# ASSOCIATE MEMBER WEBINAR SERIES – GCP APPLIED TECHNOLOGIES







### Facilitator







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CONCRE

- Approximately 40 minute webinar with Q & A at the end, followed by a Kahoot! Pop Quiz
- All participants are muted
- Questions? Use the GoToWebinar 'Questions' Pane
- Webinar will be recorded and posted on the Concrete Ontario website along with a PDF copy of the presentation.
- https://www.rmcao.org/publications/webinar-presentations/



### Presenter

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Senior Technical Specialist





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# **GCP** Applied Technologies

**Admixtures for Concrete** 

**Concrete Admixtures** 



A Construction Products Technologies Company N & PACKAGING

# **CONCERA**<sup>TM</sup>

Normal Concrete to Phenomenal Concrete



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#### What if there were a concrete that....

- Standard 25 45 MPa mix design
- Slump flow range of 400 to 600 mm
- Predictable slump-flows
- High slump flows without segregation
- Excellent flowability retention for more than 1 hour
- Superior moisture tolerance
- Minimal vibration required
- Fast pumping, rapid discharge
- Easier / faster placement and finish

**Conventional Mix Design with Unconventional Performance** 



## Concera<sup>™</sup> Admixtures for Control Flow Concrete



#### **Concera<sup>™</sup> Admixture for Control Flow Concrete**

- Concera admixtures enable the production of Control Flow Concrete, a segregation resistant high flow concrete using conventional mix designs
- **Control Flow Concrete** is new concrete category GCP introduced to help industry
  - Is conventional concrete with enhanced flow using Concera admixtures
  - <u>Is not</u> Self Consolidating Concrete with reduced flow
- Applications include horizontal slabs, elevated decks, vertical walls and columns
- Labor saving

Concera<sup>™</sup> Enables Production of Control Flow Concrete Using Conventional Mix Designs

# **CONCERA – Control Flow Concrete**

- Admixture(s) that enable ready mix producers to make cohesive concretes, which flow in a controlled manner, using conventional mix designs
- A high value concrete which delivers more value to producers and contractors vs. the standard
- Easier to produce consistently, and allows for faster construction with less labor to place
- Allows Ready Mix producers to provide a differentiated offering to their customers





#### New Concrete Category And New Product Solution

#### **Benefits and Advantages of Control Flow Concrete**

#### SIMPLE

- Conventional Mix
- No or Minimal Mix Design Adjustments

• Drop In



#### CONSISTENT

- Routine Quality
   Control
- Every Truck Same Quality
- High Flow & Workability



#### EASY

- Ease of Placement
- Ease of Finishability
- Increases
   Productivity



#### FAST

- High Quality
- Saves Project
   Time
- Environmentally Friendly



**Normal Mix - Admixtures Provide Flow and Stability** 

### **Materials and Mix Design**

Air	Water	Cement	Fin	e Aggregate		Coarse Aggr	egate	Conventional Concrete
Air	Water	Cement	Fir	ne Aggregate		Coarse Aggr	egate	Control Flow Concrete
Air	Water	Cemer	nt	Fine Aggre	egate	Coarse	Aggregate	Self- Consolidating Concrete
	Conventional Concrete slump: 180 mm w/c 0.42; with HRWR Control Flow Concrete slump-flow: 400-600 mm w/c 0.42; with HRWR + Control Flow Admixture							
		<u>Self C</u> slum <sub>l</sub> w/c 0	onsolidat o-flow > 6 .40; with					

