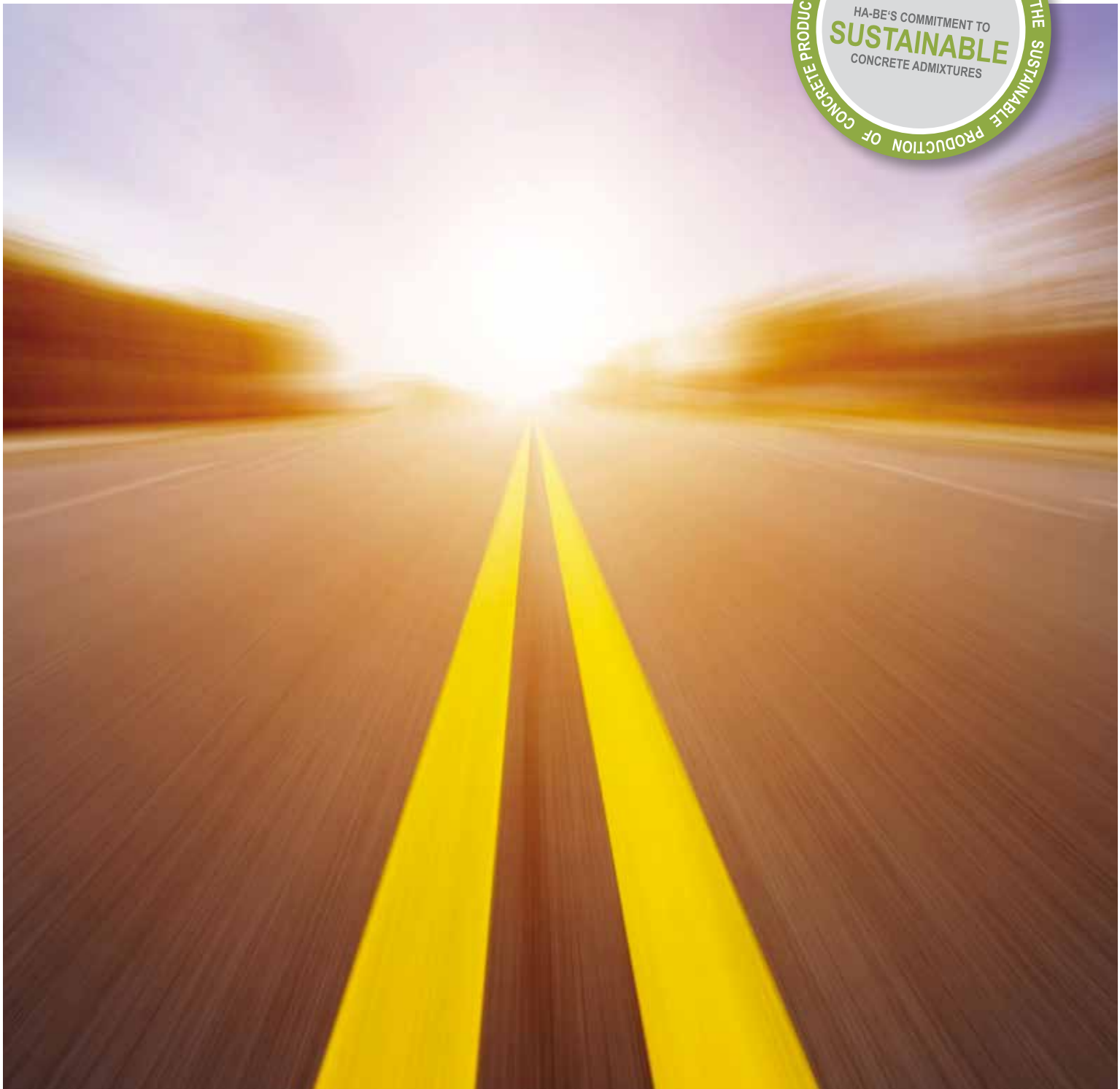


HA-BE ADMIXTURE SYSTEMES

for construction projects in the infrastructure area





Our Ha-Be system solutions for

INFRASTRUCTURE CONSTRUCTIONS

The world is changing faster than ever before, triggering a steadily increasing demand for social, transportation and utility infrastructure. Meanwhile, concrete remains the material of choice for constructions within the infrastructure area. It is not only one of the most basic, but also one of the most versatile building materials and, due to its durability, load bearing capacity and low maintenance costs, also seen as suitable for almost any field of application within infrastructure construction.

► Customised to areas of application

We at Ha-Be offer special admixture systems and provide customised solutions for concrete used locally or globally for application areas that include:

- Concrete roads
- Whitetopping
- Aviation areas
- Bridge constructions
- Concrete protection walls
- Tunnel constructions

► Product systems – Everything from a single source

According to the field of application, our product systems consist of the components admixtures, conditioners, accelerators, additives, fibres, curing compounds, concrete protections and bonding agents. Our technical experts will advise you on the best product system for your project and on how to implement it.

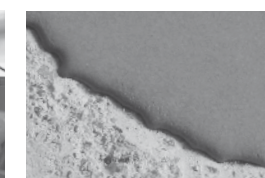
Guaranteed quality for the

COMPONENTS OF THE HA-BE PRODUCT SYSTEM



ADMIXTURES

- DIN EN 934
- German TL Beton-StB 07



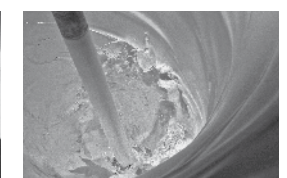
CONDITIONERS

- Factory production control



ACCELERATORS

- DIN EN 934



ADDITIVES

- DIN EN 13263



FIBRES

- DIN EN 14889
- General construction supervisory approval



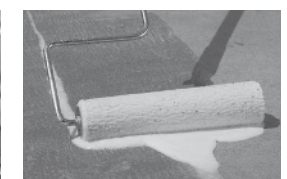
CURING

- German TL NBM-StB 09



PROTECTION

- BS EN 1504-2



BONDING

- Factory production control




Table of contents

ADMIXTURE SYSTEMS FOR ...

