Fact sheet

TOTAL PERFORMANCE CONTROL™ is a new concept for the ready-mix industry. Being so new, answers to some of the questions that users are likely to pose to understand the concept and its technology in greater detail are given below.

CONCEPT

What is the Total Performance Control concept?

The Total Performance Control concept ensures for the first time that ready-mix producers, contractors and engineers get a concrete that is of the same high quality as originally specified; starting from production at the batching plant, to the delivery and application into place, and followed by its hardening process. Utilizing Rheodynamic™ concrete it provides a concrete mix with exceptional placing characteristics and accelerated cement hydration for early strength development and high quality concrete. The Total Performance Control is based on recently developed nano technology, which builds up performances of concrete starting from the molecular interaction of polymers with cement. **Glenium® SKY** is a family of products derived directly from the Total Performance Control nano technology, based on new, specifically designed polymers, engineered and developed by the Degussa Group. The state-of-the-art technology of **Glenium® SKY** controls the two distinct features essential for high quality concrete: extended workability and low water/cement ratio.

What is the "nano technology" that is used in Total Performance Control concept and Glenium SKY?

Nano technology is the science that studies phenomena at nano meter scale. For example the study of the effect of a polymer on cement hydration is nano science and its application is nano technology. Nano technology makes it possible to start from the molecular interactions between polymers and cement to build up the desired performances in concrete. Formerly concrete performances were empirically obtained by trial and error.

What is the definition of Total Performance Control?

TOTAL includes the entire period of time in which the concrete is used: from its fresh to its hardened stage. **PERFORMANCE** stands for the physical properties of the concrete and **CONTROL** means the ability to easily and safely produce, place and achieve the required concrete according to specification.

Which products are used in the Total Performance Control concept?

For the implementation of the Total Performance Control concept the single component **Glenium SKY** superplasticizers are needed, providing the required water reduction and slump retention. When further stabilization is required and/or powder/aggregate ratio is not optimal, Glenium STREAM, as the viscosity-modifying admixture for the production of Rheodynamic concrete, might be added.

What does the word SKY mean in this context?

SKY stands for **S**ynthesis of **K**ey Performance and **Y**ield and is the acronym for our new generation Glenium admixture used in the ready-mix market (see ACE for precast). SKY also associates with ease of placement and unlimited potential.

What are the performances of GLENIUM SKY?

Glenium SKY has a water/cement reduction capability equal or better than Glenium 21/51 and slump retention equal or better than Glenium 27, both products being state-of-the-art in their fields of application.

How is the workability of concrete mixes affected by Glenium SKY?

Glenium SKY has been engineered to provide a concrete mix with exceptional workability. This is defined by a long working time even at high temperatures and a smooth, cohesive (non-sticky) behaviour.

How does Glenium SKY differ from other superplasticizers?

Traditional superplasticizers are based on polymers of melamine or naphthalene sulphonate and formaldehyde condensation. The dispersion effect is due to their adsorption on to the cement particles, imparting a negative charge that causes electrostatic repulsion between them and, therefore, dispersion. **Glenium SKY** is based on polycarboxylic ether polymers. Their dispersion effect is much higher than that of the polymers already mentioned and is caused by the combination of electrostatic repulsion and steric hindrance. Unlike other polycarboxylic or acrylic superplasticizers, **Glenium SKY** provides a unique and specific affinity and fit with cement.

What is the innovation of Glenium SKY as compared to Glenium?

Glenium SKY has been specially engineered for the ready-mix industry. Its particular molecular configuration allows its delayed adsorption onto the cement particles and disperses them efficiently. As compared to Glenium, less molecules are covered by the ettrignite lawn and thus are ineffective. As a result of this effect, it is possible to obtain a high quality concrete mix with accelerated strength development and extended workability without delayed setting characteristics.

BENEFITS

What are the benefits the ready-mix producer can obtain from the Total Performance Control concept?

- The benefits that the producer can obtain are manifold and include:
- Capability of delivering high quality concrete at any time to the job site – in place. This leads to more flexibility, safer delivery operations, fewer claims and a better reputation.
- Production of a concrete with low w/c ratio that meets EN 206-1 without loss of workability.
- Single technology/product for many application needs. The advantages are an optimised inventory, easier logistics and fewer investments in tanks and dispenser equipment.
- Cost savings through reduction of cement dosage or use of a lower class cement (e.g. 32.5 instead 42.5) and generally optimised mix-design.
- Better market position of ready-mix company through differentiation of its offer with a high value product.

