



# CONCRETE

## SIKA SOLUTIONS FOR SEMI-DRY PRECAST ELEMENTS

BUILDING TRUST





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## LARGE QUANTITIES, HIGH QUALITY AND EXCELLENT DURABILITY

The semi-dry precast concrete industry manufactures large quantities of finished concrete products with high quality surface appearance and excellent durability. Select combinations of process and concrete technology are employed to efficiently manufacture semi-dry precast concrete products of various shapes, textures and colors.

Due to the high durability requirements and rapid industrialized production process, it is necessary to achieve a high degree of compaction in as short a time as possible. SikaPaver® products significantly improve both the manufacturing process as well as the quality of semi-dry precast concrete products. Furthermore it is possible to reduce efflorescence or even incorporate water repellent behavior with the application of SikaPaver® AE technology.

# SEMI-DRY PRECAST CONCRETE TECHNOLOGY WITH SIKA

Key for efficient semi-dry precast concrete production is the targeted combination of fresh concrete with a high degree of compactability as well as yielding instant shape accuracy following compaction, meaning a high green strength.



The compactability ensures a fast production of high quality, durable concrete products, whereas a high green strength reduces damage to finished goods as well as rejects.

To develop a cost efficient concrete mix design with enhanced compaction characteristics it is essential to make use of plasticizers or compaction aids. The effectiveness of compaction aids derives from reduced surface tension of the water in the concrete mix. This results in improved wetting of the binder particles, and thus a substantially improved compaction performance of the fresh semi-dry concrete.

Technologies incorporated in compaction aids can be lignosulfonates, surfactants and polycarboxylate ether (PCE) as well as suitable combinations of these materials. The SikaPaver® C and SikaPaver® HC product ranges represent Sikas compaction aid technologies offering performance scaled for various production conditions.

The surface appearance of finished semi-dry precast concrete products plays an important role since appearance as a mark of quality is the producer's calling card. On the one hand it is of vital importance to achieve a high degree of compaction, since this has a direct influence on the surface appearance. On the other hand it is possible to reduce efflorescence with SikaPaver® AE technology. This implies application of a hydrophobic agent. The hydrophobic action of SikaPaver® AE products prevents water absorption and water transport in any capillary pores, which effectively reduces efflorescence.

With more powerful hydrophobic action like SikaPaver® AE-2 technology, it is possible to realize water repellency of the semi-dry precast concrete elements.

### SikaPaver® PRODUCT RANGE

	SikaPaver® C-1	SikaPaver® HC-1	SikaPaver® HC-2	SikaPaver® AE-1	SikaPaver® AE-2
Quick filling of forms	●	●●	●●	●	●
Plasticizing / density	●	●●	●●	●●	●
Smooth flanks with cement paste		●●●	●●●	●●	●
Anti-sticking-effect		●	●	●●	●●
Early strength (24 hours)	●	●●	●●	●	●
Final strength (28d)	●●	●●●	●●●	●●	●
Color intensification				●●●	●●
Efflorescence reduction & reduction water absorption				●●	●●●
Water repellent effect					●●●