| | |
|---------------------------------------|----|
| ▶ CONCRETE ROAD CONSTRUCTIONS | 06 |
| ▶ AVIATION AREAS | 08 |
| ▶ CONCRETE PROTECTION WALLS | 10 |
| ▶ WHITETOPPING | 12 |
| ▶ BRIDGE CONSTRUCTIONS | 14 |
| ▶ TUNNELS – USING SHOTCRETE METHODS | 16 |
| ▶ TUNNELS – USING TBM METHODS | 18 |
| ▶ SERVICES ON-SITE & SYSTEM SOLUTIONS | 20 |
| ▶ HA-BE REFERENCES | 22 |







Ha-Be Admixtures

PRODUCT SYSTEM CONCRETE ROADS

| ADMIXTURES | ADDITIVES | CURING | PROTECTION |
|---|---|--|--|
| <div>▶ PANTARHIT® Plasticizers</div> <div>▶ PANTAPOR Air-entraining agents</div> <div>▶ PANTARHOL Retarders</div> <div>For porous concretes</div> <div>▶ STABILISER Stabilisers</div> | <div>For porous concretes</div> <div>▶ DURAHIT Concrete dispersions</div> | <div>▶ PANTARHOL OVZ10 Surface retarders</div> <div>▶ CURING Curing agents</div> | <div>▶ DURAHIT Hydrophobic impregnations</div> |

Photo: Bickhardt Bau AG

Ha-Be admixture system for CONCRETE ROAD CONSTRUCTIONS

Concrete roads, as one of the most heavily stressed constructional components, require a high compressive and flexural strength. Their durability and ease of maintenance are as important as the resistance to wear, de-icing and thawing salt.

▶ Concrete roads – A two-layer system

Concrete roads generally consist of two non-reinforced layers: the lower layer, the so-called “base” and the upper layer, the “top”. They are installed above the bearing layer by a slip form paver. Both, the base and the top, consist of different compositions:

▶ Plasticizers & air-entraining agents for the base

The base is usually of a S1 consistency. Apart from attaining the defined air entrainment and compaction, the freshly produced concrete requires to be stable. These properties ensure a smooth progress of the slip form paver, the evenness of the surface and, finally, the scheduled construction progress. Especially for these kind of applications, we have designed a product system including PANTARHIT® plasticizers and PANTAPOR air-entraining agents.

▶ Plasticizers & air-entraining agents for the top

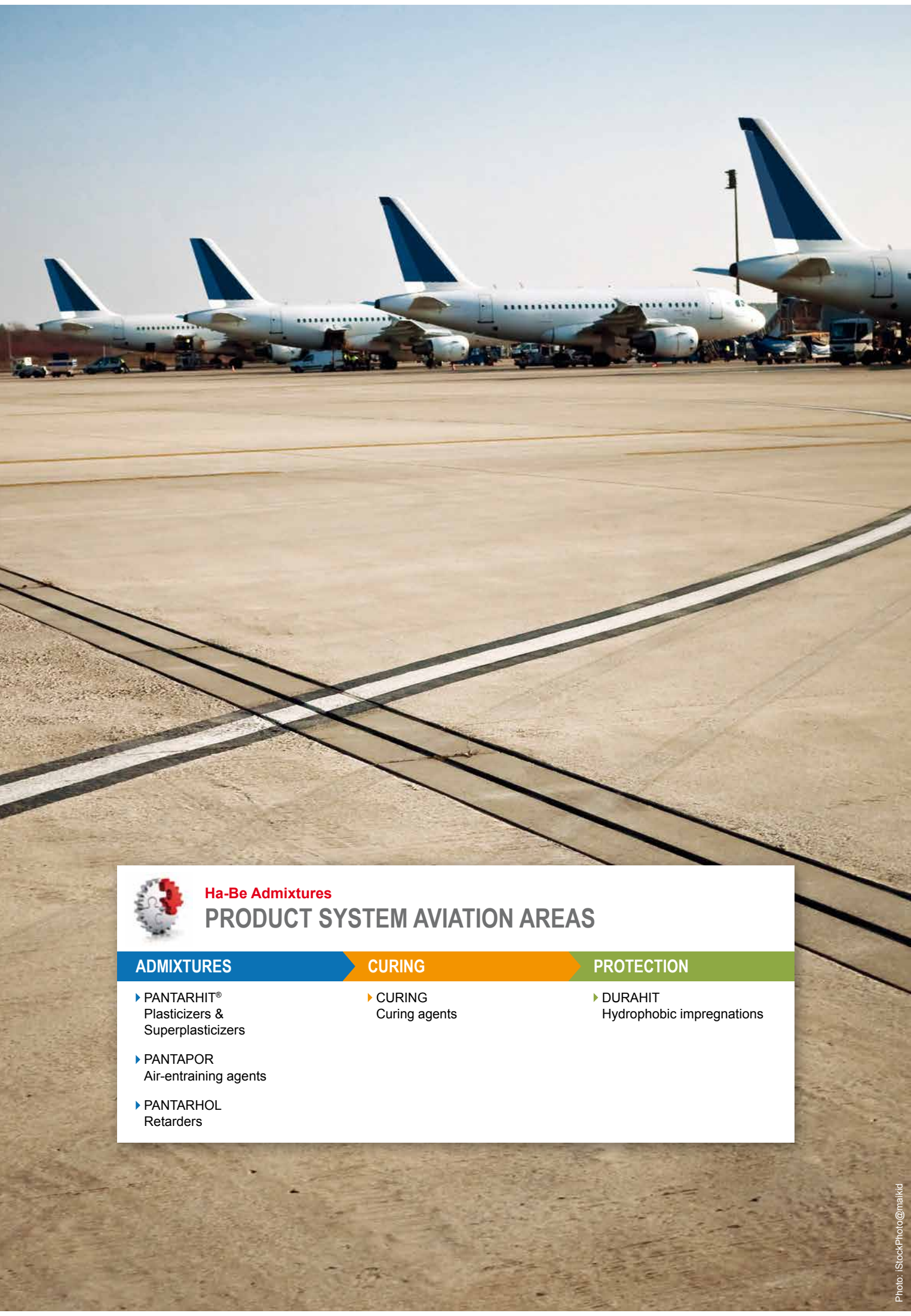
With a standard consistency of F2, the upper layer is significantly more plastic. Initially and only during installation, this layer has to meet the same requirements for freshly produced concrete as the one of the base: achieving the defined air entrainment and compaction as well as a high level of stability. These properties can be achieved with the specially designed plasticizers and air-entraining agents of the Ha-Be product system.


