# DRY MORTAR
# SIKA PERFORMANCE ADDITIVES

Technology

BUILDING TRUST

# DRY MORTAR: FOR TODAY AND TOMORROW

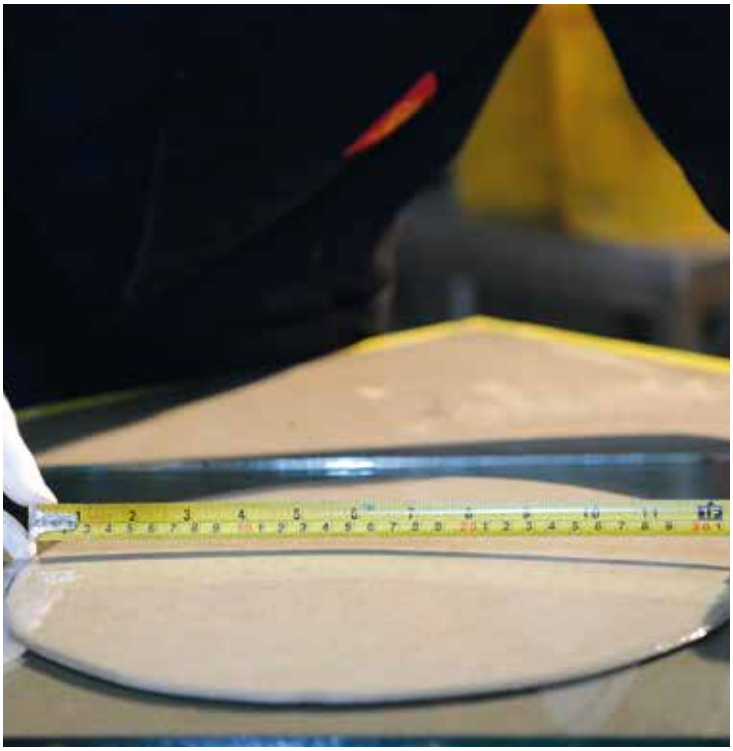
Industrially prefabricated dry mortars are used in almost all applications in new buildings and refurbishment. Most common ones are concrete, screed, plaster and masonry mortar, floor levelling compounds, tile adhesive, grout and sprayed concrete. In addition, many specialties such as concrete repair mortars or fillers, sealing slurries, concrete filler and injection mortar are based on dry mortar technology. Building materials with special properties represent a special challenge for their producers. Flowable, self-levelling screeds and underlayments or plasters with controlled setting profile are typical examples for this. The rising variety of dry mortar products with unique properties will remain as a main driver for innovations.

# SIKA ADDS VALUE TO YOUR DRY MORTARS

If production of consistent, high quality yet economical dry mortar formulations is your goal, Sika's performance powder additives are your solution. To ensure the desired application and end-product properties, today's dry mortars need to be balanced multi-component systems in which each ingredient has to perform reliably. An individually developed recipe ensures high efficiency, maximum security and allows the use of modern mixing and pumping equipment.
With more than 40-years experience in concrete admixtures and more than 10 years in powdered performance additives, Sika is a competent partner for the dry mortar industry. We understand the challenges of varying raw-material qualities and costs as well as stricter health and environmental regulations. Sika offers you professional technical support, functional service and the delivery of high-quality products – tailored to achieve your specific requirements and maximize your plant's profitability.

Our individual customer solutions include
- Competent and individual product recommendation
- Preliminary tests in Sika mortar laboratory
- Adaptation of customer mixtures
- Tailored additive compounds
- Application support on site

**SUSTAINABILITY AND COST OPTIMIZATION**
Next to cost savings, an overall sustainable production is an ever-present topic – also gaining importance in the dry mortar industry. Several measures can be taken in dry mortar plants to save costs and resources. These include implementing optimized dry mortar mix-designs in combination with innovative additive technologies.
As generally known, the production of Portland cement (OPC) – a major dry mortar component – generates a large share of world-wide $CO_2$ emissions. Accordingly, the environmental sustainability as well as cost-performance of dry mortar formulations can be improved by reducing the cement and/or binder content and replacement of OPC by secondary cementitious materials. In addition to the potential to improve the durability of the mortar, this is one of the major measures to reduce the carbon footprint over the entire service life of these building materials. The basis for this is reducing the water demand with innovative additive technologies like Sika® ViscoCrete®. By being free of formaldehyde, these solutions meet the highest health and safety standards at the same time. Sika is motivated to provide dry mortar producers with sustainable and cost optimized solutions.