#### **Performance Comparison Example**

	25 MPa +ready mix with HRWR (Conventional)	25+ MPa ready mix with Control Flow Admixture	Self Consolidating Concrete (SCC)					
Self-consolidating	No	Semi-consolidating	Yes					
Placement	Difficult	Easy	Easy					
Labor demand	High 🦊	Low	Low					
Segregation risk	Low	Low 👔	High 🦊					
Powder content	240-360 kg/m³ 1 🔒	240-360 kg/m³ 1	>420 kg/m³ 🛛 🗸					
Mix design adjustments	None	None or Minimal (robust to manufactured Sand)	Yes (high quality fine aggregates and Needs more powder)					
Moisture tolerance	Tolerant	Tolerant	Needs very close QC					
QC need	Routine	Routine	Extra effort					
Drying shrinkage	ОК	ОК	Higher					
Conventional Mix Design with Unconventional Performance								

### **CONCERA - Control Flow Concrete**

#### SIMPLE - CONSISTENT – EASY - FAST



Control Flow Concrete: <u>Is</u> conventional concrete with enhanced flow <u>Is not</u> SCC with reduced flow

#### **CONTROL FLOW CONCRETE**

- Conventional mixture designs taken to new performance levels
- Consistent high flowing concrete without segregation
- Improved flow around steel reinforcement
- Rapid discharge
- Fast pumping
- Easy placement & finishing
- Minimal vibration to consolidate
- Fast construction

# **CONCERA - Consistent Production**

Enables production of high flowing conventional concrete without segregation

- Excellent rheology control
- Excellent water tolerance
- Conventional mixes
  - *Simple*, Established mixture designs
  - **Consistent** performance day in and day out
  - *Easy* to place high flow concrete requires minimal vibration
  - Faster construction with no QC-related delays
- Increase profitability



#### **Concera™ Admixtures for Control Flow Concrete**

 Ready mix producers to differentiate with higher performing concrete versus standard. Contractors to reduce labor and equipment costs with nets savings of 10 to 20%



**Concera™ Allows Ready Mix Producers to Add Incremental Value to Contractors** 

### **CONCERA – Residential & Commercial**





- Segregation Resistance
- Cohesive Mixes
- Conventional Mix Designs

- Fast Construction
- Labor / Equipment Savings
- Impact Bottom Line

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# Concera Performance



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### **Concera In Action**

- •Concrete on left with Concera poured 1.5 hours before the one right
  - Concera helps in finishing
  - •On the right concrete bled out quickly, excessive initial bleed and began to crust
  - •One on the left is still workable after 1.5 hours



#### It is Windy



- Concrete he is finishing
  - is still workable even in heavy wind
  - Concera helps retain moisture and finishing

#### **CONCERA**

.



#### **Concera In Action**



# **CONCERA Admixtures**

#### **CONCERA CP 1124**

- ASTM C494 type A, used in conjunction with mid range or high range water reducer
- Takes concrete which has a staring slump of 125 mm to 200 mm to "400 600 mm" slump-flow concrete
- Formulated with latest best in class rheology modifying agents
- Superior tolerance to moisture fluctuations
- Can be used with non air and air entrained concrete
- Advantages Conventional
  - Lower Material cost, uses conventional mix designs instead of specialized mix proportions
  - Superior moisture tolerance, Segregation resistant
  - Minimizes aggregate blocking through congested reinforcement
  - Formulated with the latest rheology modifying technology
  - Faster discharge, high flowability and easier finishing

# **CONCERA Admixtures**

#### **CONCERA SA8080**

- Stand-alone product, does not need any additional water reducing admixtures
- ASTM C494 Type F, can be used as a conventional HRWR
- Takes "untreated" typical 75 100 mm slump concrete to "400 600 mm" slump-flow concrete
- Can be used in air entrained or non-air entrained concrete

#### **Advantages**

- Lower Material cost, uses conventional mix designs instead of specialized mix proportions
- Superior moisture tolerance, Segregation resistant
- Minimizes aggregate blocking through congested reinforcement
- Formulated with the latest rheology modifying technology
- Faster discharge, high flowability and easier finishing

# Shrinkage Reduction



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# CIPS

### Shrinkage Reducing Admixture

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#### **All Concrete Cracks!**



