



American Concrete Institute®  
Advancing concrete knowledge

## Innovations in Chemical Admixture Technology as Related to Sustainability, Part 2

ACI Spring 2012 Convention  
March 18 – 21, Dallas, TX



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### Hydration-Controlling Admixture Technology Provides Sustainable Concrete Performance For 25 Years



Joseph A. Daczko  
Product Manager  
BASF

### Presentation Overview



- Concrete Industry Challenges
- Hydration-Controlling Admixture
- Why HCA is a Sustainable Technology
- HCA Applications, Financial and Environmental Impact Examples
- Innovative HCA Value Calculator, Economic and Sustainability Reports
- Take Away Messages



### Concrete Industry Challenges



#### Returned Plastic Concrete

- Estimated 2% to 10% of all concrete produced is returned to the plant
- 2011 concrete production = 263M yd<sup>3</sup> (201M m<sup>3</sup>)
  - 5% return rate = 13.1M yd<sup>3</sup> (10.0M m<sup>3</sup>)



#### Financial Impact

- R/M plant with annual production of 38K yd<sup>3</sup> (29K m<sup>3</sup>)
  - 5% return rate = 1,900 yd<sup>3</sup> (1,453 m<sup>3</sup>)
- Materials cost of \$53 per yd<sup>3</sup>
  - Annual materials cost of \$100,700
  - Concrete waste recycle opportunity



### Concrete Industry Challenges



#### Concrete Washwater

- Typically at the end of each work day, 225 gallons (850 L) of water are used to clean out each truck drum
- Example:
  - Plant with 10 concrete trucks
  - 240 working days per year
  - Disposal of 540K gallons (2.0M L) of washwater
  - Disposal of 720 tons (655 mt) of residue waste



#### Financial Impact

- Solid waste residue is equivalent to batching 360 yd<sup>3</sup> (275 m<sup>3</sup>) of fresh concrete
- Materials cost of \$53 per yd<sup>3</sup>
  - Annual materials cost of \$19,080
  - Concrete washwater and solid waste residue recycle opportunity




## Innovative HCA Technology

(Addressing Concrete Industry Challenges)


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### Hydration-Controlling Admixture

- Technology originally developed in 1986
- Ready-mixed concrete producer idea
- Chemistry controls (stops) cement hydration
- Seven current HCA applications:
  - Same day stabilization of returned plastic concrete
  - Overnight/weekend stabilization of washwater
  - Long-haul stabilization of fresh concrete
  - Extended set time control of conventional concrete, preserving fresh concrete during truck breakdowns and job delays, pervious concrete and "400 psi flex in 4 hours" Concrete (high-early strength)



**Twenty-Five Years of Industry Experience**  
Seven patents issued on HCA technology



## Why HCA is a Sustainable Technology

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### HCA Technology Reduces:

- Returned concrete waste
- Water needed to clean truck drums
- Concrete washwater waste
- HCA Value Calculator:**
  - Determines the value of using HCA technology in one or more applications as a sustainable concrete practice
  - Creates economic and sustainability reports
  - Calculates environmental impact savings using Eco-Efficiency Analysis





## How do you Measure Ecological Benefits?

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### Eco-Efficiency Analysis

Strategic life cycle method used to compare the relative ecological and economic efficiencies of alternative

- products (like concrete)
- processes
- technologies

ISO 14040 (ecological part)