● moderate impact      ●● strong impact      ●●● very strong impact

### SEMI-DRY PRECAST CONCRETE PRODUCTS ARE IN USE EVERYWHERE



PAVERS



BUILDING BLOCKS



PIPES AND MANHOLES



CURBSTONES AND EDGINGS



LANDSCAPING ELEMENTS



CONCRETE TILES



ROOF TILES



HOLLOW CORE SLABS

# SikaPaver®

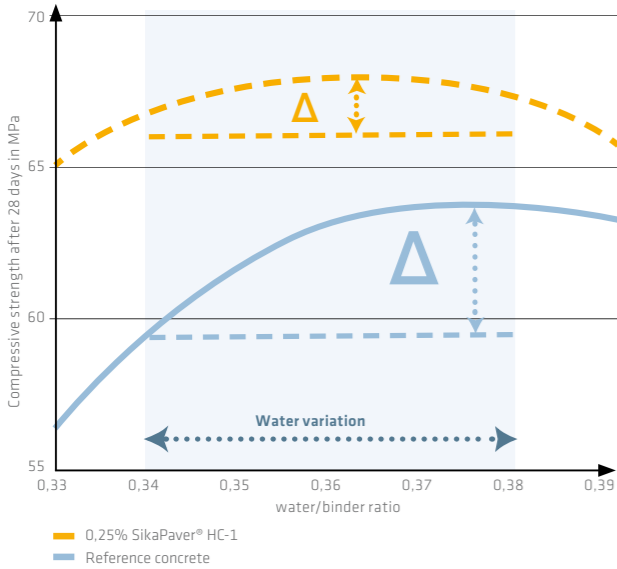
## BALANCES VARIATIONS AND ENSURES HIGH QUALITY

In a semi-dry precast concrete production process, unavoidable variations occur with regard to

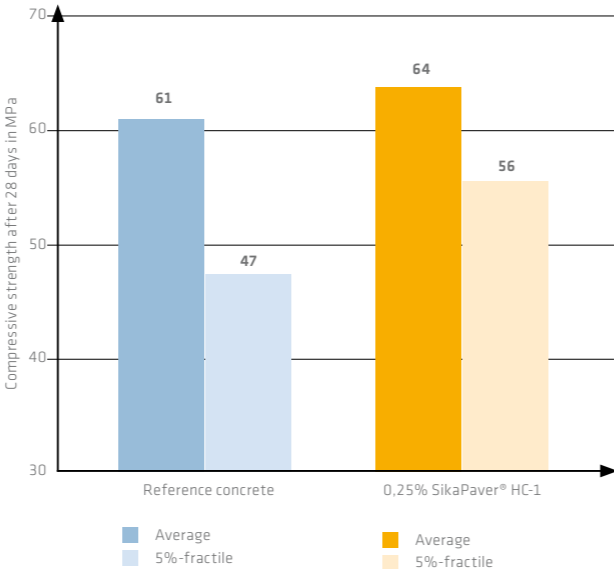
- Quality of constituent materials
- Batching of constituent materials
- Filling of molds in a rapid production process

These variations can lead to substantially changing production conditions and to indeterminate concrete quality. SikaPaver® technology balances variations and ensures a high quality production process. Furthermore, the application of SikaPaver® products enhances the filling procedure, reducing variations due to uneven filling of molds.

SikaPaver® balances unavoidable water content variations leading to reduced strength variations and ensured quality.



Quality improvement regarding consistent strength development in semi-dry precast concrete production.