▶ Surface retarders

The properties of its surface is what makes the top exceptional: This layer is usually produced using the exposed aggregate concrete construction method. Therefore, our high-quality surface retarder PANTARHOL OVZ10 is sprayed on top right after the installation of this layer. The delayed hardening of the concrete surface allows the subsequent removal of the surface mortar by mechanical brushing.

▶ Curing & surface retarding compounds

Concrete may be hard enough to walk on after a few hours, but the chemical reaction that makes cement strong will keep going for weeks or even months. So if concrete dries out too quickly, it can be weak and not harden properly. Our Ha-Be product system for concrete road construction keeps the concrete damp while it gets hard and strong. It consists of especially developed surface retarders as well as curing compounds. These formulas are specifically designed for concrete finishes in concrete road constructions, i.e. both products are sprayable and can be easily applied on the concrete surface by using spraying nozzles on the trailing platform or spray bar without clogging the nozzles.





Ha-Be Admixtures

PRODUCT SYSTEM AVIATION AREAS

| ADMIXTURES | CURING | PROTECTION |
|---|---------------------------------------|--|
| <div>▶ PANTARHIT® Plasticizers & Superplasticizers</div> <div>▶ PANTAPOR Air-entraining agents</div> <div>▶ PANTARHOL Retarders</div> | <div>▶ CURING Curing agents</div> | <div>▶ DURAHIT Hydrophobic impregnations</div> |

Ha-Be admixture system for

AVIATION AREAS

Concrete chosen for aviation areas like runways, aprons and aircraft standing areas requires an excellent load carrying performance. As these areas demand a tough, durable material that works also under extreme weather conditions, the admixture system must be perfectly matched.

▶ Plasticizers, air-retraining agents and retarders

In contrast to concrete road construction, aviation areas usually consist of only a single concrete layer. The requirements of the freshly produced concrete are therefore similar to those of the base concrete in road construction. Installed of a C1 consistency, the concrete requires to attain a defined air entrainment and compaction. Moreover, its workability and stability are important to allow the smooth progress of the slip form paver and thus, to ensure the scheduled construction progress is being met.

We have developed a product system specially for this application. Comprising of PANTARHIT® plasticizers and/or superplasticizers, and PANTAPOR air-entraining agents it is specifically designed to meet all these requirements.

▶ Curing of broom-finished concrete

Unlike as in road construction, broom finish textures provide the necessary grip to the concrete surface. After the slip form paver has installed the concrete layer, broom finishing is performed either manually or by a special device. To protect concrete from premature water evaporation and crack formation, the trailing platform sprays the CURING agent subsequently on.

Our Ha-Be product system for aviation areas contains specially developed PANTARHIT® plasticizers, PANTAPOR air-entraining agents, and CURING agents. To even further improve the lifespan of airport areas, we have also designed our special DURAHIT depth impregnation. These products are especially designed for traffic areas and thus contributing to a successful application and a solid construction.

Photo: iStockPhoto@makid



Ha-Be Admixtures

PRODUCT SYSTEM CONCRETE PROTECTION WALLS

SLIP FORM PAVERS

ADMIXTURES

▶ PANTAPOR
Air-entraining agents

FIBRES

▶ Ha-Be PP-
Macrofibres

CURING

▶ CURING
Curing agents

PROTECTION

▶ DURAHIT Hydrophobic
impregnations

PRECAST

ADMIXTURES

▶ PANTAPOR
Air-entraining agents

▶ Ha-Be PP-
Macrofibres

PROTECTION

▶ DURAHIT
Hydrophobic impregnations

▶ PANTARHIT®
Plasticizers & Superplasticizers

Ha-Be admixture system for

CONCRETE PROTECTION WALLS

Concrete must not only withstand the impact of heavy vehicles but also need to resist loads from de-icing and thawing salt. Basically, there are two different production methods for concrete protection walls: the on-site production by slipform pavers or the manufacture in precast plants. Depending on the manufacturing process, different requirements arise to the concrete:

SLIP FORM PAVERS

Whenever concrete protective walls are made using slip form pavers, they are usually installed in a semi-dry condition. The concrete-technological challenge in here is keeping the concrete stable while also attaining the defined air entrainment.

▶ Especially adjusted air-entraining agents

For an even distribution of the micro air pores in semi-dry consistencies, we have developed special air-entraining agents such as the PANTAPOR 2044. These agents are specifically designed for concrete being applied by slip form pavers.

▶ Fibres optimise stability

To improve the stability of the fresh concrete, we have special Ha-Be PP-Macrofibres available in different lengths. They additionally optimise the impact resistance in the hardened concrete and reduce the occurrence of shrinking cracks.

▶ Curing and concrete protection

To protect the fresh concrete from drying out too quickly during the hydration phase, concrete protective walls require a curing, preferably using our CURING agent. We further recommend our DURAHIT depth impregnation for a permanent protection from water, weather, and chemical loads.

PRECAST

Produced as a precast element, the concrete is poured into moulds. Requiring a significantly more plastic consistency, the challenge is to adjust the early strength development to the needs of an efficient production process.

