SCM’s and the Environment

Annual Convention
September 30, 2010

Speaker
Mike Donovan, P.E.
The Future of Concrete is Green.
Which one is it?
Is opportunity knocking???
Or Am I a Radical Environmentalist?
What are SCM’s?

- Fly ash (Class C)
- Metakaolin
- Silica fume
- Fly ash (Class F)
- Slag
- Calcined shale
Possible Disadvantages

- Delayed Setting Times
  - Less Bleeding
  - Finishing issues
  - Cracking??
  - Air entraining problems

- Delayed Strength Gain
  - Stripping/loading strength?

- Cost $ (I’m green if it doesn’t cost more)
  - Is it specified or do I have a choice
Some Unfortunate Facts about Cement?

- Main type of GHG: CO2
- Cement CO2 emissions:
  - 7% worldwide
  - 19% in China
  - 2% in the U.S.
  - 2.5% in California
Central Concrete’s 2009
Top 10 - Greenhouse Gas Breakdown

100% = 300,000 tons-CO$_{2}$eq

- Delivery-Truck fuel: 1%
- Lightweight Aggregate: 2%
- Other Ad Mixture: 2%
- Plant-Washout Disposal: 2%
- Fine Aggregate: 3%
- Slag Cement: 3%
- Fly Ash: 4%
- Diesel Combustion: 5%
- Coarse Aggregate: 17%
- Other: 6%
- Cement: 65%

FIGURE 1: GHG Emissions breakdown by Account.
Construction GHG Opportunity

Scope 1, 2, & 3 (% of US GHG)

Electricity: 45%
Food: 40%
Construction: 10%

Remaining Top Emitters:
- Plastics & Rubber Products
- Transportation
- Metal Products
- Machinery & Equipment
- Wholesale & Retail Trade
- Real Estate and Hotels
- Utilities (except electricity)
- Transportation Equipment
- Mining

Concrete
There is almost a one for one exchange...

Every ONE ton of cement replaced by fly ash or slag reduces CO2 emissions by almost ONE ton
Drivers.....
Different but parallel initiatives

**GOV’T Initiatives -**
AB32 targets carbon footprint (CO2) mandated by the law

**LEED** – targets positive results for ENV, health & financial return for owners

**PUBLIC AGENCY -**
CALTRANS Sec 90, Greenbook, cities
AB 32: The California Global Warming Solutions of 2005

GHG reduction targets:

- Reduce to 1990 levels by 2020
- Reduce to 80% below 1990 levels by 2050

*Equals approximately 60 million tons emission reduction, 11% below business as usual

** Equals approximately 174 million tons emission reduction, 29% below business as usual
The Climate

USGBC
NORTHERN CALIFORNIA

CRE: We Are Building Our Future

The Climate

Webcor Builders 11
Silicon Valley / San Jose

One of the largest general contractors in the U.S., Webcor Builders is known for its innovative and sustainable building practices.

Unable to keep the company growing, Webcor Buyers has continually turned to new buildings and partnerships to find a way to keep the company healthy.

So Webcor buyers founder, Gregg Da

KMD Architects Project →
Caltrans going performance:

- No Minor Concrete Categories
- Lower Cementitious required
- Limit on Cement
- Mandatory SCM design
- Extended Time for Strength Requirements
Remember What EF Tech is???

Technology that utilizes available Recycled material “SCM’s” to reduce cement usage pcy of concrete

50% Portland cement
50% fly ash / slag
EF Technology™ as your Specification Solution

- Reduce GHG / Carbon Footprint per AB32
- Uses recycled materials that go to landfill
- LEED
- Meeting direction of public agencies
Fly ash is fine residue produced by the combustion of coal in coal burning power stations. In the presence of moisture, fly ash reacts with calcium hydroxide to form compounds possessing cementitious properties.
What about Fly Ash?
Granulated Blast-Furnace (GGBF) Slag

Slag is a nonmetallic product developed simultaneously with iron in a blast-furnace, then chilled rapidly to form glassy granular particles. These granules are ground to cement fineness or finer. In concrete this slag will react with calcium hydroxides to form cementitious products.
SCM % Replacement History