- Cradle-to-gate
- Cradle-to-grave
- Cradle-to-cradle






## Environmental Impact Categories

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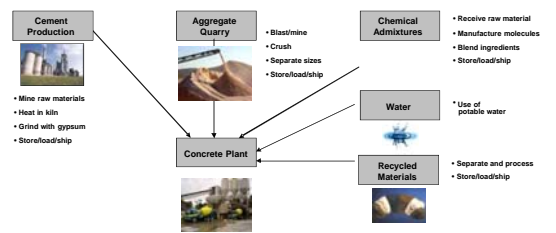
Consumption of Energy	Emissions	Toxicity Potential	Risk Potential	Consumption of Raw Materials	Land Use
<ul style="list-style-type: none"> <li>Cumulative energy utilized in the cradle-to-gate analysis</li> <li>Fossil and renewable resources are included</li> </ul>	<ul style="list-style-type: none"> <li>Described by categories:               <ul style="list-style-type: none"> <li>Air</li> <li>Water</li> <li>Solids</li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>Potential effect on human health toxicity</li> </ul>	<ul style="list-style-type: none"> <li>Potential for physical hazard (accident and occupational disease)</li> <li>Based on published statistical data</li> </ul>	<ul style="list-style-type: none"> <li>Materials are weighed according to reserves and global consumption</li> </ul>	<ul style="list-style-type: none"> <li>Degree of land development needed to fulfill the production of concrete</li> </ul>

Global Warming Potential  
Ozone Depletion Potential  
Photochemical Ozone Creation Potential  
Acidification Potential

## Eco-Efficiency Analysis for Concrete

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- EEA calculates and adds environmental data for each raw material to determine impact per yd<sup>3</sup>.
- Returned concrete and washwater is preserved using HCA can then be recycled.
- Environmental impact of recycling can be measured.

## HCA Application

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### Same Day Concrete Stabilization

- With HCA technology, stabilize returned plastic concrete in a truck drum for a short time period (30 minutes to 4 hours)
- Use the combination of recycled and fresh concrete in non-critical project applications
- Concrete Producer Value:**
  - Reduced concrete waste and disposal costs

### Example: Concrete Stabilization

**Financial Impact:**

- Reduces returned concrete waste, disposal costs and batching of fresh concrete
  - 2011 production = 38K yd<sup>3</sup> (29K m<sup>3</sup>)
  - 5% return rate = 1,900 yd<sup>3</sup> (1,453 m<sup>3</sup>)
  - Materials cost of \$53 per yd<sup>3</sup>
  - Annual materials cost = \$100,700
- Typical HCA dosage = 7 fl oz/cwt (455 mL/100kg)
  - Typical HCA treated cost per year = \$7,032
- Net annual material savings = \$93,668

**Environmental Impact:**

- 5% return rate = 1,900 yd<sup>3</sup> (1,453 m<sup>3</sup>)
  - Equivalent concrete waste = 3,800 tons (3,455 mt)
- Same day concrete stabilization application recycles waste

**Annual Savings:**

- 1,253,056 kWh (4,511,001 MJ) of energy
  - Power for 108 U.S. homes
- 1,159,363 lb (526,983 kg) CO<sub>2</sub>
  - 61,019 gal (230,957 L) of gasoline
- 165,426 lb (75,194 kg) solid waste
  - Waste equivalent to 33,085 people

### HCA Application

#### Concrete Washwater Stabilization

- With HCA technology, stabilize concrete washwater in a truck drum for a long time period (overnight or over a weekend)
- Use recycled washwater as part of the mix water in freshly batched concrete
- Concrete Producer Value:
  - Reduced washwater waste and disposal costs





### Example: Washwater Stabilization

**Financial Impact:**

- Reduces water to clean truck drums, concrete washwater waste and disposal costs
  - 10 trucks using 225 gallons (850 L)
  - 360 yd<sup>3</sup> (275 m<sup>3</sup>) concrete residue
  - Materials cost of \$53 per yard<sup>3</sup>
  - Annual materials cost of \$19,080
- Typical HCA overnight and weekend dosage = 32 fl oz (0.95 L) and 64 fl oz (1.9 L) per truck
  - Typical HCA treated cost per year = \$8,640
- Net annual cost savings = \$10,440

**Environmental Impact:**

- Overnight washwater stabilization application recycles residual waste
- 10 trucks = 540K gal (2.0M L) of water
  - Concrete waste = 720 tons (653 mt)


**Annual Water Savings:**


- 420K gal (1.6m L of washout water) Equivalent to:
  - Washing out 1,867 truck drums
  - 37,793 showers
  - 3.6M 1/2 L bottles of drinking water

