



American Concrete Institute®
Advancing concrete knowledge

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

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



Joseph A. Daczko
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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 yd³ (201M m³)
 - 5% return rate = 13.1M yd³ (10.0M m³)



Financial Impact

- R/M plant with annual production of 38K yd³ (29K m³)
 - 5% return rate = 1,900 yd³ (1,453 m³)
- Materials cost of \$53 per yd³
 - 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 yd³ (275 m³) of fresh concrete
- Materials cost of \$53 per yd³
 - Annual materials cost of \$19,080
 - Concrete washwater and solid waste residue recycle opportunity



Innovative HCA Technology (Addressing Concrete Industry Challenges)



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



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?



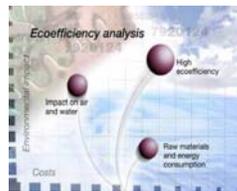
Eco-Efficiency Analysis

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

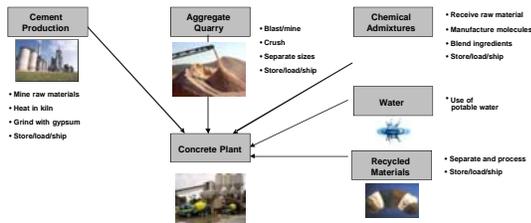


Consumption of Energy	Emissions	Toxicity Potential	Risk Potential	Consumption of Raw Materials	Land Use
• Cumulative energy utilized in the cradle-to-gate analysis • Fossil and renewable resources are included	• Described by categories - Air - Water - Solids	• Potential effect on human health toxicity	• Potential for physical hazard (accident and occupational disease) • Based on published statistical data	• Materials are weighed according to reserves and global consumption	• Degree of land development needed to fulfill the production of concrete

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



Eco-Efficiency Analysis for Concrete



1. EEA calculates and adds environmental data for each raw material to determine impact per yd³.
2. Returned concrete and washwater is preserved using HCA can then be recycled.
3. Environmental impact of recycling can be measured.

HCA Application



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 yd³ (29K m³)
 - 5% return rate = 1,900 yd³ (1,453 m³)
 - Materials cost of \$53 per yd³
 - 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 yd³ (1,453 m³)
 - 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) CO₂
 - 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 yd³ (275 m³) concrete residue
 - Materials cost of \$53 per yard³
 - 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 ³)	38,000	38,000	38,000
Annual Returned Concrete (yd ³)	1,900	1,900	1,900
Annual Returned Concrete (%)	5%		
Working Days Per Year	240		
Daily Returned Concrete (yd ³)	8	8	8
Concrete Materials Cost (\$/yd ³)	\$53.00		
Potential Increased Annual Savings (\$)		****	\$100,700
Daily Savings (\$)		****	\$420
HCA Cost (gal)	\$12.00		
Average Cementitious Content (lb/yd ³)	564		
HCA Stabilization Dosage (#/out/cwt)	7.0		
HCA Cost per Day (\$)	30	\$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

Impact of Hydration-Controlling Admixture On Sustainability and Profitability



Ryan Ready Mix Cleveland, OH

Economic and Sustainability Report



12-Jul-11

Executive Summary
Hydration Controlling Admixture Value Forecast

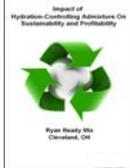
Prepared for: **Ryan Ready Mix**
Location: **Cleveland, OH**

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
		Annual Benefit (\$)	\$227,350

Environmental: Washwater and Same Day Applications

Environmental Parameter	Actual Usage	Partial Equivalents	Value Savings
Energy (Btu)	1,213,076	Number of Vehicles - Energy Tank	188
Gas Consumption (lb)	133,724	Number of Gallons of Gas Tank	\$1,919
Fossil Fuel Consumption (lb)	65,743	Water Tank - Diesel Equivalent	\$2,701
Water (lb) (Gals)	5,116,263	Water Tank - Truck Washout Equivalent	3,893
POCP (lb) (Waters)	132	Water Tank - 111, 800 Water Equivalent	3,561,473
AP (lb) (SO ₂)	60,324	Number of AC Cans Used	698
Global Warming (lb)	729,205	Number of Pavers - Cold Water Tank	33,885
Solid Waste (lb)	183,420		
SO ₂ (lb) (lb)	364,207		

POCP = Potential Oxygen Consumption
AP = Acid Potential
SO₂ = Sulfur Dioxide 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

