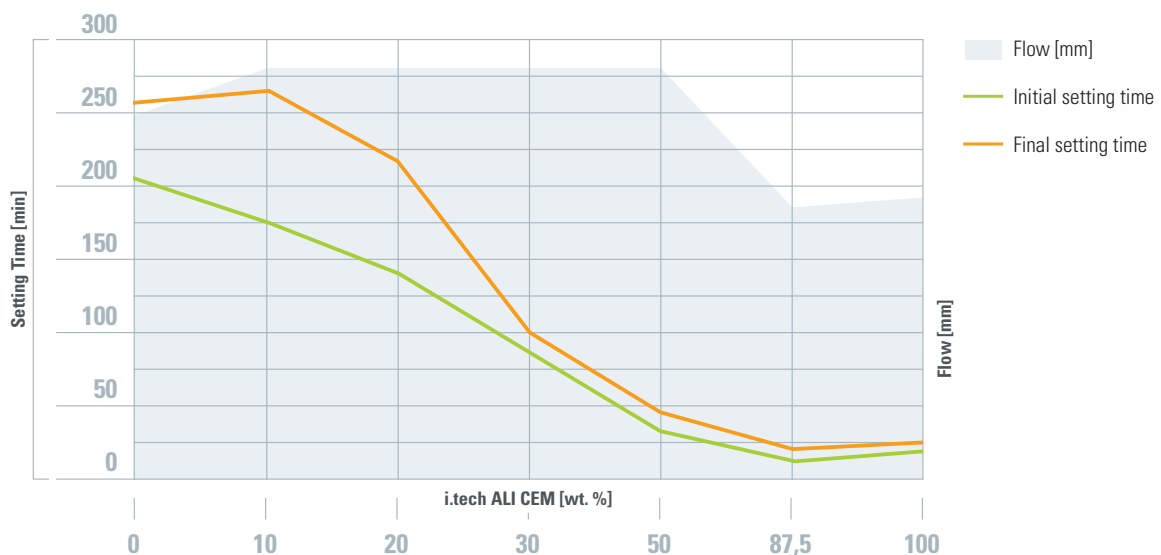
Comments

Unlike shrinkage in plastic state, with which even low additional amounts of **i.tech ALI CEM** lead to low shrinkage values, additional amounts of 40% **i.tech ALI CEM** and more are required to reduce drying shrinkage, in order to achieve low shrinkage values with a trial period of 7 or 28 days.

A3 SETTING TIMES, WORKABILITY AND FLOW

The properties of **i.tech ALI PRE** - Portland limestone cement blends have been examined in the following ratios: straight Portland limestone cement, 10 %, 20 %, 30 %, 87.5 %, 100 % **i.tech ALI CEM**.

The graphs here below show the setting times, workability and flow of the straight cements and the blends.



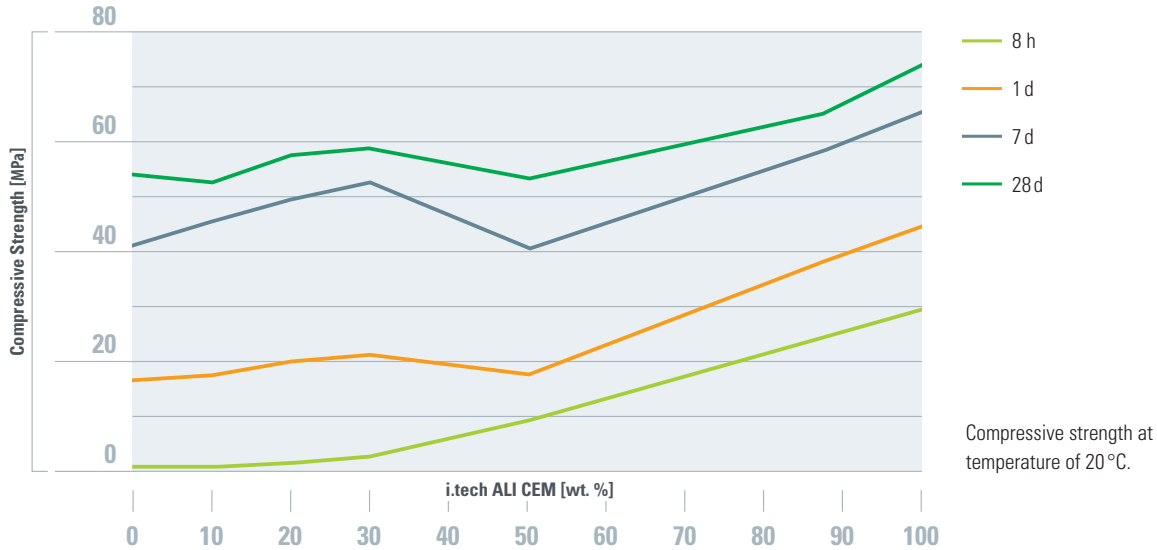
Comments

The addition of **i.tech ALI CEM** to Portland cement permits to obtain a drastic reduction of the setting times and at the same time maintaining a good workability.

A4 MECHANICAL STRENGTHS

The behaviour of **i.tech ALI PRE** - Portland limestone cement blends has been examined in the following ratios:

straight Portland limestone cement, 10 %, 20 %, 30 %, 87.5 %, 100 % **i.tech ALI CEM**.



Comments

The addition of **i.tech ALI CEM** leads to an increasing of the early strengths. With a 50 % addition it's possible to obtain high strengths at 8 h and similar performance to straight Portland cement at later ages.

For the mechanical strength evolution, the laboratory experience indicates that there is a strong influence of the type of Portland cement used in the blend with **i.tech ALI CEM**; in particular, an important role is played by alkali sulfate content and gypsum forms from the OPC.