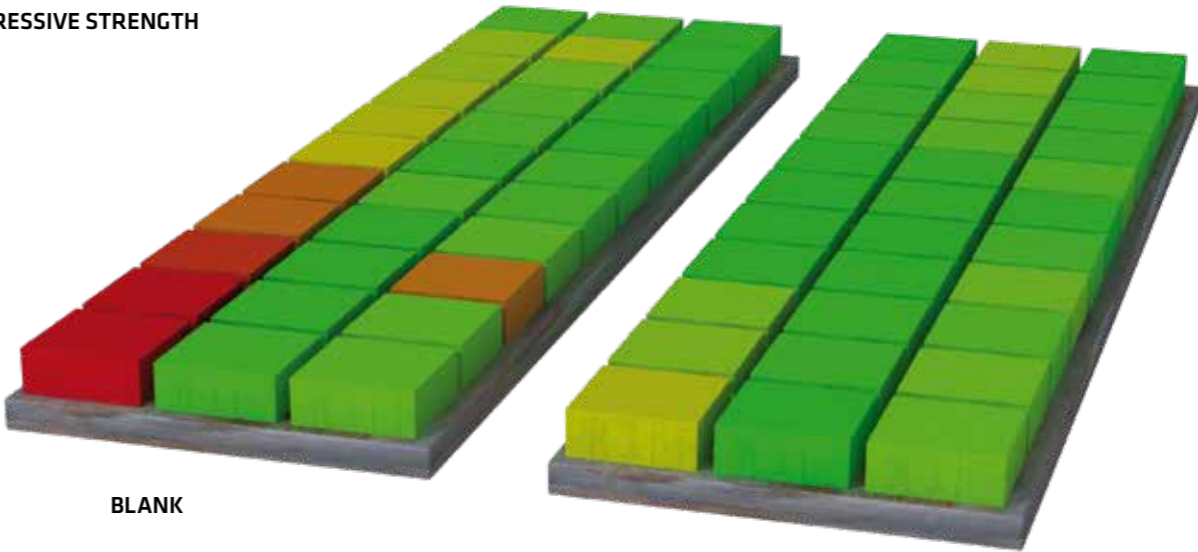


Different degrees of compaction and quality within the production process result in significantly changing durability of pavers produced on one board with the same concrete mix design.

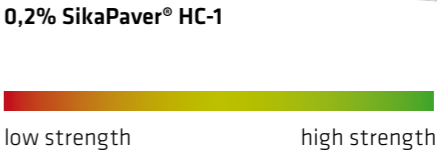
Due to uneven filling and different compaction qualities on one paver board, significant differences in compressive strength of the paver products can be the result.

With the application of suitable SikaPaver® products this undesirable effect can be reduced and balanced.

### COMPRESSIVE STRENGTH



Improved strength variations on one board in a semi-dry precast paver production with application of SikaPaver® HC-1.



# ENHANCED COMPACTION AND STRENGTH DEVELOPMENT WITH SikaPaver®

## COMPACTION

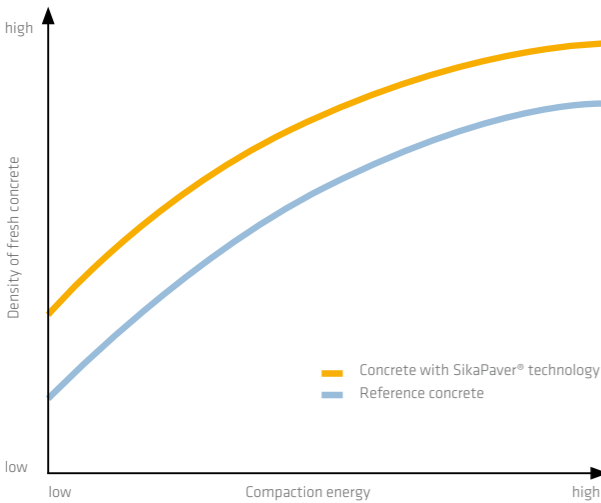
The compactability of fresh semi-dry concrete represents the driving factor in a semi-dry precast concrete production. With improved compaction the following advantages can be achieved:

- Fast production with high output
- Improved quality of products
- Higher green, 1-day and final strength
- Fewer rejects and claims
- Reduced efflorescence
- Increased durability
- Enhanced frost and freeze/thaw resistance
- Dense concrete matrix
- Smooth flanks

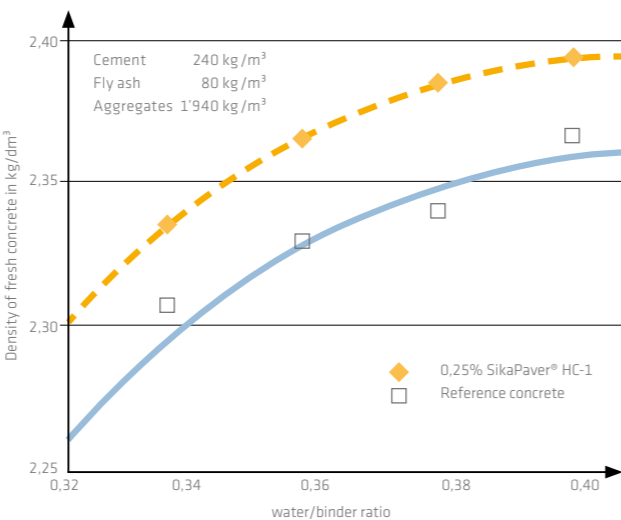
Compactability can be positively influenced by several different factors such as constituent materials, grading curve, water and cement content (water/binder ratio) as well as the applied admixture technology.