▶ Superplasticizers and air-entraining agents

Our specially developed plasticizers and high-performance superplasticizers out of our PANTARHIT® line meet these requirements: Even without heat treatment, the superplasticizers trigger high early strength in the concrete and thus reduce stripping times. The improved compaction they also set up, ensure homogeneous, low-porous surfaces. The high resistance to de-icing and thawing salt is achieved by the addition of our special air-entraining agents which are purposefully adjusted to the PANTARHIT® plasticizers and superplasticizers.

▶ Special fibres and concrete protection

Our product concept also includes Ha-Be PP-Macrofibres to improve the impact resistance in hardened concrete. We further recommend our DURAHIT depth impregnation for a permanent protection of concrete.

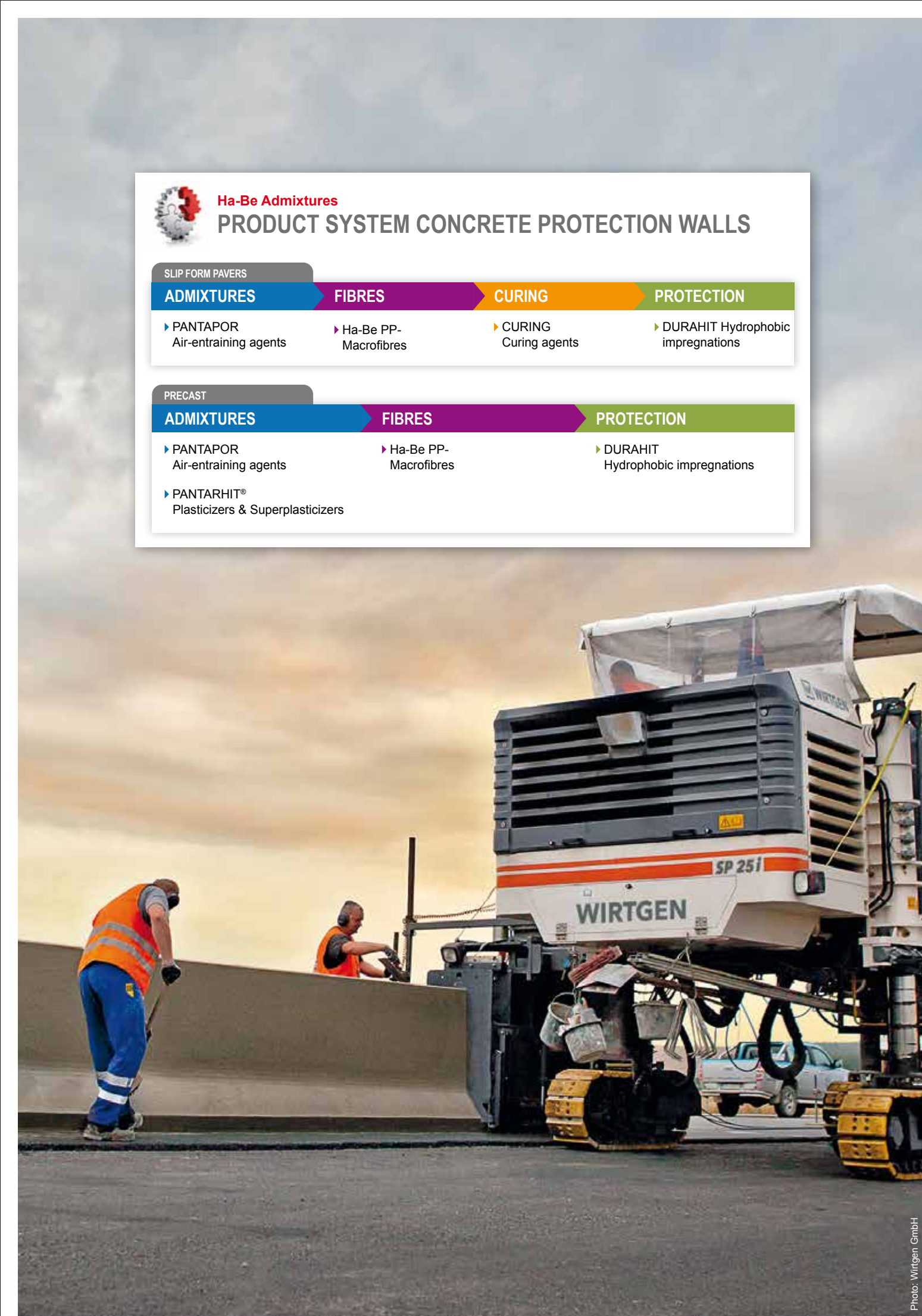



Photo: Wirtgen GmbH





Ha-Be Admixtures

PRODUCT SYSTEM WHITETOPPING

| AD MIXTURES | FIBRES | CURING | PROTECTION | BONDING |
|--|--|--|--|------------------------------------|
| <div>▶ PANTARHIT® Plasticizers</div> <div>▶ PANTAPOR Air-entraining agents</div> <div>▶ Ha-Be SRA Shrinkage reducers</div> | <div>▶ Ha-Be PP- Macrofibres</div> | <div>▶ CURING Curing agents</div> <div>▶ PANTARHOL OVZ10 Surface retarders</div> | <div>▶ DURAHIT Hydrophobic impregnations</div> | <div>▶ Ha-Be Bonding Aid</div> |

Illustration: InformationsZentrum Beton GmbH

Ha-Be admixture system for WHITETOPPING

Whitetopping has been proven an excellent solution for restoring traffic areas. Instead of a complete renewal, whitetopping changes only the damaged top layer and replaces it with a new one. Usually fibre-reinforced, low-shrinking and high-performance concrete is used for this application.

