

Products in Practice

Rheodynamic® Self-Consolidating Concrete

A Highly Workable and Stable Concrete Mixture



The Chemical Company



Self-consolidating concrete (SCC) was introduced to the concrete industry in the late 1980's. The use of SCC in the U.S. has been facilitated by third and fourth generation high-range water-reducing (HRWR) admixtures such as Rheobuild® and Glenium® admixtures that significantly increase concrete workability and fluidity.

SCC is characterized in terms of a measured slump flow of 18 - 26 inches (460 - 660 mm). SCC can be described as a very flowable concrete mixture that is able to fill every part and corner of formwork, even in the presence of dense reinforcement. As a result, SCC requires minimal or no vibration for proper consolidation.

For those situations where even more flowability and stability are required BASF Admixtures, Inc. has developed Rheodynamic Self-Consolidating Concrete (SCC) using a Glenium high-range water-reducing admixture and a Rheomac® VMA viscosity-modifying admixture to produce an ultra-stable form of SCC.

Rheodynamic SCC is different from conventional SCC because of the inherent high-fluidity, enhanced stability, and other unique properties of the mixture. Some of the characteristics of Rheodynamic SCC include:

- Slump flow of 18 to 30+ in. (460 to 760+ mm)
- Controlled rheology
- Mixture proportioning flexibility (high coarse aggregate contents)
- Reduced sensitivity to variations in aggregate gradations and mix water content
- Assured stability, non-segregating
- Self-consolidating without vibration
- Optimized surface appearance
- Excellent engineering properties
- Overall structural integrity

**Master
Builders**

Products In Practice: Rheodynamic® Self-Consolidating Concrete

When producing Rheodynamic SCC, Glenium® high-range water-reducing admixtures provide a high degree of workability with up to 40%+ water reduction potential with minimal retardation. Other benefits of using Glenium admixtures include linear water reduction performance, improved workability retention, better workability and finishability compared to conventional superplasticizers (especially at higher doses), and increased early and ultimate strengths.

Rheomac® VMA viscosity-modifying admixtures function by modifying the viscosity of Rheodynamic SCC and providing stability to the mixture with minimal or no loss of workability.

A service is available from BASF Admixtures, Inc. for proportioning Rheodynamic SCC mixtures. Trial mixes are essential to optimize SCC and Rheodynamic SCC mixtures.

Key Attributes

Two key attributes of Rheodynamic SCC are its high degree of workability and ability to remain stable (non-segregating) during and after placement, thereby maximizing the structural integrity and durability of concrete in place.

Workability: The workability of all SCC concrete mixtures is typically characterized by using ASTM C1611, "Slump Flow of Self-Consolidating Concrete." In this procedure, called the Slump Flow test, the concrete is not rodded after placement in the slump cone; and the spread of the concrete (slump flow) is measured instead of slump. The Slump Flow test measures the unconfined fluidity of the concrete and gives a relative indication of the degree to which concrete can travel.

Stability: Concrete stability is the ability of a concrete mixture to resist segregation of the paste from the aggregates. This is important both during and after concrete placement. The slump flow test method can provide a qualitative assessment of the stability of the concrete. The table to the right was developed to place a numerical value on stability. It is based upon a visual examination of the concrete after the flowing or movement has stopped. In general, a rating of 0 or 1 is desirable. Some applications may require a rating of 0 because concrete stability is key to a successful project.

*in-place cost of
the concrete will
actually decrease...*



Example of 26" Slump Flow from Rheodynamic SCC Mixtures (VSI Rating of 0-High Stable)

Visual Rating of Stability

Rating	Criteria
0	Highly Stable No evidence of segregation in slump flow or in mixer drum or wheelbarrow.
1	Stable No mortar halo or aggregate pile in the slump flow but some slight bleed or air popping on the surface of the concrete in the mixer drum or wheelbarrow.
2	Unstable A slight mortar halo (<10 mm) and/or aggregate pile in the slump flow and highly noticeable bleeding in the mixer drum and wheelbarrow.
3	Highly Unstable Clearly segregating by evidence of a large mortar halo (>10 mm) and/or a large aggregate pile in the center of the concrete spread and a thick layer of paste on the surface of the resting concrete in the mixer drum or wheelbarrow.

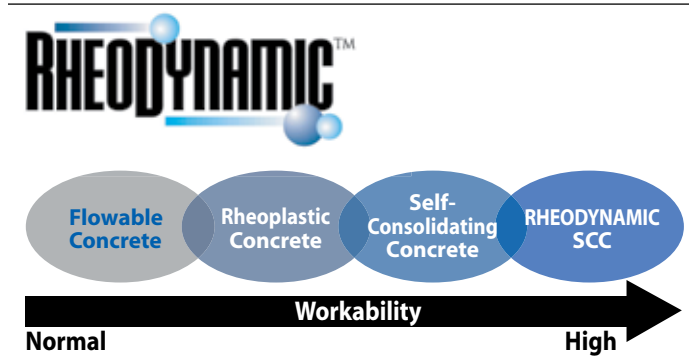
Plastic and Hardened Properties of Rheodynamic SCC

Plastic Properties: For Rheodynamic SCC mixtures, the spread and not the slump of the concrete is measured. The spread is generally between 18-30 inches (460-760 mm), however, the spread can be greater than 30 inches (760 mm). Because of its inherent stability, Rheodynamic SCC can be produced and placed at greater spreads than conventional SCC.