The significant influence of SikaPaver® technology results in measurably higher fresh concrete densities across all water/binder ratios. In addition, the production process becomes more efficient with application of SikaPaver® products, because with a defined amount of compaction energy a higher fresh concrete density can be attained.

Easy to compact semi-dry concrete with SikaPaver® technology.



Improved compactability of a semi-dry concrete mix with the application of SikaPaver® HC-1.



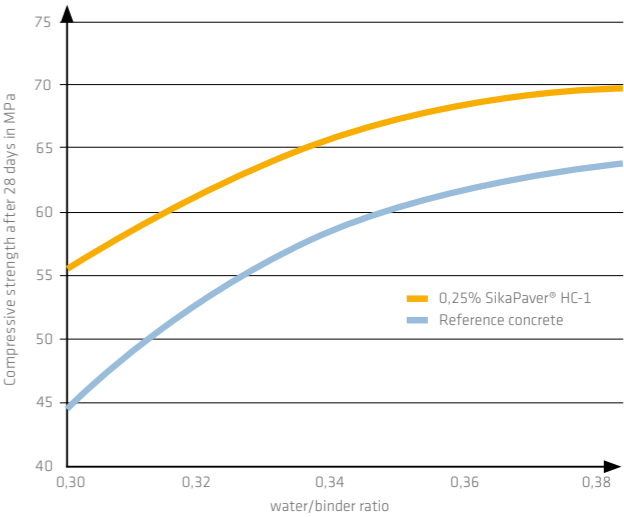
## STRENGTH DEVELOPMENT

The specialized semi-dry precast concrete manufacturing process requires that fresh concrete products have an initial strength immediately upon compaction. This so-called green strength is crucial in guaranteeing the shape accuracy of produced elements and thereby their quality. Green strength results from the combination of compactability and cohesiveness of fresh concrete. It has direct influence on product damages and rejects.

After curing, semi-dry precast concrete products must already have sufficient one-day strength, because the products are usually transported, packed and stocked at this time. In order to reduce damage and rejects within the production process the sure achievement of a target one-day strength is essential for the whole production process.

The final strength of precast products is important to ensure the required durability of the semi-dry concrete elements, since in many cases the products must withstand significant loads during their lifecycle. A high degree of compaction as well as hydration of the cement are the influencing factors affecting the early strength development and final strength.

Substantial strength increase with SikaPaver® HC-1 across a range of water/binder ratios.



# SikaPaver®

## REDUCES EFFLORESCENCE AND IMPROVES DURABILITY

Durability considerations also play a major role in the semi-dry precast concrete production process, because depending on the finished product it must withstand high loads, e.g. from traffic, frost or freeze/thaw attack.



### DURABILITY

It is important moreover that semi-dry concrete products sustain their technical performance and appearance over an extended length of time, since this reduces and avoids maintenance costs.