<table>
<thead>
<tr>
<th>Year</th>
<th>SCM Replacement %</th>
</tr>
</thead>
<tbody>
<tr>
<td>2005</td>
<td>18.6</td>
</tr>
<tr>
<td>2006</td>
<td>23.5</td>
</tr>
<tr>
<td>2007</td>
<td>28.9</td>
</tr>
<tr>
<td>2008</td>
<td>32.6</td>
</tr>
<tr>
<td>2009</td>
<td>40</td>
</tr>
</tbody>
</table>

QTR 4
SCM Performance

- Reference Cement
- Ref. w/ 30% Slag
- Ref. w/ 30% Fly Ash
- Standard Ternary Blend

PSI

7 Day
28 Day
56 Day

THE NEW RESOURCE FOR GREEN CONSTRUCTION
Shrinkage Comparison
550 lbs Cementitious

- Cement Only
- 50% Slag Only
- 15% Fly Ash
- Ternary Blends 50%

Comparison of shrinkage across different materials and blends:

- Cement Only
- 50% Slag Only
- 15% Fly Ash
- Ternary Blends 50%

Days:
- 7 Day
- 14 Day
- 21 Day
- 28 Day

Materials:
- Cement Only
- 15% Fly Ash
- 50% Slag Only
- Ternary Blends 50%

Blends:
- 100
- 85/15
- 50/35/15
- 50/30/20
- 50/25/25
- 50/50

Values for each blend and day.
Where the charts are from

4 point curve example.pdf

GENERAL EF (7500) 4PT CURVE 10-8-09(SHRINK AND PSI).xls
Compressive Strength Comparisons

28 Day Compressive Strength

Cementitious (lbs.)

psi

0 1000 2000 3000 4000 5000 6000 7000 8000 9000 10000

25% 20% 15% 100% EFv2

THE NEW RESOURCE FOR GREEN CONSTRUCTION
ASTM 1157 Shrinkage - 28 Day Dry SEONC Modified

Cementitious (lbs.)

- 450
- 550
- 650
- 750

EFv2

25%, 20%, 15%, 100%

ASTM 1157 Shrinkage - 28 Day Dry SEONC Modified
Rapid Chloride Permeability Tests
Per ASTM C 1202 at 56 Day Standard Cure

Charge Passed | Chloride Ion Penetrability
---|---
> 4,000 | High
2,000 - 4,000 | Moderate
1,000 - 2,000 | Low
100 - 1,000 | Very Low

<table>
<thead>
<tr>
<th>Total Cementitious (Lbs)</th>
<th>Charged Passed (Coulombs)</th>
</tr>
</thead>
<tbody>
<tr>
<td>450</td>
<td>100% Cement, 25% Fly Ash, EF V2 50%</td>
</tr>
<tr>
<td>550</td>
<td>100% Cement, 25% Fly Ash, EF V2 50%</td>
</tr>
<tr>
<td>650</td>
<td>100% Cement, 25% Fly Ash, EF V2 50%</td>
</tr>
<tr>
<td>750</td>
<td>100% Cement, 25% Fly Ash, EF V2 50%</td>
</tr>
</tbody>
</table>

THE NEW RESOURCE FOR GREEN CONSTRUCTION
### Average Cementitious

<table>
<thead>
<tr>
<th></th>
<th>2005</th>
<th>2006</th>
<th>2007</th>
<th>2008</th>
<th>2009</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cement</td>
<td>441</td>
<td>426</td>
<td>402</td>
<td>379</td>
<td>384</td>
</tr>
<tr>
<td>Fly Ash</td>
<td>85</td>
<td>90</td>
<td>97</td>
<td>100</td>
<td>108</td>
</tr>
<tr>
<td>Slag</td>
<td>16</td>
<td>41</td>
<td>66</td>
<td>83</td>
<td>79</td>
</tr>
<tr>
<td>Overall</td>
<td>542</td>
<td>557</td>
<td>565</td>
<td>562</td>
<td>570</td>
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</tbody>
</table>
EFT as your Specification Solution

- It makes BETTER CONCRETE!!!!!!