# SUPERPLASTICIZERS

**SIKA® VISCOCRETE® POWDERS ARE** extremely efficient liquefiers which are tailored for applications like self-levelling and pumpable screeds as well as underlayments, non-shrink grouts, repair mortars and plasters.
Today Sika is a leading producer of PCE-based plasticizers, with a dense network of ViscoCrete® production sites worldwide and international experience in countless applications.

Sika® ViscoCrete® superplasticizer are based on PCE technology, which was invented in the early 2000s. 'PCE' stands for PolyCarboxylate Ether and describes a polymer which is similar to a comb in shape. The backbone consists of a polycarboxylic acid (polycarboxylate) and the side chains of the comb are made of polyether chains. Comparable to conventional plasticizers PCE molecules adsorb on solid surfaces via the polycarboxylic acid in the backbone. However, the side chains do not adsorb but extend into the aqueous solution and prevent the convergence of solid particles. This effect is known as dispersing through steric stabilization. By varying the polymer structure, the properties of the resulting superplasticizer can be influenced to a hitherto unknown extent. The main parameters which are varied thereby are the length and nature of the polycarboxylic acid backbone and the length and number of side chains used. These essential properties can be adjusted for each application. In addition, the PCE technology allows target-oriented combination of different polymer structures.
By understanding the effect of different polymer designs, Sika is able to offer tailor-made solutions for many applications and various binder systems. This allows adjusting essential characteristics tailored to the respective application, as

- Polymer adsorption
- Liquefaction and water reducing capacity
- Stickiness/stability/viscosity
- Workability and setting characteristics
- Strength development
- Robustness with respect to variations in water content, temperature and quality of raw materials