In general, the setting time for Rheodynamic SCC is relatively normal compared to that of conventional concrete, but it can be accelerated or retarded. The use of accelerating or retarding admixtures can be used to produce Rheodynamic SCC with the desired setting characteristics.

Products In Practice: Rheodynamic® Self-Consolidating Concrete

Rheodynamic SCC can also exhibit thixotropic properties when produced with Rheomac® VMA 450 admixture. A thixotropic characteristic means that the mixture will stiffen and become stable when at rest. If energy is applied, the mixture will become fluid again. This phenomenon will occur until the concrete is at the point where the mixture begins to stiffen due to hydration.



Degree of workability of Rheodynamic SCC relative to other types of concrete

Hardened Properties: The strength and durability of Rheodynamic SCC mixtures are similar or even slightly higher than those mixtures with the same cement content and water-cementitious materials ratio.

The drying shrinkage of Rheodynamic SCC is generally in, but not limited to, the range of 0.025 to 0.050 microstrain, which are typical values for most concrete mixtures. Like any other concrete exposed to water-saturated, cyclic freezing and thawing conditions, Rheodynamic SCC should be air-entrained to resist deterioration. As a result of its high fluidity, superior stability, and self-consolidating characteristics, the structural integrity of in-place Rheodynamic SCC is excellent.

What are the types of concrete?

Flowable Concrete is a concrete mixture with a slump up to 8 inches (210 mm). Flowable concrete allows for more rapid concrete placement compared to traditional low slump concrete mixtures. It works great in areas that are congested with rebar or other material. Vibration is required for adequate consolidation of these mixtures.

Rheoplastic Concrete is a flowable, stable concrete mixture with a slump of 8-11 inches (210-280 mm). Rheoplastic concrete may require some vibration for consolidation. Rheoplastic concrete incorporates Rheobuild® or Glenium®, high-range water-reducing admixtures that provide sufficient slump retention to allow for batch-plant addition.

Self-Consolidating Concrete (SCC) is a highly flowable concrete mixture that may require minimal to no vibration for consolidation. SCC can be produced with Rheobuild or Glenium high-range water-reducing admixtures along with an increase in fines content as well as other mixture proportion adjustments.

Rheodynamic SCC is the premier level of self-consolidating concrete. Rheodynamic SCC is produced using Glenium high-range water-reducing admixture technology and Rheomac viscosity-modifying admixture that enhances stability and maximizes the durability and structural integrity of concrete in-place. Rheodynamic SCC is self-consolidating without vibration.

Benefits

For precast/prestressed concrete producers, ready-mixed concrete producers, and contractors the following benefits are a result of the Rheodynamic SCC characteristics described earlier. SCC or Rheodynamic SCC will generally be more expensive than a traditional 6 in. (150 mm) slump concrete mixture. However, in most cases the in-place cost of the concrete will actually decrease because less manpower is required for placement, vibration, and rubbing; and patching and equipment cost (e.g. pumping, vibrators, truck turnaround) are reduced.

- Concrete placement savings through improved productivity
- Reduced noise due to the elimination of vibration
- Better consolidation around reinforcement and strand
- Improved/optimized surface appearances
- Improved working conditions and increased safety



Finished precast units using Rheodynamic SCC

Products In Practice: Rheodynamic® Self-Consolidating Concrete

Applications

Rheodynamic SCC can be used in virtually any concrete application, precast or cast-in-place.

Precast concrete products can be categorized as architectural, structural, or utility. Because every precast product has a different shape, level of intricacy, size, level of reinforcement, and coarse aggregate content, a different mixture may be necessary. Rheodynamic SCC has been used and is suitable for use in exposed-aggregate, intricate pieces, any structural applications [double-Tees, inverted-Tees, I-beams, columns, box beams, girders, etc.] vaults, culverts, and barrier precast applications.

Ready-mixed concrete applications can also benefit from the use of Rheodynamic SCC mixtures. Areas containing congested reinforcement such as columns, walls (exposed surfaces), and specialty applications like insulated concrete forms (ICF) are particularly challenging. Highly fluid, stable concrete mixtures permit faster placeability with minimal effort.

Like any other concrete mixture, a SCC mixture must be suitable for the application. For example, a 12 ft. (3.7 m) high wall would require different mixture proportions than a 4 in. (100 mm) slab because of an increased risk of segregation and bleeding and the need for controlled rheology. In this application, the use of Rheodynamic SCC instead of a conventional SCC mixture would be the appropriate choice because the Rheomac® VMA viscosity-modifying admixtures would minimize the high potential for segregation and provide the required stability.

More Information

For further information or assistance, contact your local BASF Admixtures, Inc. sales representative.

BASF Admixtures, Inc. is a leading provider of innovative chemical admixtures and silica fume for specialty concrete used in the ready mix, precast, manufactured concrete products, underground construction and paving markets in the United States and Canada. The Company's respected Master Builders brand products are used to improve the placing, pumping, finishing, appearance and performance characteristics of concrete.

www.basf-admixtures.com

United States 23700 Chagrin Boulevard, Cleveland, Ohio 44122-5544 ■ Tel: 800 628-9990 ■ Fax: 216 839-8821

Canada 1800 Clark Boulevard, Brampton, Ontario L6T 4M7 ■ Tel: 800 387-5862 ■ Fax: 905 792-0651

® Construction Research & Technology GMBH

© BASF Admixtures, Inc. 2006 ■ Printed in USA ■ 08/06 ■ LIT # 1021727

**Master
Builders**