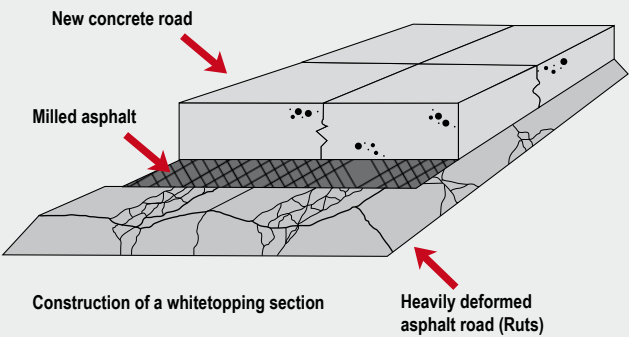
► **Superplasticizers, air-entraining agents and fibres**
As the whitetoppings are applied at no more than 8-20 mm, high-performance concrete is usually used for this kind of application. Therefore, our product system includes an especially designed and carefully matched admixture concept that includes plasticizers, superplasticizers, air-entraining agents, as well as shrinkage reducers. When added to concrete during the batching stage, shrinkage reducers, e.g. our Ha-Be SRA, can significantly reduce both the early and long-term drying shrinkage. To even enhance this effect, we further recommend adding Ha-Be PP-Macrofibres.

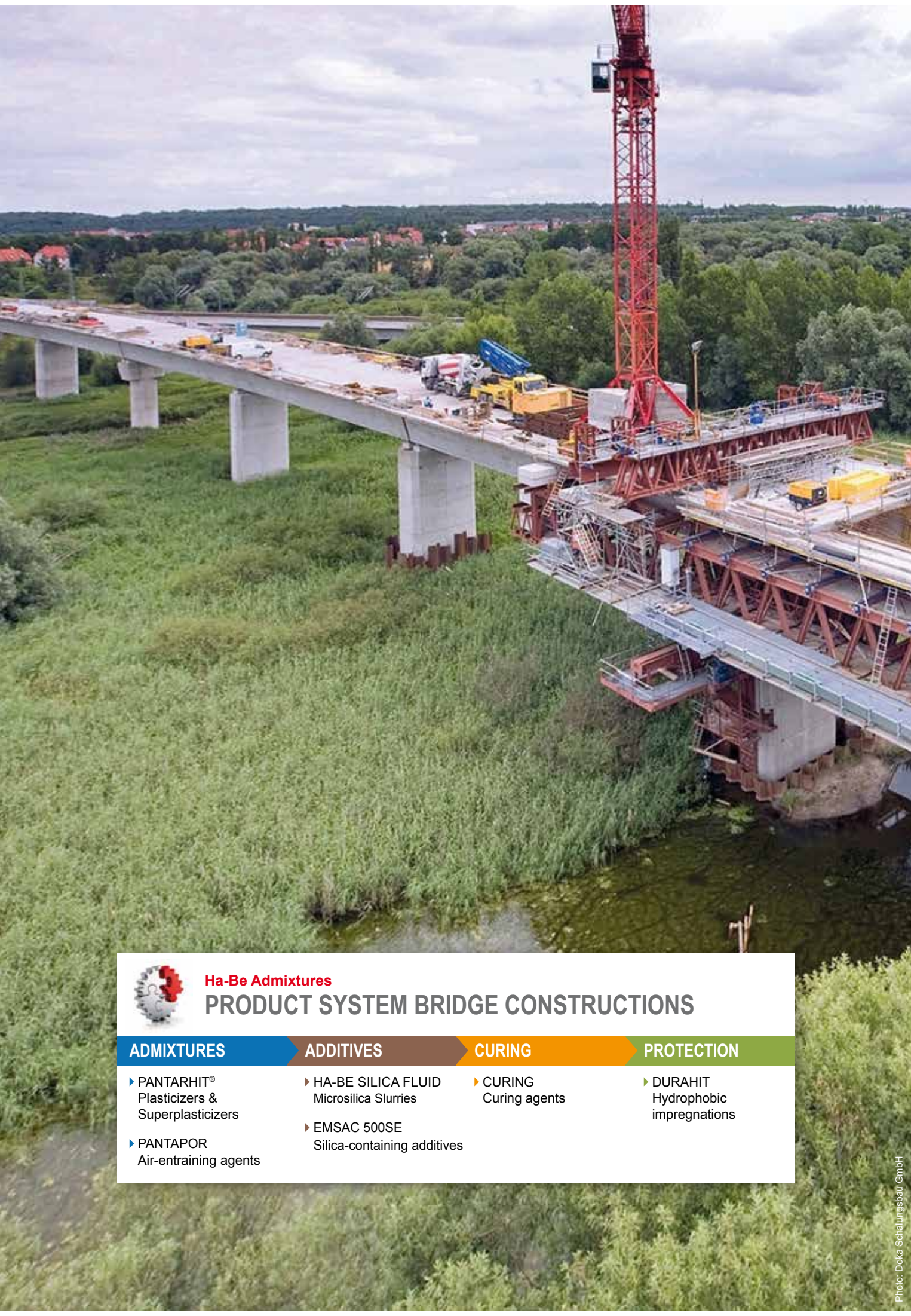
► **Surface retarders and curing agents**
To provide a durable, high-traction surface, broom finishes or exposed-aggregate finishes are usually created. Exposed Aggregate finishes mostly require to spray a retardant on the surface. Our high-performance surface retarder PANTARHOL OVZ10 for example allows the concrete to completely set up while the surface is still soft.


The subsequent removal of the mortar can be performed easily by washing off and / or mechanical brushing.

Broom finishes require an adequate curing in order to avoid shrinkage cracking in the concrete overlay. We recommend to spray our CURING agent on the surface. To further improve the durability of concrete surfaces, our especially developed DURAHIT depth impregnation can be applied.

► **Durable bonding**
The permanent bonding between the remaining layer and the newly applied one is essential for successful whitetopping constructions. For this purpose, we developed our bonding agent Ha-Be Bonding Aid which provides excellent, durable adhesion between the two layers.