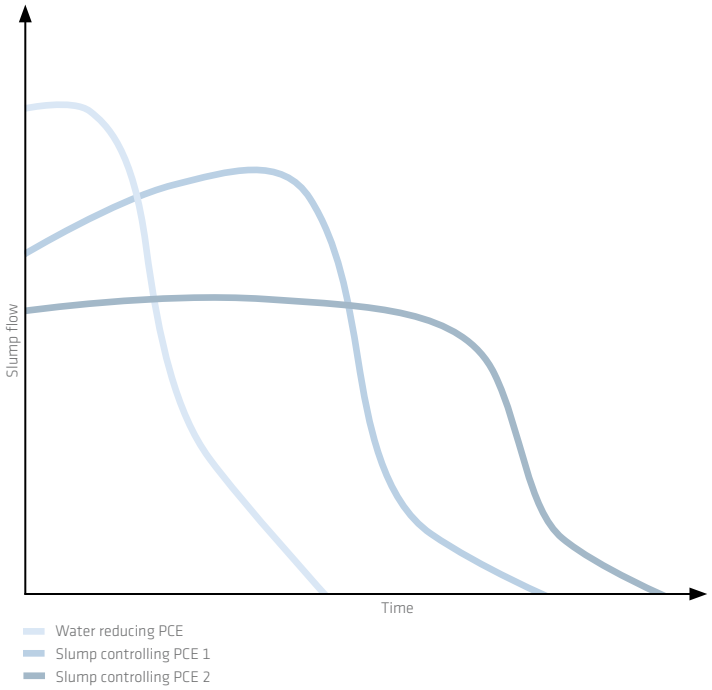
## KEY FACTORS FOR THE SUCCESS OF THE PCE TECHNOLOGY

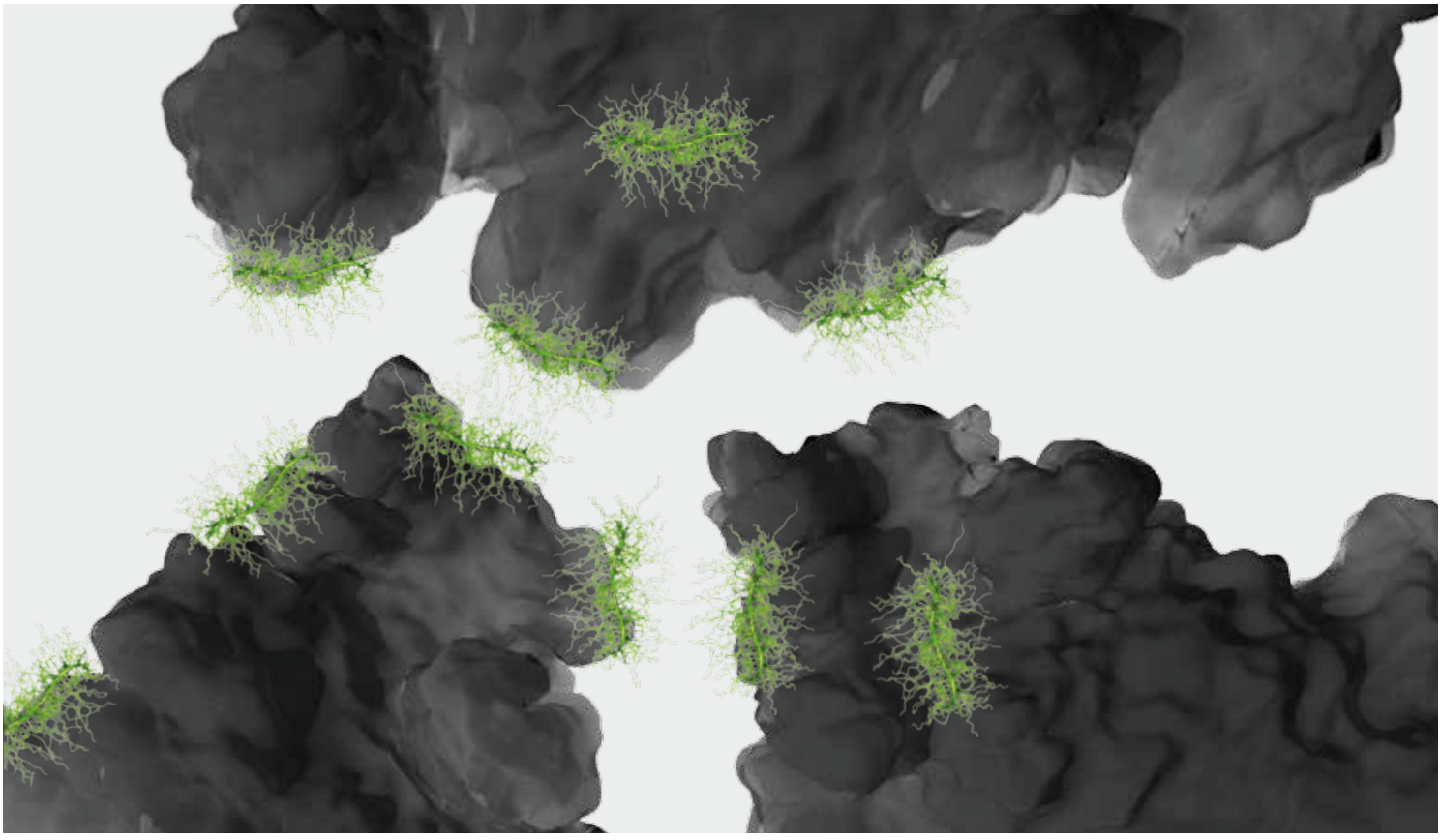
- Tailor made design for specific requirements
- High water reduction
- High liquefaction
- Strength increase
- Shrinkage reduction
- No release of formaldehyde
- Improved cost performance

## POWDERED VS. LIQUID SUPERPLASTICIZERS

For processing reasons, concrete admixtures are classically defined dilutions of polymers in water, usually containing a defoamer component. Powdered superplasticizers for dry mix applications, instead, are typically pure PCE active substances. Unless otherwise requested, they do not contain defoamers to enable the adjustment of the air content of the final mortar formulation according to application requirements.