# Why didn't this floor crack?



#### Many ways for Concrete to Crack

- Concrete is:
  - fundamentally weak in tension
  - relatively high stiffness
  - > usually restrained from movement, and
  - Iots of different effects cause it to want to move:
    - Plastic Shrinkage
    - □ Thermal movements (early thermal shock, seasonal)
    - □ Structural (reflective, settlement) [gravity and service loads]
    - □ Corrosion, ASR, DEF, Carbonation,
    - □ Autogenous Shrinkage
    - Drying Shrinkage

#### **Causes of Cracks**



#### **Concrete shrinks and cracks because**



- Even after hydration, concrete is a porous material
- Concrete has more water then required for hydration
- Loss of this excess water from concrete as it hardens results in volume reduction



#### Let's take a microscopic look

- Pores lose water due to hydration and evaporation
- As pores become less than fully saturated, menisci forms at the air-water interface due to surface tension
- The surface tension of pore solution which forms menisci also exerts inward pulling force on the side walls of the pore
- These forces, in all pores, in the range of 2.5 to 50 nm is the primary cause of shrinkage



### It's all the meniscus' fault !

### Shrinkage – Timing and Size Effect (ACI209)



#### **How Eclipse Works**

#### It reduces the surface tension



Reducing 28 day shrinkage typically 40-60%

#### Reducing ultimate shrinkage typically 30-50 %

#### Curling

• "Curling is caused by drying shrinkage and by negative moisture or temperature gradients across the thickness of the slab"



R. Yetterberg, Concrete International

#### **Curling's Impact on Cracking**



#### **Eclipse Product Line**

- Eclipse 4500
  - For air entrained or non air applications
- Eclipse Floor 200
  - For non air entrained concrete
- If you have a non air entrained project you can use either product.
- If you have an air entrained project Only Use Eclipse 4500

#### What Applications Are Common With Eclipse?

- Large Slabs
  - Slab on Grade, Elevated Slabs
- Specified
- To Meet Shrinkage Specifications
- Low Shrinkage Grout
- Water Treatment Facilities





#### **Applications**

- Topping Slabs
- > Moisture concerns in slabs will require a vapor barrier
  - $\hfill\square$  Concerns of curling
- Concerns of drying shrinkage cracking
- ➤ "we want a good looking slab"
- > Meeting a shrinkage specification



#### **Eclipse Summary**

- Eclipse addresses demands for crack reduction performance in concrete
  - > present new offering for value-added concrete for flooring market
- Represents a major value offering to owner's
  - reduced jointing
  - Iower first cost
  - Iower life-cycle cost



#### **Eclipse Summary**

- Several hundred shrinkage data points have been collected from producers utilizing a wide array of materials/mix designs
- By incorporating Eclipse into the mixture you can expect:
  - Significant reduction in drying shrinkage
  - Reductions in cracks caused by drying shrinkage
  - Reductions in curling

### **Rheology Modifier**®



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# VMA What are they and How do they Improve my Concrete.

- Rheology and it's importance
- Viscosity Modifiers:
- VMA Applications and Why
  - SCC
  - Pumping
  - Anti-washout
  - RCC
  - Improve use of borderline aggregates
  - Improved Product Finish

# **Rheology**\*

- "The science dealing with flow of materials, including studies of deformation of hardened concrete, the handling and placing of freshly mixed concrete, and the behavior of slurries, pastes, and the like."
- \*Cement and Concrete Terminology, ACI Publication SP-19

# Viscosity\*:

- "The property of a material which resists change in the shape or arrangement of its elements during flow, and the measure thereof."
- \*Cement and Concrete Terminology, ACI Publication SP-19

# 'Thixotrophic' behavior

- Thixotrophy is the tendency of a material to act as a semi-solid (gel) at rest and a fluid while in motion.
  - A material is said to have thixotrophic properties when it exhibits a decrease in viscosity with time when the material is subjected to a constant shearing stress.