Ha-Be Admixtures

PRODUCT SYSTEM BRIDGE CONSTRUCTIONS

| ADMIXTURES | ADDITIVES | CURING | PROTECTION |
|--|---|---------------------------------------|--|
| <div>▶ PANTARHIT® Plasticizers & Superplasticizers</div> <div>▶ PANTAPOR Air-entraining agents</div> | <div>▶ HA-BE SILICA FLUID Microsilica Slurries</div> <div>▶ EMSAC 500SE Silica-containing additives</div> | <div>▶ CURING Curing agents</div> | <div>▶ DURAHIT Hydrophobic impregnations</div> |

Photo: Doka Solungsbau GmbH

Ha-Be admixture system for

BRIDGE CONSTRUCTIONS

Bridges are often designed for a lifespan of up to 100 years. In order to do so, the concrete used must withstand large variability of traffic conditions, changing weather conditions, and chloride attacks.

- ▶ Concrete requirements depend on component


There are many different designs and components that each serve a particular purpose and apply to different situations. Therefore, different concrete technological properties are required. Based on e.g. the respective exposure class, tensile and compressive strength, and the consistency, the planner defines properties for concrete.
- ▶ Specially-matched air-entraining agents

Some components like bridge caps require a certain resistance to de-icing and thawing salt. Therefore, we included perfectly-matched PANTAPOR air-entraining agents in our bridge construction product system. They ensure an exact adjustment of the necessary air void content in concrete.
- ▶ Flexible admixture system

To meet these various requirements, we have developed a particularly flexible admixture system for balancing certain concrete technology properties. The processing and setting time of the concrete for instance can be exactly controlled using our especially developed PANTARHIT® concrete plasticizers, superplasticizers, and PANTARHOL retarders.
- ▶ Permanent protection

For a permanent protection of concrete used in bridge construction, we recommend our hydrophobic depth impregnation DURAHIT as an additional component. This highly effective product protects the concrete from extreme weather conditions, water absorption and chemical attacks.





Ha-Be Admixtures
PRODUCT SYSTEM SHOTCRETE

| SHOTCRETE | | | |
|--|---|--|---|
| ADMIXTURES | ADDITIVES | FIBRES | ACCELERATORS |
| <ul style="list-style-type: none"> ▶ PANTARHIT® Plasticizers & Superplasticizers ▶ PANTARHOL Retarders | <ul style="list-style-type: none"> ▶ HA-BE SILICA FLUID Microsilica Slurries | <ul style="list-style-type: none"> ▶ Ha-Be PP-Microfibres ▶ Ha-Be PP-Macrofibres | <ul style="list-style-type: none"> ▶ PANTAQUICK Accelerators |

| INNER SHELL | | |
|--|---|--|
| ADMIXTURES | ADDITIVES | FIBRES |
| <ul style="list-style-type: none"> ▶ PANTARHIT® Superplasticizers ▶ STABILISER Stabilisers | <ul style="list-style-type: none"> ▶ HA-BE SILICA FLUID Microsilica Slurries | <ul style="list-style-type: none"> ▶ Ha-Be PP-Microfibres ▶ Ha-Be PP-Macrofibres |

Ha-Be admixture system for TUNNELS – USING SHOTCRETE METHODS

Concrete in tunnel and underground construction is exposed to extreme conditions must permanently withstand mountain pressure, meet a high level of fire protection requirements and endure chemical attacks. The construction method, however, is determined by the varying geological conditions, i.e. weight-bearing properties and stability of the substrate tunnelled through. A general distinction is made between shotcrete constructions and the TBM-Drive. Tunnels using the shotcrete construction method have two tunnel shells: an outer shell (shotcrete) and an inner shell (ready-mix concrete). The concrete requirements and designs vary accordingly.

PRODUCT SYSTEM SHOTCRETE

The supplied concrete mixture requires long workability times, good pumping properties and an excellent sprayability. Our product system therefore includes specially designed PANTARHIT® superplasticizers, PANTARHOL retarders, the additive Ha-Be SILICA FLUID and Ha-Be PP-Micro- and Macrofibres. These products allow an adequately and purposefully adjustment of workability retention, stabilise the mixture and secure an accurate, application-compliant processing.