**Examples for consistency curves of various PCEs**



# GYPSUM RETARDERS

**RETARDERS ARE TYPICALLY USED** to increase the setting time and therewith the workability time of mineral binders. Sika's Retardan® products are very effective gypsum retarders, successfully applied in the gypsum industry for decades.

## Retardan® TECHNOLOGY

Retardan® products are very effective gypsum retarders, characterized by low dosage and high retarding effect. They show excellent performance in the adjustment of the setting and workability time in a variety of calcium sulfate binders, also in combination with other performance additives such as rheological additives, foaming agents and accelerators.

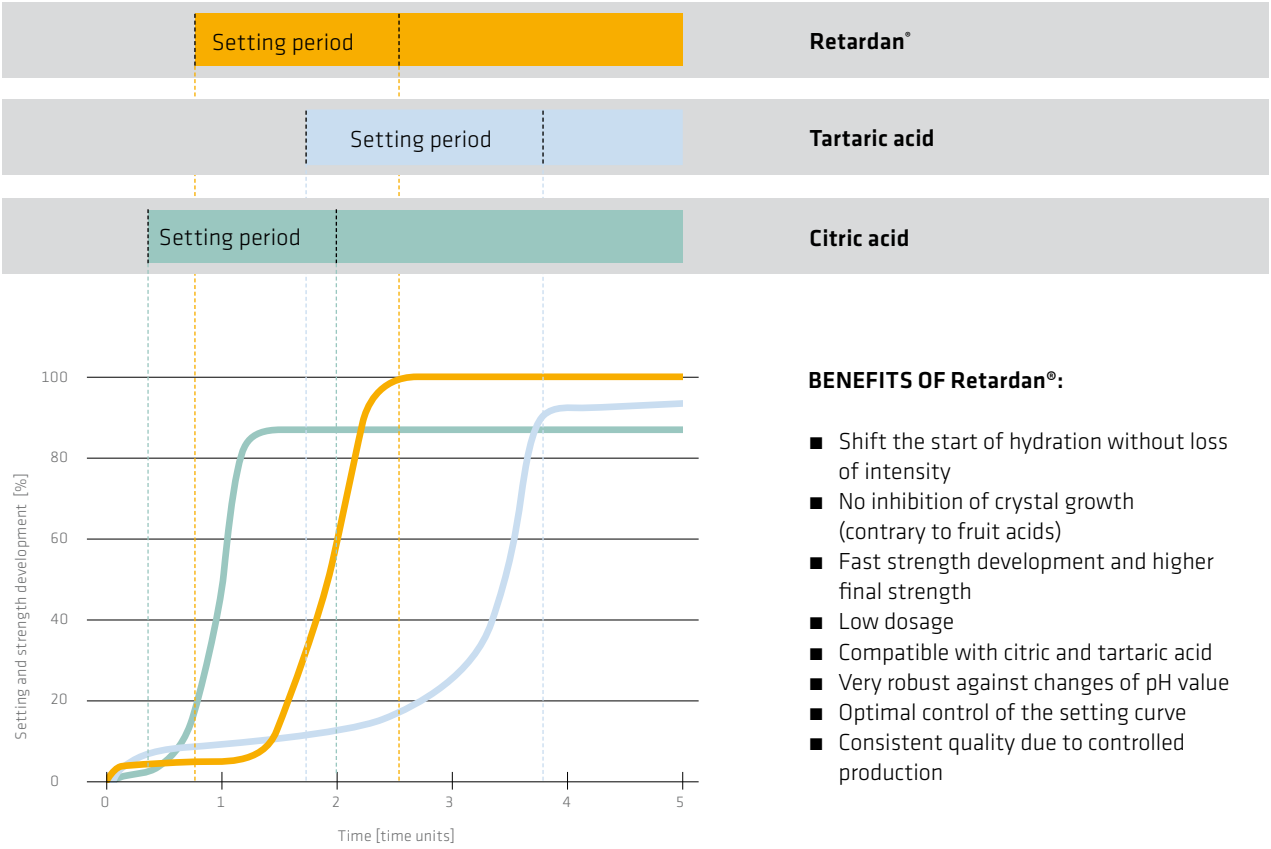
There mode of retarding action is based on a targeted intervention in the process of gypsum crystallization. By adsorption on the gypsum crystal surfaces the further integration of calcium and sulfate ions is blocked. Thus gypsum crystal growth and therewith setting and hardening are retarded for a certain period of time (depending on additive dosage).