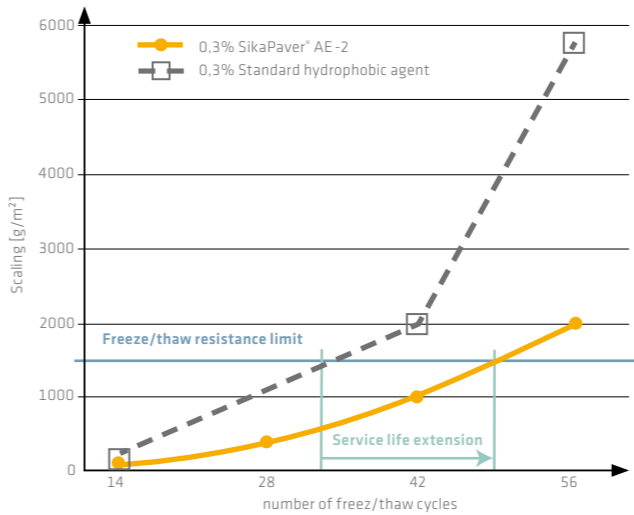
On the one hand the durability of the semi-dry concrete can be enhanced with a high degree of compaction, since the ingress of water and pollutants is reduced with increased concrete matrix density. On the other hand the application of SikaPaver® AE type products substantially reduces capillary water absorption through hydrophobic action. In addition, frost and freeze/thaw resistance of semi-dry concrete products can be significantly increased with the application of SikaPaver® technologies; their service life is thereby prolonged.

### EFFLORESCENCE

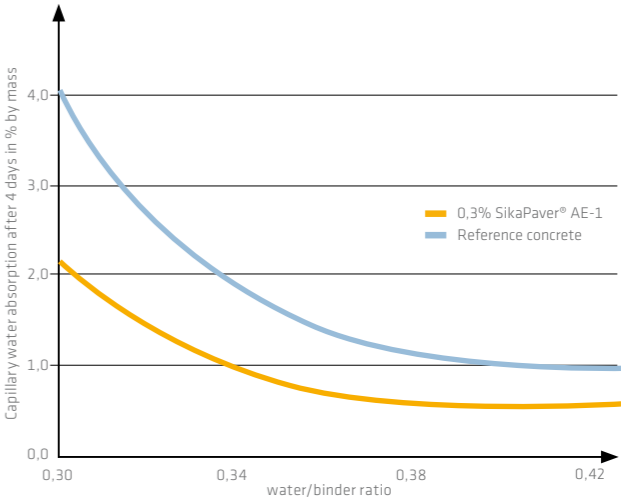
The phenomenon of efflorescence challenges semi-dry pre-cast concrete producers daily. It generally occurs with certain ratios of calcium hydroxide and water in the presence of air, whereby these conditions arise through the combination of concrete mix design, the curing process and stocking.

Measures for improvement can include the adjustment of the mix design or change in storing conditions to namely protect the stocked concrete products from rain and dew. To effectively reduce efflorescence and to ensure a constant, durable concrete surface quality it is necessary to apply an anti-efflorescence admixture: SikaPaver® AE technology. Within the SikaPaver® AE range, available products combine a strong plasticizing effect, improved compactability and powerful hydrophobic action, thus offering efficient anti-efflorescence treatment.

Extended service life with SikaPaver® AE-2 under severe freeze/thaw conditions.



Significantly reduced water absorption with SikaPaver® AE leads to reduced efflorescence risk.



# BRIGHT COLORS WITH SikaPaver® AND Sika Colorflo®

The architectural design of streets, parking lots, pedestrian areas and other places with semi-dry precast concrete products offers a wide array of design opportunities. With different shapes, textures and colors the versatility of semi-dry precast concrete products enables creation of aesthetic living environments.



### COLOR APPEARANCE

The color appearance of concrete depends on many factors:

- Cement content and color
- Water content (w/c ratio)
- Pigment dosage, particle size and dispersion
- Color of aggregates
- Concrete pore structure
- Surface texture
- Efflorescence
- Compaction aid

A change in the water content as small as w/c 0.02 is already clearly visible. Higher water content leads to lighter cement matrix. Typical variations in the semi-dry concrete production process such as water/binder ratio, cement content and achieved compaction affect the color of the finished products. These variations can be balanced with the application of SikaPaver® technology, such as SikaPaver® C or the SikaPaver® HC series. Furthermore it is even possible to brighten the concrete color and extend its longevity by using SikaPaver® AE type admixtures.