▶ Setting accelerators

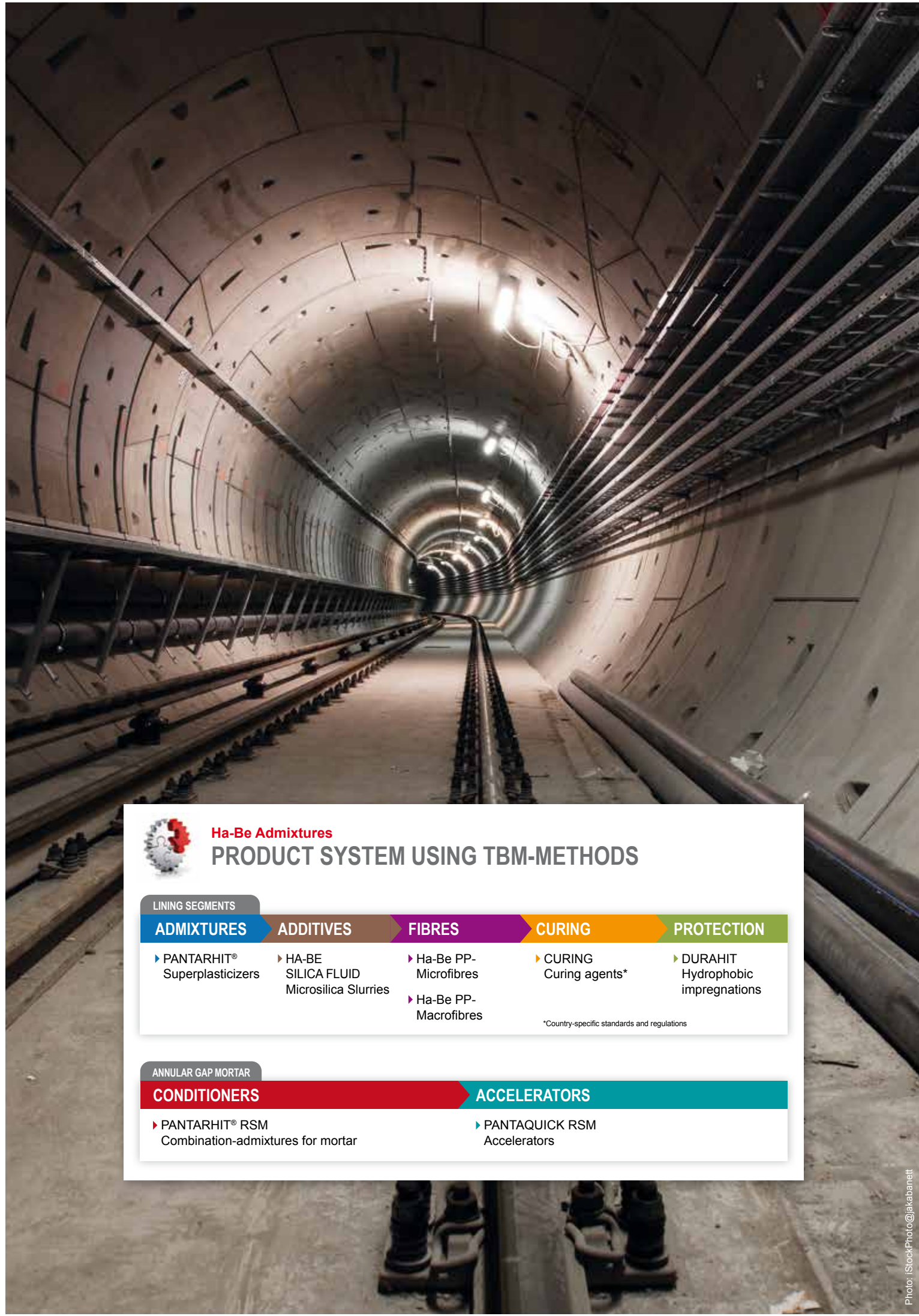
Accelerators out of our PANTAQUICK line activate concrete's setting immediately after their addition. The products are especially designed for shotcrete applications and enable an extra fast early strength development.


PRODUCT SYSTEM INNER-SHELL

Concrete for the inner shell is applied by a tunnel formwork carriage. For the timely stripping, the development of early strengths is of central importance. Furthermore, the demands on concrete focus on high durability requirements and strong resistance to de-icing and thawing salt.

▶ Admixtures, additives and fibres

Our especially designed product concept includes high-performance superplasticizers out of our PANTARHIT® line. Even without heat treatment, the superplasticizers trigger high early strength in the concrete and thus reduce stripping times. Apart from improving the homogeneity and density of the concrete, a perfectly-matched addition of microsilica slurry strengthen the frost and freeze-thaw resistance. Fire-protection requirements are met adding Ha-Be PP-Microfibres.



**Ha-Be Admixtures**
PRODUCT SYSTEM USING TBM-METHODS

LINING SEGMENTS

ADMIXTURES

ADDITIVES

FIBRES

CURING

PROTECTION

▶ PANTARHIT®
Superplasticizers

▶ HA-BE
SILICA FLUID
Microsilica Slurries

▶ Ha-Be PP-
Microfibres
▶ Ha-Be PP-
Macrofibres

▶ CURING
Curing agents*

▶ DURAHIT
Hydrophobic
impregnations

*Country-specific standards and regulations

ANNULAR GAP MORTAR

CONDITIONERS

ACCELERATORS

▶ PANTARHIT® RSM
Combination-admixtures for mortar

▶ PANTAQUICK RSM
Accelerators

Ha-Be admixture system for TUNNELS – USING TBM METHODS

Tunnels using the TBM-method have normally just one shell. The shell consists of prefabricated concrete segments which are installed to form a complete ring. They are placed directly after the boring process. After their installation in the tunnel, they have to withstand demanding use for up to 100 years.

PRODUCT SYSTEM CONCRETE SEGMENTS

Each tunnel project has special tunnel lining requirements. Our especially developed plasticizers and high-performance superplasticizers of our PANTARHIT® line enhance the durability and high quality of these special parts.

▶ Specially developed superplasticizers

Our superplasticizers reduce stripping times by triggering high early strength in the concrete – even without heat treatment. The improved compaction they also set up, ensure homogeneous, low-porous surfaces. In order to meet the requirements for lining segments on fire resistance, we recommend to add Ha-Be microfibers that are adjusted to this kind of application.

▶ Curing

In observance of country-specific rules and regulations, lining segments may be cured after removing the formwork. Our CURING agent supports concrete to cure in a controlled way and thus to increase its hardness and durability.

PRODUCT SYSTEM ANNULAR GAP MORTAR

In order to provide the segment rings with a stiff bedding, the annular gap created between the excavation wall and the segmental lining is filled continuously with mortar as the machine progresses.

▶ Unique 2-component system

Especially for this kind of application, i.e. in situations where controlled injection and very fast setting is required, we have developed a unique two-component system that consists of conditioner and accelerator. When added during production, the conditioner out of our PANTARHIT® RSM line densifies the mortar, improving its workability and pumpability. The setting of this stable grout suspension is then accelerated with our especially designed PANTAQUICK RSM. This accelerator is attached to the injection hose and activates the hydration process of the grout suspension. Controlled injection and fast setting at a time!

