Innovations in Chemical Admixture Technology as Related to Sustainability

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Mark A. Bury is a Product Manager and a member of the Sustainability Leadership Team with BASF with 31 years of concrete experience. He has a degree in Applied Science, and a Bachelors Degree in Business Administration from Baldwin Wallace College. Mark is a Fellow of the American Concrete Institute (ACI) and a member of several ACI and ASTM Committees in C09 on Concrete and Aggregates. He is chairman of subcommittee C09.47 on Self-Consolidating Concrete. Mark has a patent on a corrosion-inhibiting admixture for concrete, published numerous papers on concrete and admixture technology and performed unique experimentation on concrete in outer space aboard the space shuttle Endeavour.

Using Chemical Admixtures and Advanced Methodologies to Produce and Quantify Sustainable Concrete

Innovations in Chemical Admixture Technology
As Related to Sustainability, Part 1
March 20, 2012
Dallas, Texas
Mark A. Bury and David Green

Presentation Overview
Most of the focus of our industry today is on the economy and sustainability. These issues will continue to challenge and shape our industry.

Two main concrete goals:
- Optimize mix economics and performance
- Lower the overall environmental impact

The Old Way

1. Mix 5 minutes
2. Deliver to job site
3. Place

Cash and carbon costs are heavy

Advanced Concrete Technology

Redefining the concrete space

High

Low

Proportioning Expertise
Recycled Materials
Special PCE Admixtures
Workability Retention

Optimized Concrete

High

Low

Porosity

Durability

High

Low

Concrete
Advanced Mix Optimization: The New Way!

Start with an existing reference mix

Cash and carbon costs are minimized!

Available Materials
- Novel Chemistry
- Custom Molecules
- Rheology
- Slump Retention

Available Materials
- Regional Admixtures
- Novel Chemistry
- Custom Molecules
- Rheology
- Slump Retention

Integration of the Three Pillars of Sustainability

Sustainable Development

Economy
- €
- $

Ecology
- €

Social Responsibility

Sustainability means combining economic success with environmental protection and social responsibility.

Buzz Words

Goal: Make a more fuel-efficient car.

How?
- Lighter
- Aerodynamic
- Lower rolling resistance
- Battery assistance
- Lower AC requirement

Potential Net Effect
- More oil
- Higher energy/cost
- Land usage
- Heavy metal disposal
- Toxic

Buzz Words

Are these options sustainable?

Concrete Sustainability

Recurring Conference Themes

- Reduce cement content
- Use more supplementary cementitious materials
- Use recycled concrete

Material (lb/yd³) Material (lb/yd³)
Cement 517 Cement 564

Fly Ash 85

Mix A Mix B

Material (lb/yd³) Material (lb/yd³)
Cement 564 Cement 479

Fly Ash 479

Recycled Concrete 0 Recycled Concrete 20

Myth Busters

- Cement from Mix A comes from China - larger CO2 footprint
- California project - no fly ash
- Fly ash comes from east of Mississippi
- Fly Ash has a carbon footprint
- Depends on recycler efficiency and distance

Measuring Sustainability

Challenge: many sustainability activities are actually “Greenwashing”

Greenwash (green’wash; gwoosh"
) — verb: the act of misleading consumers regarding the environmental practices of a company or the environmental benefits of a product or service.

Solution: the ability to measure and compare the environmental impacts of a product or service differentiates one from another.

Eco-Efficiency Analysis is a credible methodology that achieves that goal.

Eco-Efficiency Analysis

- Eco-Efficiency Analysis is a strategic life cycle methodology for comparing the relative ecological and economic efficiencies of alternative
  - Products (like baby diapers or concrete)
  - Processes (curing compounds or steam curing)
  - Technologies (automobiles or motorcycles)
NSF Protocol P352

- Considers EEA methodologies developed for evaluation at the product category level.
- Relies on concepts outlined in LCA standards developed by ISO.
- Protocol divided into two parts:
  - Validation of an EEA methodology
  - Verification of EEA studies

Developing EEA using NSF Protocol P352

1. Establish study goals
2. Define functional unit and alternatives
3. Determine environmental inventories of life cycle segments
4. Calculate and normalize environmental burden
5. Create eco-efficiency portfolio

ISO 14040 - 14043

A Tool for Concrete

Eco-Efficiency Analysis quantifies the economical and ecological impact of concrete mixes:

1. Customized Interactive Program specifically for concrete mix designs
   - Data gathered from vendors, industry associations, government databases, contract consultants
2. Evaluates environmental and economical impact of concrete ingredients based on input
3. Quantifies environmental and economical impact for each mix
4. Compares up to five different concrete mix designs for six environmental impact areas

Eco-Efficiency Analysis for Concrete Cradle-to-Gate

EEA concrete analyses can be conducted on ready mixed, precast, manufactured concrete products, highway paving, self-consolidating and pervious concrete.

Environmental Impact Categories

- Consumption of Energy
- Emissions
- Toxicity Potential
- Risk Potential
- Consumption of Raw Materials
- Land Use

Eco-Efficiency Analysis

- Custom Quantitative of Raw Materials
- Social and Relevance Factors
- Calculate and normalize environmental burdens
- Create eco-efficiency portfolio
- Environmental Report

Conducting an Eco-Efficiency Analysis

- Data Input:
  - Producer/Plant Information
  - Volume of Concrete
  - Raw Material Costs
  - Transportation Distances
  - Design Mix
- Computer Analysis:
  - Environmental profiles
  - Sums raw material data
  - Calculations
  - Compare mix designs

Custom Quantitative Environmental Report
**Eco-Efficiency Analysis (EEA) Program Results**

**Eco-Fingerprint**
- The four concrete alternatives are progressively more environmentally preferable.

**EEA Profile**
- Optimized concrete has the lowest overall environmental burden and is the most economical to produce.

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**One World Trade Center, New York (Freedom Tower)**

- Optimized mixes used in columns
  - 12,000 and 14,000 psi column designs
  - SCC high strength mixes
  - 38,000 yd³ thru 40 floors
- ECO-Efficiency Analysis performed

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**Benefits of Eco-Efficiency Analysis**
- Demonstrate the economical and ecological benefits of optimized mixes
  - Increase attractiveness to stakeholders
  - Support sustainability initiatives
- Quantify the ecological impact of optimized concrete mixes
  - Community/social sustainability acceptance
  - Market acceptance of green concrete
  - Position industry as leaders in sustainable construction
  - Specification changes to more sustainable mixes
  - Project acquisition where sustainability is required/desired

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**Eco-Efficiency Analysis for Concrete**
- Is so much more than a CO₂ footprint……………..
- Is so much more than LEED points………………..
- Eco-Efficiency Analysis
  - measures multiple environmental categories
  - addresses economics
  - includes social relevance
  - provides comprehensive environmental impact data to make good decisions on sustainability based on facts!