The Economics, Performance, and Sustainability of Internally Cured Concrete, Part 2

ACI Fall 2012 Convention
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Wilasa Vichit-Vadakan is a Senior Researcher at Siam Research and Innovation Co. Ltd., a research company owned by SCG Cement, Thailand’s oldest and largest cement manufacturer. Her research interest lies in two major areas: optimization of specialized Portland cement and the use of superabsorbent polymers in Portland cement-based systems. Both of these areas overlap in that their mechanisms can be used to explain and improve the durability of concrete and mortar. Prior to coming to SCG, she was a Clare Boothe Luce Assistant Professor at the University of Notre Dame. She holds a Ph.D. from Princeton University, M.S. from Massachusetts Institute of Technology, and B.S. from Cornell University, all in civil engineering.

Mass Production and Utilization of Self‐Curing Cement in Thailand

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Outline
• Background
• Laboratory Experiments
• Commercialization
• Field Results
• Conclusions

Background

SCG was established in 1913 following a royal decree of His Majesty King Ramas V to produce cement, a main building material for infrastructure projects that greatly contributed to the progress of the country during that period. The Group has diversified into five core businesses which include SCG Chemicals, SCG Power, SCG Cement, SCG Building Materials, and SCG Distribution.

Dow Jones Sustainability Indexes

SCG, the sustainable development role model, has been ranked as Sector Leader in DJSI Building Materials & Fixtures by SMI. SCG has been in ‘Gold Class’, the highest group, for 4 consecutive years.
Our interests...

Superabsorbent Polymers

Background on Polymerization

Outline

Lab: Mix Design

Lab: Concrete Strength

Our interests...

Superabsorbent Polymers

Background on Polymerization

Outline

Lab: Mix Design

Lab: Concrete Strength
Lab: Slump Loss

Lab: Setting Time

Outline

- Background
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Rice Drying Pavement

Construction Practice

Construction Practice
Outline

• Background
• Laboratory Experiments
• Commercialization
• Field Results
• Conclusions

Typical Site Layout

Slab on grade: 5.0 x 10.8 m

Slump Test

Typical Site Layout

Resistance to Segregation

OPC Type I
Self-curing cement
No segregation
Segregation

Field Test: Workability

Field Test: Follow-up

Segregation
No segregation
Self-curing cement
Self-curing cement

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Surface Follow-up

Field Test: Site Follow-up

Field Test: Compressive Strength

Ionic Polymer

Swelling in Different Environments

Swelling Behavior


**Swelling Behavior**

<table>
<thead>
<tr>
<th>Type of SAP</th>
<th>At 1 h</th>
<th>At 24 h</th>
</tr>
</thead>
<tbody>
<tr>
<td>Solution polymerized SAP</td>
<td>24.7 ± 0.4</td>
<td>51.1 ± 1.5</td>
</tr>
<tr>
<td>Micromulsion polymerized SAP</td>
<td>19.4 ± 0.6</td>
<td>41.3 ± 1.6</td>
</tr>
<tr>
<td>Ratio of micromulsion polymerized</td>
<td>79</td>
<td>82</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Type of SAP</th>
<th>Initially in Na(OH) solution and transferred into Ca(OH)₂ solution</th>
</tr>
</thead>
<tbody>
<tr>
<td>Solution polymerized SAP</td>
<td>31.8 ± 0.2</td>
</tr>
<tr>
<td>Micromulsion polymerized SAP</td>
<td>24.9 ± 2.1</td>
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</tbody>
</table>

**Ion Filtration Behavior**

<table>
<thead>
<tr>
<th>Type of SAP</th>
<th>Ca²⁺ (%)</th>
<th>Na⁺ (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Solution polymerized SAP</td>
<td>0</td>
<td>81</td>
</tr>
<tr>
<td>Micromulsion polymerized SAP</td>
<td>0</td>
<td>80</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Type of SAP</th>
<th>Initially in NaOH solution and transferred into Ca(OH)₂ solution</th>
</tr>
</thead>
<tbody>
<tr>
<td>Solution polymerized SAP</td>
<td>77</td>
</tr>
<tr>
<td>Micromulsion polymerized SAP</td>
<td>85</td>
</tr>
</tbody>
</table>

**Conclusions**

- Internal curing can be integrated into a cement
  - Favorable strength gain
  - No negative impact on fresh properties: slump loss or setting time
  - Positive impact on fresh properties: tendencies to segregate
- Mechanisms for the use of SAPs in cement is starting to be quite clear
  - Observed benefits even at high w/c
  - Observed early strength gain