Richard Szecsy, PhD, PE, is the president of Texas Aggregates and Concrete Association. He has worked internationally as a technical expert for a four billion dollar ready mix and aggregate company, a Department Head at a university, and as an independent engineering consultant. He serves on several state and national committees as well as Boards of Direction for Texas Aggregates and Concrete Association, ASTM, ACI, ASCE and the NRMCA. Rich has written and collaborated on over thirty articles and publications ranging from concrete material science to technology management and integration for various periodicals including Concrete Producer, Concrete Construction and Concrete International. He is a frequent speaker and lecturer for ACI, ASCE, NRMCA and numerous conference proceedings.

**General Overview**

- Battle of the Specification(s)
- First Principles
- Conflict Management

**Hot Weather Specifications**

- "Concrete shall not exceed 85°F when arriving at job site."
- "Concrete shall not exceed 90°F when arriving at job site."
- "Concrete shall not exceed 95°F when arriving at job site."
- "Ice shall be used when concrete temperatures exceed 90°F."

**Let the Battle Begin!**

- Hot Weather (Limitations)
- Architectural (Requirements)
- Structural (Code)
**Architectural Specifications**

- "Architectural concrete shall maintain consistent color and hue."
- "In place concrete shall match color and shading of test panels."
- "No fly ash shall be used on architectural concrete."
- "Architectural concrete shall be consistent in color to the test panels as measured from 30ft away by a three person panel composed of the architect, the contractor, and the supplier."

**Structural Specifications**

- "...w/cm shall not exceed 0.45"
- "Minimum 5.0 sack for all concrete."
- "Maximum slump of 4.0 in for all architectural concrete."
- "Air content shall be 5% on all exposed concrete."
- "Maximum of 20% fly ash replacement."

**First Principles: Cement Chemistry and Reactions**

**Heat**

The "GOOD"

- Set time (decreased)
- Initial strength (increased)
- Final strength (unchanged?)

The "BAD"

- Set time (increased)
- Initial strength (unchanged)
- Final strength (unchanged)

**Chemically Driven**

- Cement content
- w/cm ratio
- Pozz. replacement

**Structural Temperatures**

- Curing temperature (ambient conditions)
- Core temperature (fixed conditions)
- Mix design and Element shape

**Chemically Driven**

- C3S + H → CSH + CH

**Practical Construction Methods**

- Mix Design
  - Lowest practical cement factor
  - Maximum practical aggregate
- Pozzolanic Materials
  - Maximum practical replacement
- Chemical
  - Set retarders, ASTM C494 Type D
  - Water reducers, ASTM C494 Type A
- Mechanical
  - Chilled water and/or ice
  - Evaporative cooling of aggregate
Actual Impact on Production

- At initial mixing w/cm = 0.29??
- Admixtures work from wetted cement grains
- What is actual mixing time?
- Inconsistent mixing equals
  - Inconsistent workability,
  - Inconsistent cement admixture interactions
  - Inconsistent slump
  - Inconsistent color

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<table>
<thead>
<tr>
<th></th>
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<tbody>
<tr>
<td>Cement</td>
<td>489 lb</td>
</tr>
<tr>
<td>Fly ash</td>
<td>122 lb</td>
</tr>
<tr>
<td>w/cm</td>
<td>0.45</td>
</tr>
<tr>
<td>Water</td>
<td>275 lb</td>
</tr>
<tr>
<td>Ice</td>
<td>100 lb (for 85 deg F)</td>
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</tbody>
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Economics and Ownership

- Example:
  - 500 yd placement, 85 deg F temp. limitation
  - 700 lb, 20% replacement, 0.45 w/cm, 5000psi in 28 day
  - Owner spent $6,000 on ice for each placement
  - Project will take $360,000 in ice

- What direct benefits to the Owner?
  - Stronger concrete? Once the spec is met...
  - "Better" concrete?
  - Was the architectural design goal accomplished?

Temperature Limits and Architectural Results

- Temperature of concrete is chemically driven
  - Mechanical process can impact the rate of chemical reaction, but will not determine the outcome.
  - Concrete core temperature is more important than delivery temperature.

- Temperature specifications exist as a measurement, not an indication of performance.
  - The concrete is not smart enough...

Temperature Limits and Architectural Results

- Architectural success is a combination
  - Allowances are more important than restrictions, limitations, or prohibitions.
  - Let the materials work for you, not against you.

- Conditions can change rapidly, should decisions?
  - Have prior discussions about changes in ambient conditions
  - Have clear decision controls (actual people) available.

Questions

Richard S. Szecsyy, PhD, PE
President
Texas Aggregates and Concrete Assoc.
900 Congress
Austin, Texas 78701
214-202-1379 cell
512-451-5100 ofc
rich.szecsyy@tx-taca.org
www.tx-taca.org