# VMAR 3 Performance



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#### V-MAR 3: Concrete Rheology Modifying Admixture

- Meets ASTM C 494 Type S –(Specific Performance)
- V-MAR 3 has, and can be successfully used, in an array of applications including
  - Self-Consolidating concrete (rheology, moisture tolerance improvements)
  - Pumped and extruded concrete (pump pressure reduction)
  - Underwater concrete (anti-wash out)
  - Mix designs using harsh/manufactured fine aggregate (finishability)







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#### V-MAR 3: Self-Consolidating Concrete

- V-MAR 3 mechanism involves increasing viscosity while maintaining the flowability properties of the concrete
- V-MAR 3 benefits/attributes when used in SCC
  - > Overall easier production of quality SCC
  - Minimizes segregation and blocking
  - Minimizes negative impact of poor water control
  - Enhances surface appearance
  - > Allows for mix design flexibility and optimization
  - Enables use of not always optimal aggregates (borderline gradation)
  - Controls bleeding

#### V-MAR 3: SCC and Rheology



VMAR-3 can improve moisture tolerance when necessaryHowever, may need increased HRWR to achieve desired flow.



#### V-MAR 3: When to Incorporate it into an SCC Mix

- V-MAR 3 dosage rate(s) should be determined by conducting trial mixes
  - Current mix design is showing some level of segregation
  - > You would like to pour at higher slump flow (ie >600 mm)
  - Plant has difficulties controlling batch to batch water contents
  - Poor or borderline aggregate gradations
  - Inconsistent aggregates and/or aggregate gradations
  - Hardened concrete surface appearance improvements desired
  - Bleed rate reductions
  - Improved "blocking" characteristics
  - > Mix design optimization (ie slight reductions in cementitious contents)
- ANY OTHERS ?????

#### **Effects of VMAs Under Applied Energy**



#### Large polymer structure of the VMA align in the direction of the applied energy (flow) and allow paste to lubricate coarse, angular sand particles reducing internal friction.

#### V-MAR 3: Pumping Concrete

- The inclusion of V-MAR 3 into a mix design results in improved pumpability that will reduce pump pressures by 25-75%.
  - This is achieved by polymer chain alignment under energy resulting in reduced viscosity when pumping
- V-MAR 3 use in pumped concrete
  - > Will readily allow mix designs containing coarse, harsh fine aggregates to be pumped
  - > Reduction in pump pressures thereby minimizing "wear and tear" on pump equipment.
  - ➤ The concrete "acts" like it has an extra cement
  - > Mix design optimization reduce cementitious content
- V-MAR 3 has and can be successfully used throughout NA to enhance the pumpability of concrete.

#### **V-MAR 3: Pumping Concrete**



#### V-MAR 3: Underwater Concrete (Anti-wash out)

- V-MAR 3 benefits/attributes when used in underwater concrete include:
  - > Overall easier production of quality underwater concrete
  - Dramatically reduces mortar washout
  - Provides concrete stability underwater
  - Reduces segregation
- V-MAR 3 has been successfully used in many NA underwater concrete applications

#### V-MAR 3: Harsh and/or Manufactured Fine Aggregate

- V-MAR 3 imparts improved finishability in mix designs containing harsh/ manufactured sands
  - Achieved by polymer chain alignment under energy resulting in reduced viscosity when finishing
- An excellent use of V-MAR 3 with harsh/manufactured sands
  - Due to a shortage of quality natural sands, many concrete producers are being forced to use often angular harsh manufactured sands that are difficult to finish in many cases.
  - > Manufactured sand is readily available and cheaper!
  - Some producers are blending natural/manufactured sands in various ratios (ie 60/40, 80/20)
  - V-MAR 3 enables producers to use more and higher ratios of less expensive manufactured sands in many mix designs, included those that require finishing (flatwork)
- V-MAR 3 has and can be successfully used throughout NA to improve the finishability of mix designs containing harsh/manufactured sands