Retardan® products are noted for their well-defined retarding effect.

Retardan® does not show the typical side effect of conventional gypsum retarder (esp. fruit acids and their salts), such as extension of final setting strength loss.

In addition to its retarding effect, the use of retarder can have a positive rheological influence: An early binder reaction during mortar processing phase is typically accompanied by reduced mortar flow. The addition of Retardan® counterbalances this effect and therewith allows for water reduction.

Comparison of the setting characteristics of different retarders




Test conditions: Constant retarder dosage, alkaline environment

### BENEFITS OF Retardan®:

- Shift the start of hydration without loss of intensity
- No inhibition of crystal growth (contrary to fruit acids)
- Fast strength development and higher final strength
- Low dosage
- Compatible with citric and tartaric acid
- Very robust against changes of pH value
- Optimal control of the setting curve
- Consistent quality due to controlled production

# APPLICATION EXAMPLE LEVELLING FLOOR SCREED

The market share of flowable screeds in Germany is already at about 25 % and will increase in the future. Very simply installation due to the almost self-compacting properties and even surfaces are the main advantages. Sika® ViscoCrete® shows good liquefaction performance in levelling screeds even at very low dosages. It is compatible with other additives such as the retarder Retardan®.

**System:** Anhydrite flow screed

**Mission:** Improve screed quality and optimize recipe costs

**Solution:** Reduce w/b-value and set flow behavior by using PCE (Sika® ViscoCrete®-425 P); Increase in strength: +16%!

**Mortar recipe and test results**

| | Reference System | Sika® ViscoCrete®-225 P | Sika® ViscoCrete®-425 P |
|---|---|---|---|
| **Binder: Synthetic Anhydrite [g]** | 4,587 | 4,587 | 4,587 |
| **Sand: Norm sand 0-8mm (B8) [g]** | 10,000 | 10,000 | 10,000 |
| **PCE-based Superplasticizer (powder compound with inert filler) [g]** | 45.8 (1.0 binder %) | 45.8 (1.0 binder %) | 45.8 (1.0 binder %) |
| **Water [ml]** | 1,930 | 2,030 | 1,800 |
| **w/b [-]** | 0.42 | 0.44 | 0.39 |
| **Initial flow [cm]** | 23.0 | 23.5 | 23.0 |
| **Workability time [-]** | OK | OK | OK |
| **Strength 3 d (FTS / CS) [N/mm²]** | 2.7 / 22.9 | 2.5 / 19.1 | 3.1 / 26.4 |
| **Strength 7 d (FTS / CS) [N/mm²]** | 4.3 / 29.6 | 4.8 / 27.9 | 4.4 / 34.0 |
| **Strength 28 d (FTS / CS) [N/mm²]** | 7.1 / 36.7 | 6.0 / 30.8 | 7.1 / 42.4 |

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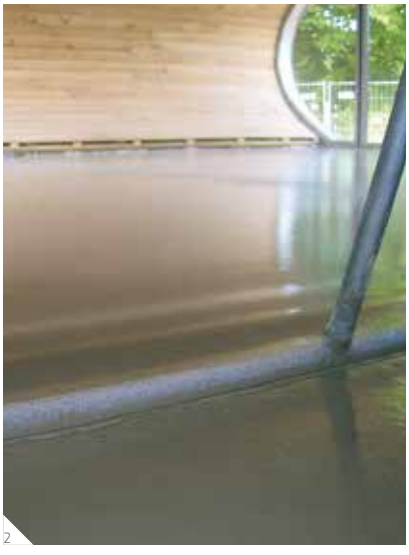

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**1** Convenient installation while standing
**2** Easy surface finishing

# APPLICATION EXAMPLE GROUTING MORTAR

Grouts are used in new buildings and in refurbishment. They are mainly applied in safety related areas. Grouting of rails or mounting plates, connection of prefabricated, reinforced concrete and backfilling of sleeve foundations are typical applications.