### COLOR CREATION

Sika's ColorFlo® system allows concrete to be accurately, economically and permanently colored in a great variety of colors and with this offers a sustainable and attractive way to design concrete elements.

Colored concrete places the highest demands regarding uniformity on the concrete ingredients as well as a professional manufacture and flawless processing of the concrete. Sika possess well-founded expertise accumulated over decades across the entire breadth of concrete technology. A technically correct and economically profitable concrete formula is our way of attaining customer benefit and trust.

Sika® ColorFlo® Liquid Colors are pre-dispersed iron oxide pigments in water with high pigment solids content. Products in powder form are also available for delivery. A targeted selection of primary colors and nearly endless blending possibilities allow preparation of concrete in the most diverse color tones. A wide palette of mixing and dosing systems ensures the proper employment of the colors. For a constant color appearance, the concrete mixer should be loaded to a minimum of 40% capacity and same mix design, water/cement-ratio, compaction and Curing have to be ensured.



# SUPPORTING PRODUCTS

## Sika Separol<sup>®</sup>, Sika MonoTop<sup>®</sup>

### AND Sikagard<sup>®</sup>

#### BOARD PROTECTION

Semi-dry products are manufactured in a heavy block making machine. The concrete is compacted in a mould due to the pressure of the tamper head and the parallel vibration below the transportation board. These special boards can be made of wood, coated wood, plastics or steel. They are of highest importance for the quality of the semi-dry products: deformation of the board and defects in the surface of wood boards reflect on the bottom side of the precast elements which can lead to claims. But the boards themselves have a value which needs to be maintained.

Sika Separol<sup>®</sup> W-series are solvent free oil emulsions to be used as protection for all types of board. They reduce the adhesion of concrete on all types of boards while avoiding oil stains on the concrete and facilitate the board cleaning. Applied on wooden boards, they regulate the moisture content in the wood and prevent the planks from separating. Consequently, the wooden boards remain perfectly flat and maintain their smooth surface without regrinding of the surface.

Sika Separol<sup>®</sup> W-series provides reliable protection against decay of the boards and ensures highest quality of the semi-dry concrete products.



#### REPAIR

The semi-dry precast concrete quality and surface appearance are the producer's calling card. Nevertheless in the semi-dry precast concrete production process, surface defects and broken or spalled edges are unavoidable. The repair of these defects has to be carried out with a repair mortar that is easily and rapidly applicable as well as having high durability. Moreover a defect should not be visible following repair, which implies a crack-free appearance and similar colour and texture to original concrete of the repair mortar. These requirements can be fulfilled with Sika<sup>®</sup> MonoTop<sup>®</sup> repair mortars.



#### PROTECTING

In order to prolong durability, ensure the brightness of colored semi-dry concrete elements and avoid the formation of dirt and moss, a protective should be applied. This applies especially after a subsequent cleaning process. The easily and quickly applied Sikagard<sup>®</sup> range ensure the longevity of precast concrete elements and the surface appearance can be significantly improved for an extended period of time.



# SUSTAINABILITY AND COST OPTIMIZATION

Sustainable production, saving energy and lowering CO<sub>2</sub> emissions continue to gain attention. Naturally these topics are growing in importance in the concrete industry, because cement and concrete production generate a large share of world-wide CO<sub>2</sub> emissions.



In the semi-dry precast concrete industry a number of measures help save resources. These include implementing optimized concrete mix designs in combination with innovative admixture technologies; this extends durability, resulting in reduced carbon footprint over the entire service life of semi-dry concrete products. The sustainability of the concrete mix design can be improved by reducing the cement and/or binder content, replacement of OPC by secondary cementitious material and the utilization of recycled or manufactured sand and aggregates.