✓ Finishability
✓ Good Set times
✓ 28 Day Strengths
✓ Equal to or Better Shrinkage
EF Technology™

✓ Reduce GHG / Carbon Footprint per AB32
✓ Uses recycled materials that go to landfill
✓ Helps your customer achieve additional LEED
✓ Improves the quality of our concrete
✓ Best of all: NO ADDITIONAL COST!!!!!!!
## The New Carbon Calculator

### Carbon Footprint Report

<table>
<thead>
<tr>
<th>Mix Code</th>
<th>Mat Foundation, Core Walls, Columns</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mix Label</td>
<td></td>
</tr>
<tr>
<td>Location Code</td>
<td>004W</td>
</tr>
<tr>
<td>Location City</td>
<td>San Jose</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>KG CO2eq / Cyd</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>132.5</td>
<td>kg CO2eq / Cyd (mix)</td>
</tr>
<tr>
<td>12.5</td>
<td>kg CO2eq / Cyd (location overhead)</td>
</tr>
<tr>
<td>145.0</td>
<td>kg CO2eq / Cyd (total)</td>
</tr>
<tr>
<td>319.0</td>
<td>lbs CO2eq / Cyd (total)</td>
</tr>
</tbody>
</table>

![Bar Chart showing carbon footprint components](image)

*Note: The bar chart illustrates the carbon footprint components for the given location and mix code.*
Central Concrete Supply Inc.
of Northern California

THE NEW RESOURCE FOR GREEN CONSTRUCTION
EF Technology™

✓ 60,000 Cyd Mat Foundation
✓ Reduced CO2 by 22,000,555 lbs or 11,000 tons.
✓ Utilizing our larger capacity trucks
  ✓ Eliminated 1000 truck trips
✓ Saved 10,000 Gallons of diesel fuel
✓ Improved public safety
✓ Reduced wear on the road system.
### SFPUC – the numbers that count!

<table>
<thead>
<tr>
<th>Mix Description</th>
<th>Mix Design Number</th>
<th>Climate Earth SF PUC</th>
<th>BASF SF PUC</th>
<th>BASF Reference</th>
<th>Difference</th>
<th>Estimated Yardage</th>
<th>Reference Description</th>
<th>Est. Reduction lbs CO2 eq</th>
</tr>
</thead>
<tbody>
<tr>
<td>Post Tension Slabs 4500 psi @ 3 days</td>
<td>H5EE932</td>
<td>654</td>
<td>562</td>
<td>944</td>
<td>362</td>
<td>6411</td>
<td>799 Straight cement high early mix</td>
<td>2,449,002</td>
</tr>
<tr>
<td>Retaining Walls 4000 @ 56 Days</td>
<td>3FAEC9P1</td>
<td>366</td>
<td>304</td>
<td>592</td>
<td>268</td>
<td>660</td>
<td>480 cement 85 Fly ash</td>
<td>190,080</td>
</tr>
<tr>
<td>Misc Concrete 3000 psi @ 28 Days</td>
<td>330PC9P1</td>
<td>400</td>
<td>361</td>
<td>496</td>
<td>134</td>
<td>391</td>
<td>400 Cement 70 Fly ash</td>
<td>52,314</td>
</tr>
<tr>
<td>First floor slab 6000 psi @ 56 days</td>
<td>P6G1C9P3</td>
<td>382</td>
<td>326</td>
<td>734</td>
<td>408</td>
<td>927</td>
<td>597 Cement 105 Fly Ash</td>
<td>378,216</td>
</tr>
<tr>
<td>Matt Foundation, Core Walls 8000 psi @ 90 Days</td>
<td>1EH1C9P1</td>
<td>376</td>
<td>335</td>
<td>760</td>
<td>425</td>
<td>10102</td>
<td>600 Cement 200 Fly ash</td>
<td>4,293,350</td>
</tr>
</tbody>
</table>

**Total Estimated lbs CO2 eq Reduction**

7,363,042

**Total Estimated tons CO2 eq Reduction**

3,682

**BASF numbers do not include all scopes for CO2. But the difference in the relative numbers is accurate.**
In 2009 Central Concrete prevented more than more than 93,000 tons of carbon dioxide from polluting our atmosphere in California!

What can our environmentally friendly technology do for you?