Ha-Be on-site

OUR SERVICES AND SYSTEM SOLUTIONS



APPLICATION TECHNOLOGY



TUNNEL TEAM



SUSPENSION PRODUCTION



LOGISTICS & STORAGE SYSTEMS

Photos: iStockPhoto@semit340, iStockPhoto@jps33

Competent – Flexible – Economical

SERVICES ON-SITE & SYSTEM SOLUTIONS

Whether concrete-technological services, economic storage- and dosage systems, or the efficient on-site manufacture of construction materials suspensions: We at Ha-Be offer an extensive range of services to facilitate and support your work processes. On this page you will find information on how our customers benefit from our services on-site.

► Concrete technological support

Concrete technology depends on various different parameters. Often, conditions change and the ones existing on the day of installing concrete differ from those existed during trials on previous days. Being aware of and considering these changing parameters is crucial, in order to, nevertheless, meet the defined requirements for the concrete. Take advantage out of a pool of experience of our concrete technologists and engineers in application technology. They support you on site in adjusting our admixtures according to the application and thus achieving the required properties of your concrete.

The network of certified concrete laboratories within the Ha-Be group of companies offers an additional benefit. It provides support for the mix design, test procedures for raw materials, fresh, and hardened concrete, as well as monitoring services and is thus an important guarantor for quality assurance.

► Benefit from the Tunnel-Team

You can rely on the expertise of our highly specialised working force for underground construction. The Ha-Be Tunnel Team consists of specialised concrete engineers and application engineers who develop proposals for concrete technology adaptation, application and procedure on international construction sites. Take advantage out of the know-how and experience gained from numerous renowned projects by our practice-proven specialists.

► Manufacture of construction materials suspensions

In underground construction areas, various different liquid materials, such as suspensions, dispersions, and slurries are required. All of them are having their own specific properties in order to meet the defined requirements. The most common types of powdery substances, however, are cement, bentonite, lime, gypsum, anhydrite filter dusts, and rock powder. Get the best out of them! It is our proven and long expertise that you can benefit from. We support you in developing recipes, selecting supplementary cementitious materials, and in the implementation of the industrial production of liquefied construction material. The industrial production, however, includes both, consulting in the design and selection of the systems as well as their adjustment and the efficient toll manufacturing on-site by our technical experts.

► Logistics, storage & dosage systems

Often, precious time is wasted with the procurement of material. Optimise your processes by reducing delivery times: We offer and maintain our own logistics service, representing real added value for our customers. By having an own transport fleet, we ensure that all our products are delivered on time and on-site.

For large-scale projects, you may also want to benefit from our storage and dosing systems: By supplying you with mobile systems on a rental basis, we also provide you with additional storage capacity on-site. These flexible storage systems are – as well as our dosing systems – adjustable, i.e. customised according to your specific project requirements. Thus, you ensure the permanent availability of required materials.

Ha-Be References

OUR INFRASTRUCTURE PROJECTS



SAADIYAT ISLAND BRIDGE, ABU DHABI

Photo: Perl GmbH



MOTORWAY A7 HAMBURG, GERMANY



SUEZ-CAIRO SERVICE ROAD, EGYPT



MOTORWAY S8, POLAND

Photo: BT Betontechnik GmbH



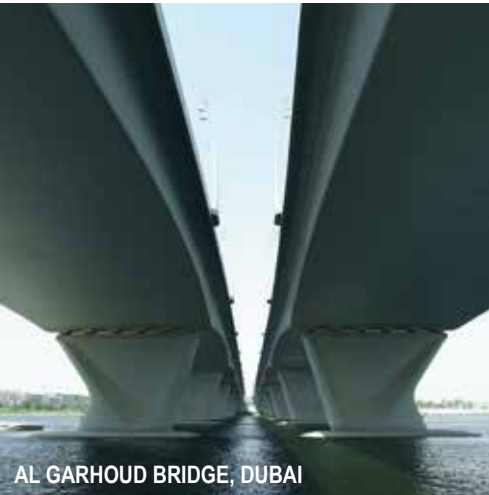
MOTORWAY A14 LUDWIGSLUST, GERMANY

Photo: Bickhardt Bau GmbH



MOTORWAY A2 BRANDENBURG, GERMANY

Photo: Bickhardt Bau GmbH



AL GARHOUD BRIDGE, DUBAI



BERLIN AIRPORT, GERMANY



CONSTANTA AIRPORT, ROMANIA

Photo: BT Betontechnik GmbH



RIGA AIRPORT, LATVIA

Photo: BT Betontechnik GmbH



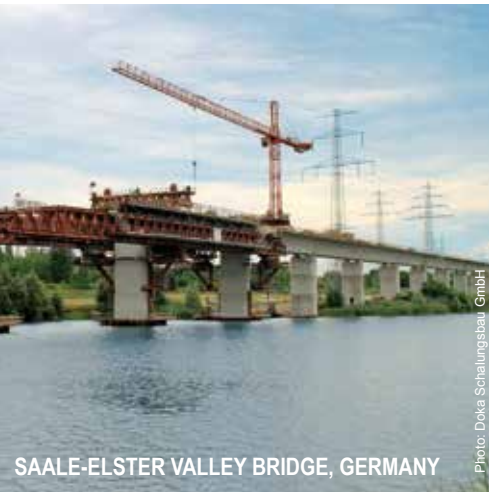
DÜSSELDORF AIRPORT, GERMANY

Photo: Wirgen GmbH



FRANKFURT AIRPORT, GERMANY

Photo: Fraport AG / Photo: S. Reischer



SAALE-ELSTER VALLEY BRIDGE, GERMANY

Photo: Doka Schalungbau GmbH



EMSCH SEWAGE CANAL, GERMANY

Photo: Gode Reum GmbH



CITYRINGEN KOPENHAGEN, DENMARK



BIBRA TUNNEL, GERMANY



GOLDEN LINE METRO DOHA, QATAR



CROSSRAIL C510, LONDON, ENGLAND

Photo: BAMV

Ha-Be Betonchemie GmbH

Stüvestraße 39 | 31785 Hameln | Germany | Phone: +49 (0) 5151 587-0 | Mail: info@ha-be.com | www.ha-be.com