Section B – Examples of formulations

B1 SELF LEVELLING FLOOR SCREED

Component	%
OPC (CEM II/A-LL 32.5 R)	12.12
i.tech ALI PRE	7.27
Anhydrite	4.85
NHL	0.97
Sand 0/0.5	14.20
Sand 0.5/1.25	7.58
Sand 1.25/4	38.95
Filler	13.60
Accelerating agent	0.10
Retarding agent	0.22
Superplasticizer	0.06
Stabilizer	0.01
Defoamer	0.05
Sum	100.0

Performance	
Water	15.7%
Workability	(ASTM cone) >220 mm
Workability time	at 20 °C > 60 min
Flexural strength (24h)	at 20 °C 50 % RH 3.5 MPa
Flexural strength (28d)	at 20 °C 50 % RH 4.5 MPa
Compressive strength (24h)	at 20 °C 50 % RH 21.5 MPa
Compressive strength (28d)	at 20 °C 50 % RH 52.0 MPa
Drying shrinkage (28d)	(50 % RH, 20 °C) 120 µm/m



B2 SELF LEVELLING UNDERLAYMENT

Component	%
OPC (CEM I 52.5 R)	15.0
i.tech ALI PRE	12.5
Anhydrite	5.5
NHL	0.3
Sand 0/0.6	56.0
Filler	7.65
Latex	2.0
Accelerating agent	0.3
Retarding agent	0.075
Superplasticizer	0.5
Stabilizer	0.075
Defoamer	0.01
Summe	100.0

Performance	
Water	21.5 %
Workability	141 mm (EN 12706)
Workability time	at 20 °C approx 30 min
Compressive strengths (3h)	at 20 °C 12.5 MPa
Compressive strengths (24h)	at 20 °C 25.0 MPa
Compressive strengths (28d)	at 20 °C 41.0 MPa
Drying shrinkage (28d)	(50 % RH, 20 °C) 367 µm/m



B3 RAPID HARDENING MORTAR

Component	%
OPC (CEM I 52.5 R)	30.0
i.tech ALI PRE	15.5
Anhydrite	4.9
Sand 0/0.5	49.0
Accelerating agent	0.15
Retarding agent	0.20
Superplasticizer	0.30
Sum	100.0

Performance	
Water	18.5 %
Spreading	(EN 13395): 328 mm
Workability time	at 20°C approx. 60 min
Compressive strengths (2h)	at 20°C 26.0 MPa
Compressive strengths (28d)	at 20°C 41.0 MPa
Drying shrinkage (28d)	(50 % RH, 20°C) 486 µm/m



B4 RAPID SETTING MORTAR

Component	%
OPC (CEM I)	27.8
i.tech ALI PRE	21.5
Accelerating agent	0.7
Sand 0/0.6	50.0
Sum	100.0

Performance	
Water	20.0 %
Initial Setting time	2 min
Final Setting time:	3 min
Compressive strengths (30 min)	at 20°C 10.0 MPa
Compressive strengths (24h)	at 20°C 19.0 MPa
Compressive strengths (28d)	at 20°C 61.0 MPa

Final remarks

In this Technical Report a general overview of performances and of some potential applications of **i.tech ALI PRE** is given.

The results of the tests in Section A:

- shrinkage in the plastic state
- shrinkage in the hardened state
- setting time and workability
- compressive strength tests

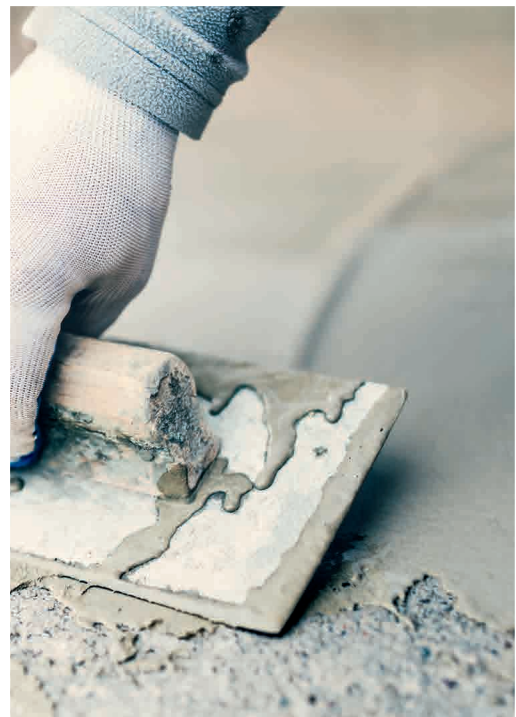
carried out on mixtures of ordinary composite Portland limestone cements (CEM II/A-LL 42.5) and **i.tech ALI CEM** show how it is possible, by using **i.tech ALI PRE**, to prepare formulations with peculiar performance (from rapid hardening to low shrinkage), where ordinary Portland cement usually fails.

A good compromise, for obtaining both low shrinkage and high early strength seems to be reached with a blend of 40% **i.tech ALI CEM** – 60% Portland cement.

The tests have been carried out without using any kind of admixture, that can play an important role in the final performance of a formulated product.

For these reasons, the data in Section A have to be considered purely indicative and only as an useful starting point for the formulation of special mortars.

In Section B some examples of formulations are given, in order to help our customers to develop faster and easier their own final formulations. The use of these formulations, with the raw materials of the dry mortar producer, may lead to performances that are different from those listed in Section B. This fact is quite common in complex ternary systems. We have extensive experience that will be made available to customers while developing formulations based on **i.tech ALI PRE**.



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