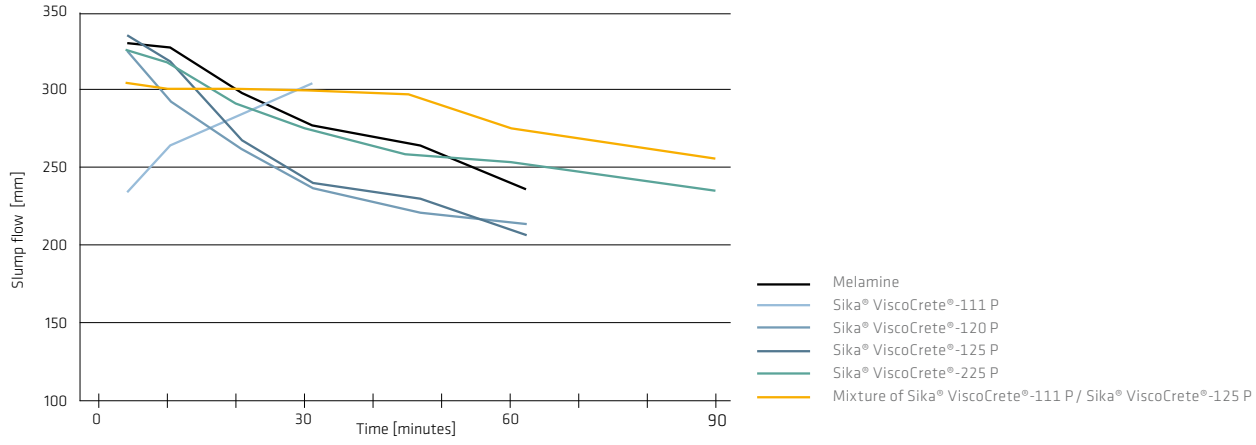
Due to these different applications continuously new and improved formulations are required – also up in the high strength range. Different qualities of cement and special additives are the major challenges for the mortar formulation.

**System:** Cementitious grout

**Mission:** Superplasticizer optimization to a target value of 30 cm (Hägermann cone) over 45 min

**Solution:** Combination of two PCE's

**Slump development over time**




None of the selected Superplasticizer causes a constant slump-flow over a processing period of 45 min.
It was only the mix of Sika® ViscoCrete®-111 P and Sika® ViscoCrete®-125 P that provided the desired slump-keeping effect.

**1** Flow channel for grout testing

# APPLICATION EXAMPLE SELF-LEVELLING UNDERLAYMENT

With the installation of floor coverings, a flat, evenly absorbent substrate is required. Self-levelling compounds fulfill these tasks. They must be tailored to the particular substrate and floor covering. Excellent flow properties and rapid drying of floor coverings are the key arguments for the floor layers.

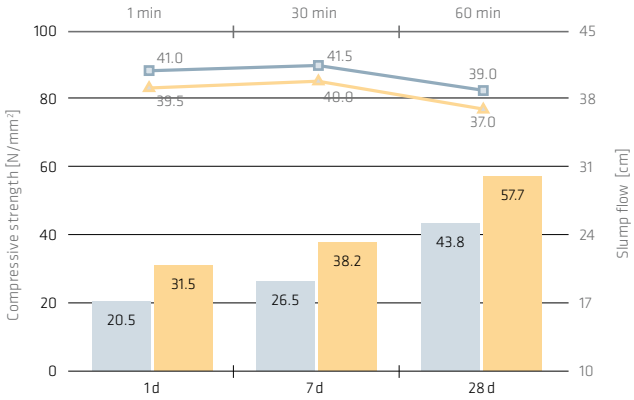
The use of special mixing and pumping equipment increasingly gets into the focus of the mortar developers. Sika® ViscoCrete® superplasticizer shows especially here good liquefaction performance.