# VMAR F-100 Performance



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#### **V-MAR F100: Description and Advantages**

#### **Product Description**

- V-MAR F100 is a high efficiency, rheology-modifying liquid admixture. The use of V-MAR F100 admixture imparts lubricity to the concrete resulting in increased productivity, and concrete with improved surface texture.
- Conventional slump concrete, SCC.
- Very effective in zero slump and low slump concrete applications like concrete pipe, extrusion, paving, slip form concrete

#### **Advantages**

- Increased productivity through higher throughput
- Concrete moves easier and faster through machinery
- Improved paste creaminess and enhanced finishability
- Concrete consolidates with reduced vibration
- Provides superior water tolerance to the concrete making it less susceptible to normal manufacturing moisture fluctuations
- Facilitates the use of angular aggregates and/or manufactured sands in concrete
- Produces finishes with a noticeable reduction in surface defects
- Concrete requires less cement to close surfaces, resulting in lower material costs

#### V-MAR F100: Benefits

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- Rheology modifier acting as a lubricant:
  - Flows more readily at low shear rates, without vibration (SCC, paving, truck discharge, poorly shaped aggregates)
- Improve extrusion and surface texture (creamier with more body than V-MAR 3)



- Mix lubricityCohesive without being sticky
- Less clumping and lumps
- Improved surface finishes
- Even flows from the mixer

   up the belts out of the hopper and into the
- machinery
- Less sticking in the chutes
- Wide window of water flexibility
- No effect on water contents
- Generates more paste potentially reduce cement content
- Able to use less than optimum sand and stone

   especially if added
   cement is used to enable

Moisture retention aids curing
Higher strengths through better curing, lower air contents
Less cracking / moisture retention
Better surface finish, swipe/webbing
More paste on surface, generally less bugholes

Benefits

crete

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- Crisper edges
- Pallets and headers remove easier
- Fewer defects

#### V-MAR F100: PreCast/Pre-Stressed

• Used in SCC to reduce/eliminate "bugholes" in the formed finish



#### V-MAR F100: Barrier Rail





A RMX producer was struggling to produce quality slip formed barrier rail, requiring a considerable amount of hand work to be performed behind the machine. In addition, the mix was difficult to discharge from the mixer.



#### V-MAR F100: Curb

This Contractor typically placed the curb at a 25 mm slump resulting in a wavy surface.



#### V-MAR F100: Curb



#### **GCP's VMA products:**

#### V-MAR 3

- Flatwork with coarse or manufactured sand
- Flowing concrete
- Curb and Gutter mixes with manufactured sand
- Stabilize grout mixes
- Pumpable flowable fill mixes
- Stabilize entrained air in high flow/ SCC mixes

#### V-MAR F100

- Drycast products Pipe, Manholes, etc
- Hollowcore
- SCC mixtures to reduce bug holes
- High cementitious content, low water content mixes; making it easier to discharge & place
- Flatwork with coarse or manufactured sand
- Curb & Gutter/Barrier wall mixes with manufactured sand

### Questions?







### **Concrete Ontario Pop Quiz**

Please use your smart phone to access the following website:

www.kahoot.it

- Please enter the Game "Pin" that will be shown on the screen shortly
- Enter both your email address (so we can send you a prize if you finish in the top three) and your "Nick Name" (please think of your HR department and don't use something you will regret!)
- The faster you answer each question the more points you can earn for correct answers



Build to



### **Concrete Ontario Pop Quiz**

Amazon Gift Cards for Today's Competition

- First Place = \$150
- Second Place = \$100
- Third Place = \$50

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### **Next Webinar**

- Join us on July 22<sup>nd</sup>, 2021 at 10:00 am – 11:00 am
- Carbon Cure Reducing Embodied Carbon Through the Use of Mineralized CO<sub>2</sub>

# CARBON CURE

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### Thank you!

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![](_page_69_Picture_3.jpeg)