

# CONCERA™ SA Series

## Rheology-modifying high range water reducer

### Introduction

The CONCERA™ SA Series is a patented, rheology-modifying, polycarboxylate-based (PC) ASTM C494 Type A and F high range water reducer (HRWR) that enables the production of Control Flow Concrete, a highly flowable concrete with minimal or no segregation using unmodified conventional mix designs. Control Flow Concrete typically have slump flow values in the 400 to 650mm range and may require minimal external energy to properly consolidate. CONCERA SA Series is a component of GCP Applied Technologies' Control Flow Concrete System and is typically used as a standalone HRWR. It does not need to be used with other mid- or high range water reducers. CONCERA SA Series imparts many desirable properties to Control Flow Concrete including segregation resistance, stability, improved passing and filling ability, excellent tolerance to moisture variation and extended slump life. CONCERA SA Series also produces concrete with consistent, predictable slump flow and air control properties. CONCERA SA Series typically has minimal impact on other concrete properties including early and later age compressive strength and drying shrinkage, while initial time of set and total bleed may slightly increase.

*ASTM C 1611-Standard Test Method for Slump Flow of Self-Compacting Concrete (SCC)* details a qualitative visual test procedure for measuring rheology, stability and segregation resistance properties of highly flowable concrete and SCC. Test procedure includes a visual inspection of the concrete spread after the slump flow test is completed. Visual inspection includes observing the distribution of coarse aggregate within the concrete spread and mortar fraction and bleeding characteristics around the perimeter of the spread. Finally, a Visual Stability Index (VSI) value is assigned to the concrete spread using 0-3 criteria as detailed below.

### Visual Stability Index Values

- **0 = HIGHLY STABLE** - No evidence of segregation or bleeding.
- **1 = STABLE** - No evidence of segregation and slight bleeding observed as a sheen on the concrete mass.
- **2 = UNSTABLE** - A slight mortar halo  $\leq$  10mm and/or aggregate pile in the center of the concrete mass.
- **3 = HIGHLY UNSTABLE** - Clearly segregating by evidence of a large mortar halo  $\geq$  10mm and/or a large aggregate pile in the center of the concrete mass.

A CONCERA SA8080 field test evaluation program using an array of 24.2-44.8 Mpa (3500-6500 psi) mix designs containing different types and quantities of cements, pozzolans and fine and coarse aggregates was conducted at several test sites in North America. The mix design and HRWR test matrix included:

- Conventional 200mm slump using polycarboxylate-based HRWR
- Highly flowable 400 to 650mm slump flow using polycarboxylate-based HRWR
- Control Flow Concrete 400 to 650mm slump flow using CONCERA SA8080 HRWR

**TABLE 1 - CONCERA™ SA8080 Field Test Results**

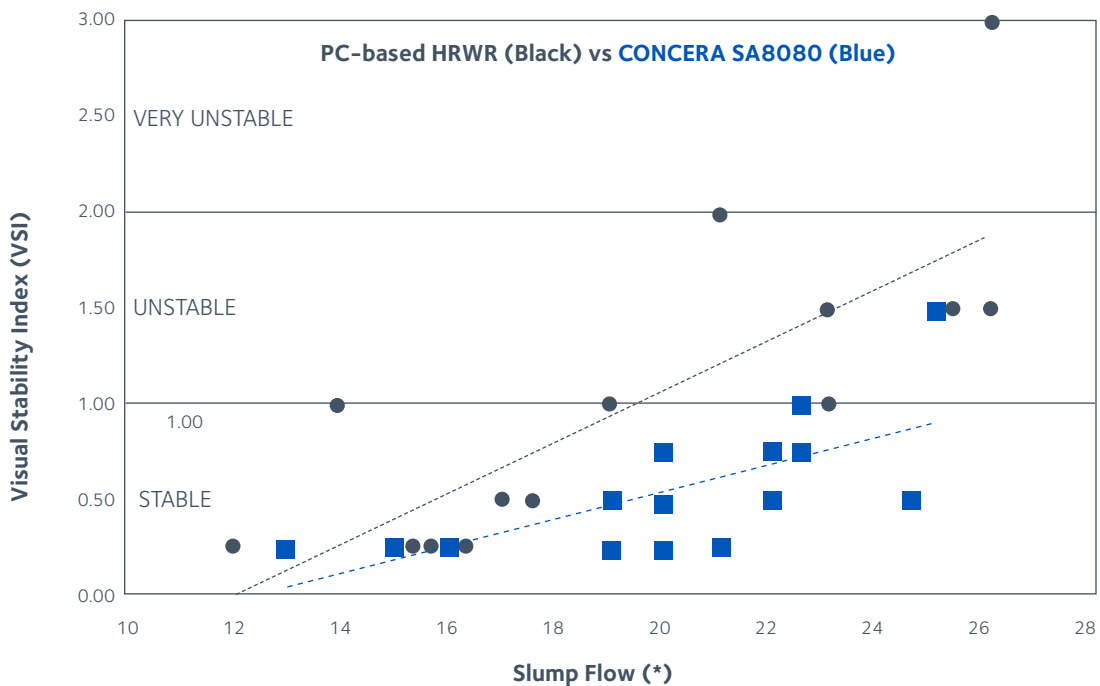
(Results below represent averages from 6 tests)