What are the benefits the contractor / applicator can obtain from Total Performance Control concept?

The benefits that the contractor and/or applicator can obtain are manifold and include:

- Easier placing and faster strength development ensure labour savings, earlier form stripping/turnaround and overall improved economics.
- Improved concrete surfaces due to less sticky behaviour, higher quality concrete with extended workability.
- Guarantee to place the same concrete as specified and ordered from ready-mix plant.
- Fewer claims due to more versatile and forgiving concrete mix.
- If used in a site-mix operation, the same benefits as for the ready-mix producer.

What are the benefits the engineer can obtain from the Total Performance Control concept?

The benefits that the engineer can obtain are manifold and include:

- Insurances that concrete meets original specification
- . High quality concrete with better durability for extended service life, less maintenance/repair work and overall maximized economics.
- . Low water/cement ratio in combination with long workability provides a concrete suitable for applications with heavy reinforcement and/or thin sections.

What are the specific advantages of Rheodynamic concrete with Glenium SKY?

The advantages are numerous including economical, technical and social aspects that derive from the elimination of vibration and early strength development of the concrete. These advantages include:

- Reduction of labour costs. Faster placing rates with fewer people involved in the placement and consolidation of concrete.
- . Improved, homogeneous surface appearance for better aesthetics.
- . Homogenous concrete in the structure (no variation caused by differential or prolonged vibration and reinforcement congestion).
- . No need for skilled personnel
- . Complete filling of the forms thus avoiding costly and non-aesthetic repairs after de-molding.
- . Improved durability (due to the absence of vibration the “near surface” properties of the Rheodynamic concrete are similar to that of the “core”, which is usually more dense and less permeable to aggressive environments.
- . Decrease in loss of man-hours due to high frequency and intensity vibration related health issues (white fingers, cardiovascular ailments, etc.), which can affect workers.
- . Elimination of vibrating equipment and its maintenance and operating costs.

What are the benefits of Glenium SKY if I am interested only in workability retention?

You can exploit its powerful water reduction capability to decrease the quantity of cement needed to comply with strengths requirement.

MECHANISM OF ACTION

Does the Total Performance Control concept affect the nature of the cement hydration products?

No. The chemical nature and the morphology of the cement hydration products do not differ from that of concrete cured under normal conditions. The rate of strength development is accelerated purely because of the low water/cement ratio

What type of cement is normally used with the Total Performance Control concept?

The type and the amount of cement used depends on the specification, the strength requirements and the durability considerations. The most common cement used in the ready-mix industry in Europe is either CEM I 32.5 N or 42.5 N, meeting the requirements of EN 197-1. Also, CEM II /A-L 32.5 N and A-L 42.5 N are used when very high performances at early ages are not required or in the hot season (ambient temperatures above 25°C).

When can a ready-mix operator switch from cement type 42.5 to cement type 32.5?

If not explicitly specified, he may be able to switch from cement type CEM I 42.5 to CEM I 32.5 by using Glenium SKY, keeping the cement content unchanged from the same application with Glenium 27.

How does the cement content affect the performances of Glenium SKY?

Glenium SKY is a new and a powerful superplasticizer, which has a marked effect on the dispersion of the very fine particles in the concrete mix. Its dosage is based on the cement and fines content and, therefore, its performances are independent from the cement content, which in a concrete mix, controls the water cement ratio and, therefore, the strength. Typically, in ready-mix concrete applications, the cement content varies from 275 to 400 kg/m^3.

MIX-DESIGN AND COST CONSIDERATIONS

If the application requires stiff consistency concrete, can the Total Performance Control concept be applied?

In this case, all the advantages of the Total Performance Control concept, except those related to Rheodynamic concrete, are available to the producers. These include cost savings, higher strength development and faster stripping of forms.

Self-compacting concrete is already being used in the production; which other advantages can be obtained applying the Total Performance Control concept?

Rheodynamic concrete is more user friendly, safer, and easier to produce than the type of self-compacting concrete proposed by others. It attenuates the batch-to-batch variations of the constituent materials of the concrete mix, including the moisture content of the sand and the coarse aggregates. All other advantages of the Total Performance Control concept as stated under the points “BENEFITS” are still available.