**EXAMPLE: BINDER CONTENT OPTIMIZATION FACILITATED BY SikaPaver® TECHNOLOGY**

Good compactability and constant production of high quality products are targets of a semi-dry precast concrete production. Sufficient compactability of the concrete mix depends on the grading curve, suitable water/binder content and cement or binder content.

The following example shows how a semi-dry concrete mix was optimized with the target of attaining the required technical performance with improved cost structure of the mix while also reducing the carbon footprint of the production.

All mixes tested contained the same aggregate grading curve and water/binder ratio of 0.38 with a water content of 120 kg/m<sup>3</sup>. The improved binder content with concurrent application of SikaPaver® HC-1 offered cost advantages and reduced the CO<sub>2</sub> footprint of the produced products.

	Initial Mix	Optimized Mix 1	Optimized Mix 2
Cement	320 kg/ m <sup>3</sup>	240 kg/m <sup>3</sup>	240 kg/m <sup>3</sup>
Fly ash	0	80 kg/m <sup>3</sup>	80 kg/m <sup>3</sup>
SikaPaver® HC-1	-	-	0.25% b.w.o.c.
1 d strength	44	26	34
28 d strength	74	67	74
Cost per m <sup>3</sup>	41.6 €	38.4 €	39.6 €
Net savings per m <sup>3</sup>			2.0 € / m <sup>3</sup>



# CUSTOMER SUPPORT

The semi-dry concrete industry, as a highly industrialized branch, is constantly looking for innovative improvement of production processes and final products. Furthermore the efficient production of high quality semi-dry concrete products is depending on several individual factors that vary from producer to producer. This leads to different challenging requirements regarding chemical admixture performance and it is important to serve different individual needs with different technologies and products.



Solutions for these challenging individual requirements are elaborated with Sikas customer support. Customer support in the plant is one important part of Sikas supporting activities in order to evaluate the customers' individual needs and identify the specific production process. Once the requirements and targets are defined optimizations can be evaluated in Sikas laboratory. The semi-dry concrete performance is tested with a "Gyratory" testing machine. With this testing machine the compactability of a defined semi-dry concrete mix can be derived and hence suitability of a semi-dry concrete mix as well as used admixture is determined. Moreover customers can actively take part at the laboratory trials. This enables customers to trial semi-dry concrete mixes without interruption of their ongoing production process in the plant, which means in detail:

- Opportunity to test new raw materials
- Find optimum SikaPaver® solution
- Mix design optimization
- Utilization of optimal binder type and content
- Customized product development

With fast evaluation of results regarding compactability, strength development and water adsorption it becomes possible to develop solutions serving the customer needs. In addition color appearance and water repellency characteristics can be investigated very quickly.