	Units	Conventional HRWR 200mm slump mix design	Conventional HRWR highly flowable 400-650mm slump mix design	CONCERA SA8080 highly flowable 400-650mm mix design
Conventional HRWR dosage rate	mL / 100kg	326	567	-
CONCERA SA8080 dosage rate	mL / 100kg	-	-	893
Initial slump/slump flow	mm	slump-206	597	569
Initial VSI (ranked 0-3)	0-3	(not applicable)	1.7	0.75
Initial VSI description	-	-	unstable	stable
60 minute slump flow	mm	(not tested)	376	457
60 minute VSI (ranked 0-3)	0-3	(not applicable)	0.45	0.4
60 minute VSI description	-	-	highly stable	highly stable
Initial plastic air	%	1.8	0.9	2.0
Initial time of set	(hr:min)	5:28	6:30	6:26
2/3 day comprehensive strength	Mpa (psi)	22.7 (3287)	23.6 (3428)	21.2 (3072)
7 day compressive strength	Mpa (psi)	30.9 (4475)	31.7 (4592)	29 (4206)
28 day compressive strength	Mpa (psi)	37.5 (5436)	37.3 (5410)	36.3 (5259)

**Table 1** above details summary of test results including initial slump flow, VSI, plastic air, initial time of set, early, 7, 28 day compressive strength along with 60 minute slump flow and VSI. Field test results clearly show CONCERA SA8080 produces highly flowable, stable, segregation-resistant concrete with excellent slump retention properties over 60 minutes and minimal impact on other pertinent plastic and hardened concrete properties.

**Figure 1** below further details polycarboxylate-based HRWR (black) and CONCERA SA8080 (blue) concretes visual stability index (VSI) values over a range of slump flows. CONCERA SA8080 concretes consistently show better (lower) visual stability index values when compared to highly flowable polycarboxylate-based HRWR concrete with all VSI's < 1. **Note:** ACI 237-Self Consolidating Concrete document states – A VSI rating <1 is an indication that the highly flowable concrete is stable. ACI 237 further states that VSI ratings are subjective and should be used primarily as a quality control tool, rather than as acceptance/rejection criteria for a specific mix design.

**Figure 1 - Slump Flow (") vs Visual Stability Index (0-3)**



When CONCERA™ SA8080 is added to a conventional off-the-shelf mix design, and additional incremental improvements to the overall rheology, segregation resistance, stability or other properties are desired, relatively minor and inexpensive mix design modifications can be made. Several of these mix design adjustments are detailed below, with implications related to making a specific adjustment detailed in parentheses. It is highly recommended CONCERA SA8080 Control Flow Concrete be tested prior to job startup using applicable mix designs and materials:

- Reduce total coarse aggregate content (increases drying shrinkage)
- Reduce nominal coarse aggregate size (increases drying shrinkage)
- Optimise coarse aggregate particle shape/angularity
- Optimise coarse aggregate gradation, avoid severely gap graded coarse aggregate
- Increase fine aggregate, reduce coarse aggregate content (water demand and shrinkage impact)
- Increase mortar and/or paste fraction (water demand and shrinkage impact)
- Slightly increase total cementitious content (cost increase)
- Incorporate or increase the percentage of fly ash in the mix design
- Reduce slump flow to low end of 400 to 650mm range (workability impact)
- Slightly increase plastic air content (strength impact)
- Slightly reduce water content, increase CONCERA SA8080 dosage rate

In summary, a widespread North America-based field test program confirmed CONCERA SA8080 enables the production of 400 to 650mm Control Flow Concrete with minimal or no segregation using typically unmodified conventional mix designs. CONCERA SA8080 imparts many other desirable properties to Control Flow Concrete including improved passing and filling ability, tolerance to moisture variation, consistent slump flow and slump flow properties and minimal impact on compressive strength and set time. Several minor mix design modifications can also be tested and implemented if additional improvements to overall rheology, stability and segregation resistance properties are desired.

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