### HCA Application

#### Long-Haul Concrete Stabilization

- With HCA technology, stabilize fresh plastic concrete in a truck drum for a specific time period (generally 3 to 10 hours)
- Concrete Producer Value:
  - Increased revenues from having an expanded ready-mixed concrete delivery zone
  - Reduced labor and material costs for constructing a portable concrete batch plant





Zone A < 10 miles  
Zone B = 10 - 25 miles  
Zone C > 25 miles

### Additional HCA Applications

#### Extended Set Time Control

- With HCA technology, extend concrete set time for a few minutes or hours as needed on a given project
  - Conventional concrete subjected to higher ambient temperatures
  - Truck breakdowns and job delays
  - Pervious concrete
  - High-early strength concrete (400 psi flex in 4 hours)








### Innovative HCA Value Calculator

#### Hydration-Controlling Admixture Same-Day Stabilization Application

Inputs	Conventional	HCA Treated
Number of Plants	1	
Annual Production (yd <sup>3</sup> )	38,000	38,000
Annual Returned Concrete (yd <sup>3</sup> )	1,900	1,900
Annual Returned Concrete (%)	5%	
Working Days Per Year	240	
Daily Returned Concrete (yd <sup>3</sup> )	8	8
Concrete Materials Cost (\$/yd <sup>3</sup> )	\$53.00	
Potential Increased Annual Savings (\$)		\$100,700
Daily Savings (\$)		\$420
HCA Cost (gal)	\$12.00	
Average Cementitious Content (lb/yd <sup>3</sup> )	564	
HCA Stabilization Dosage (#/out/cwt)	7.0	
HCA Stabilization Dosage (#/out/yd <sup>3</sup> )	39	
HCA Cost per Day (\$)	\$0.00	\$29.30
Annual HCA Cost (\$)	\$0.00	\$7,032.38
Additional Net Material Savings per Day (\$)		\$390
Annual Net Material Savings per Plant (\$)		\$93,668
Annual Net Material Savings per Year (\$)		\$93,668



# Economic and Sustainability Report



12-Jul-11

**Executive Summary**  
**Hydration Controlling Admixture Value Forecast**

Prepared for: **Ryan Ready Mix**  
Location: **Cleveland, OH**

Financial	Application	Value	
Track Down Clearing	Wastewater	\$5,895	Net Cost Savings
Retained Plastic Concrete	Same-Day Stabilization	\$93,668	Net Material Savings
Expanded Delivery Zone	Long Haul	\$124,784	Net Revenue Increase
		<b>Annual Benefit (\$)</b>	<b>\$227,350</b>

**Environmental: Washwater and Same Day Applications**

Environmental Parameter	Actual Usage	Partial Equivalent	Value Savings
Energy (Btu)	1,213,076	Number of Vehicles - Energy Tank	188
Gas Consumption (lb)	133,724	Number of Gallons of Gas Tank	\$1,819
Fossil Fuel Consumption (lb)	65,743	Water Tank - Diesel Equivalent	\$2,761
Water (Btu eq)	5,116,263	Water Tank - Truck Washout Equivalent	3,893
POCP (lb. Washout eq)	132	Water Tank - 111, 800 Water Equivalent	3,561,473
AP (lb. SO <sub>2</sub> eq)	60,324	Number of AC Cans Used	69
Global Warming (lb)	729,205	Number of Pavers - Cold Water Tank	33,885
Solid Waste (lb)	183,420		
SO <sub>2</sub> (lb. eq)	364,207		

Water = Global Warming Potential  
POCP = Photochemical Oxidant Creation Potential (summer usage)  
AP = Acidification Potential (acid rain)



# Take Away Messages



## Hydration Controlling-Admixture Technology

- HCA chemistry controls cement hydration
  - Allows recycling of concrete and washwater
  - Seven applications for concrete producers
  - Twenty-five years of industry experience
- HCA Value Calculator:
  - Creates economic and sustainability reports
  - Calculates environmental impact savings
- HCA technology helps concrete producers:
  - Manage concrete and washwater waste streams
  - Increase plant operational efficiency