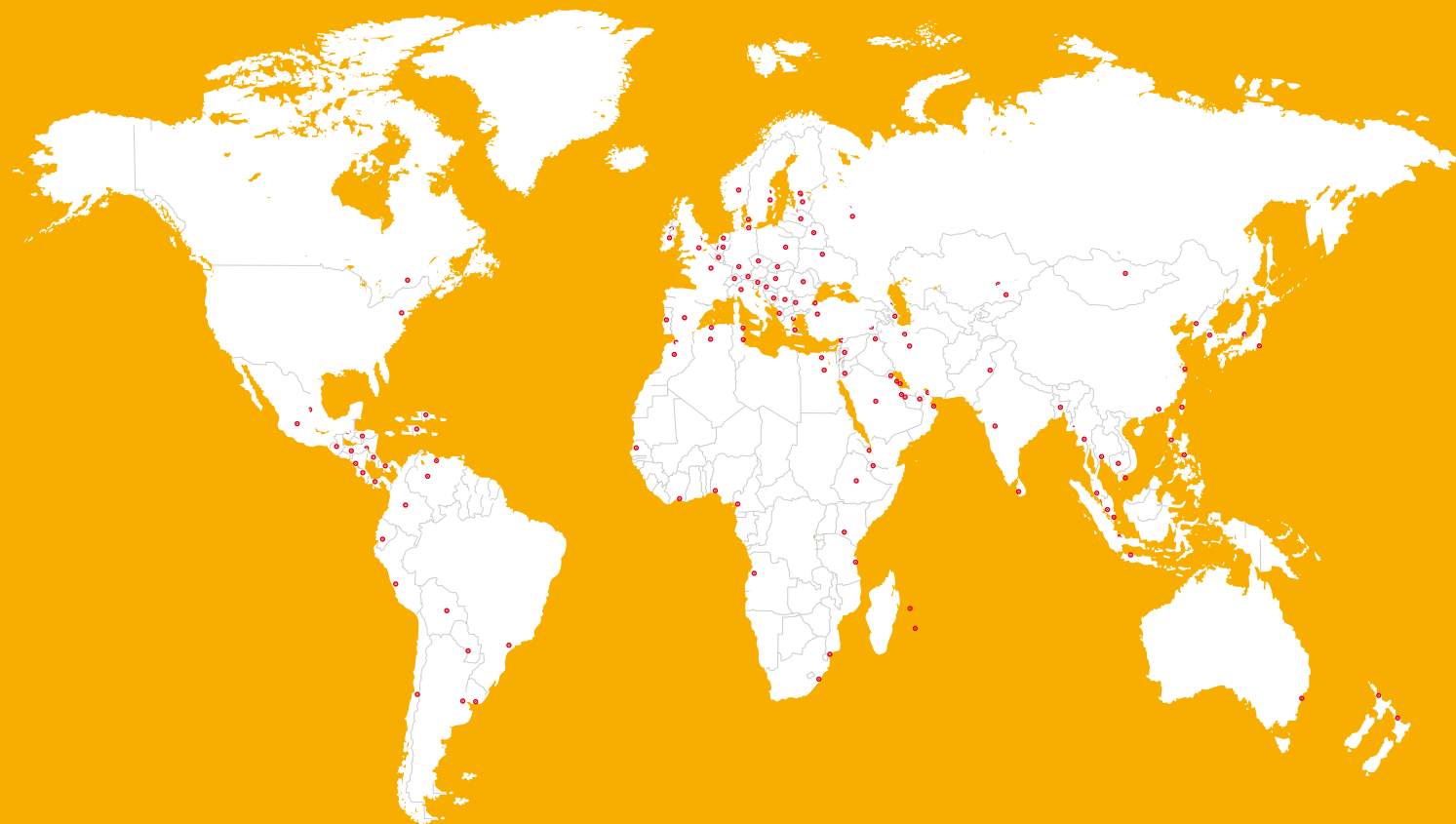


Sikas Technology and Research Center is continuously evaluating the suitability of different raw materials for semi-dry concrete admixtures. An indispensable step within the evaluation of new materials and development of products is determining the product performance in semi-dry concrete with the "Gyratory" testing machine. This leads to incorporation of innovative materials like polycarboxylate ether (PCE) and hydrophobic agents, which opens opportunity for

- Superior compactability
- Reduced variations
- Ensured quality and strength development
- Efflorescence reduction
- Water repellency
- as well as improved cost / performance of semi-dry concrete mixes.



# GLOBAL BUT LOCAL PARTNERSHIP



## FOR MORE CEMENT PRODUCTION INFORMATION:



### WE ARE SIKA

Sika is a specialty chemicals company with a leading position in the development and production of systems and products for bonding, sealing, damping, reinforcing and protecting in the building sector and the motor vehicle industry. Sika's product lines feature concrete admixtures, mortars, sealants and adhesives, structural strengthening systems, industrial flooring as well as roofing and waterproofing systems.

Our most current General Sales Conditions shall apply. Please consult the most current local Product Data Sheet prior to any use.



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