**System:** Ternary, self-levelling underlayment

**Mission**: Replacement of casein by PCE with comparable flow properties
Challenge: Due to the significantly lower dosage of the superplasticizer Sika® ViscoCrete®-225 P, the retarding effect is correspondingly low

**Solution:** Adjust flow properties using superplasticizer Sika® ViscoCrete® and setting process using retarders (such as tartaric acid)

**Compressive strength and flow rate in comparison**




Improved results:

- High water reduction (from 24% to 20%)
- Comparable flow behaviour
- Very good surface aspect
- Increase in strength

Slump flow
Original with Casein
New with Sika® ViscoCrete®

Compressive strength
Original with Casein
New with Sika® ViscoCrete®

Corresponding dosage:
Original with Casein 0,26 %
New with Sika® ViscoCrete® 0,015 % and tartaric acid 0,08 %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2

**1** Flow test with Hägermann cone
**2** Perfect flow properties

# APPLICATION EXAMPLE GYPSUM PLASTER

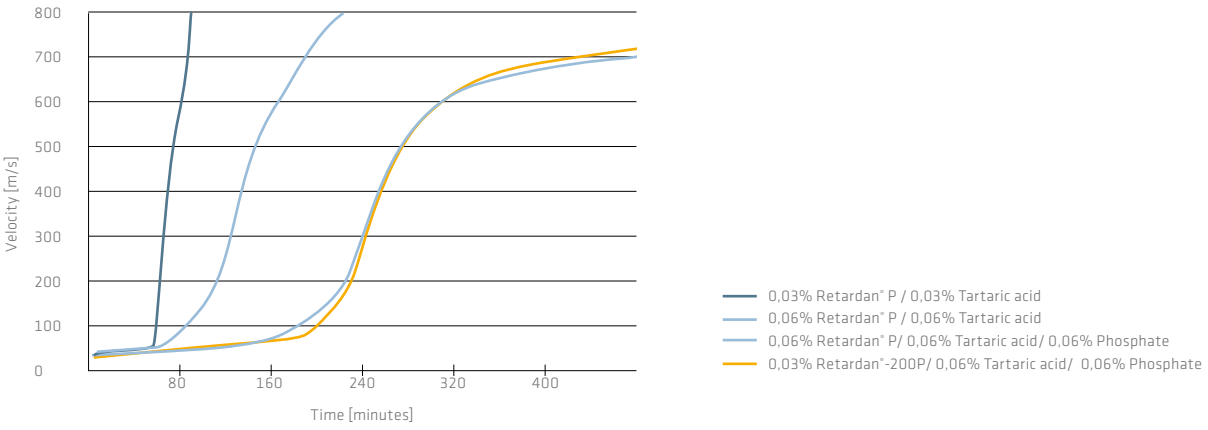
Gypsum plaster or gypsum-lime plaster is at present the most frequently used interior plaster. Easy application and a consistent setting behavior is critical to the success of the user. Retardan® is especially suitable as a setting regulator for use in the gypsum plaster through the large pH-value tolerance and can be optimally combined with other retarders e. g. fruit acids to fulfill the need for longer workability period .

**System:** Gypsum-lime lightweight plaster, pH approx. 12,3 (mixed with 10 % water)

**Mission:** Set the processing time with Retardan®

**Solution:** The combination of different retarders fulfills the ideal setting curve with enlarged workability period

**Combination of setting profile retarders by ultrasound**




The ideal setting curve is reached by a combination of Retardan®, tartaric acid and phosphate retarder. After spraying, the plaster is levelled with the metal straight edge perpendicular and flush right. Once the stiffening begins after about 90 minutes, ridges and tracks can be pulled out with the trowel. After about 3 hours, when the plaster is sufficiently stiffened, the surface can be wetted slightly and felted by using a sponge float. After another 30 to 60 minutes, once the surface is dull, the smoothing can be started.

The setting profile of the gypsum plaster can be adapted to the regionally differing working practices.

**1** Wall finishing with gypsum plaster

# GLOBAL BUT LOCAL PARTNERSHIP

# FOR MORE INFORMATION:

**WHO WE ARE**
Sika AG, Switzerland, is a globally active specialty chemicals company. Sika supplies the building and construction industry as well as manufacturing industries (automotive, bus, truck, rail, solar and wind power plants, façades). Sika is a leader in processing materials used in sealing, bonding, damping, reinforcing and protecting loadbearing structures. Sika's product lines feature highquality concrete admixtures, specialty mortars, sealants and adhesives, damping and reinforcing materials, structural strengthening systems, industrial flooring as well as roofing and waterproofing systems.

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