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

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WEB SESSIONS

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Mass Production and Utilization of Self-Curing Cement in Thailand

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Outline

- Background
- Laboratory Experiments
- Commercialization
- Field Results
- Conclusions

Background

SCG

SCG was established in 1913 following a royal decree of His Majesty King Rama VI 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 Paper, 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 SAM. SCG has been in 'Gold Class', the highest group, for 4 consecutive years.

Background

SCG

Our interests…

Superabsorbent Polymers

Background on Polymerization

Superabsorbent polymers

ASTM C 150
Type I OPC

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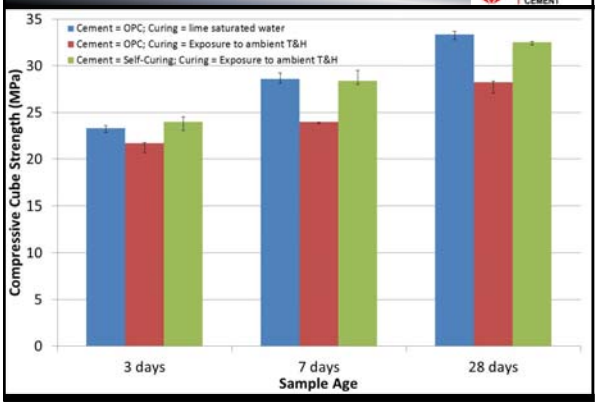
Lab: Mix Design

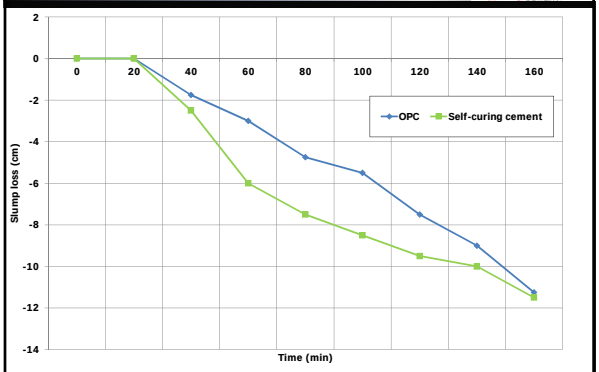
Self-curing cement: Type I OPC entrained with superabsorbent polymers

Component	Quantity
Water	190 kg
Cement	300 kg
Fine aggregate	730 kg
Coarse aggregate	1160 kg

Lab: Concrete Strength



Lab: Slump Loss



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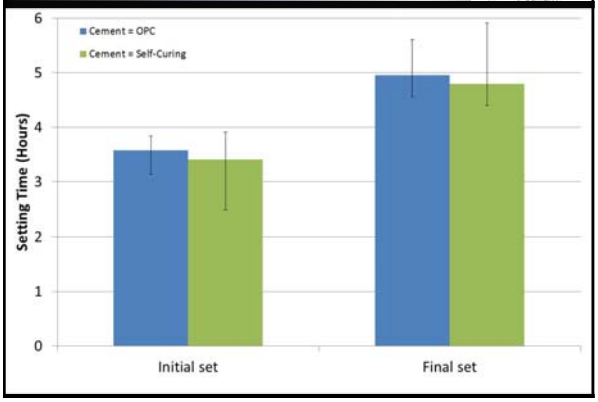
Lab: Setting Time



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Rice Drying Pavement

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Construction Practice

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Construction Practice

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Typical Site Layout

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Slump Test

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Resistance to Segregation

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Field Test: Workability

Segregation

No segregation

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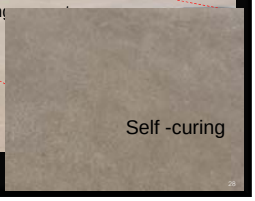
Field Test: Follow-up



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Surface Follow-up

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Field Test: Site Follow-up

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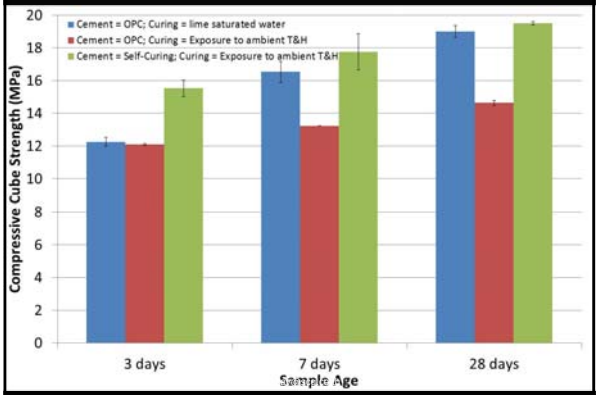
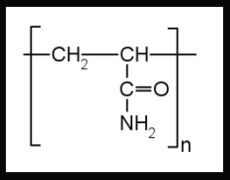
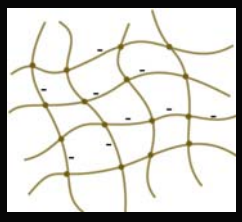
Field Test: Compressive Strength



Ionic Polymer

- At high pH
  - $-NH_2$ group in acrylamide is deprotonated
  - leading to electrostatic repulsion





Basic condition

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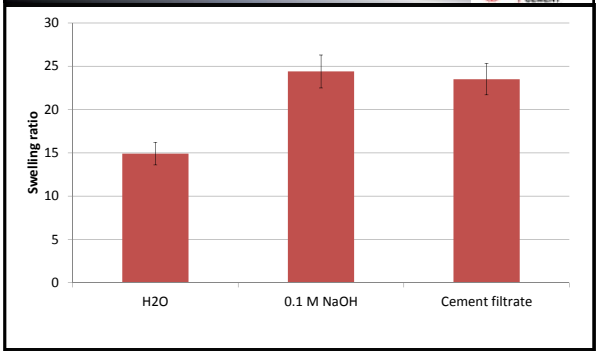
Swelling in Different Environments



W. Siriwatwechakul, J. Siramanont, W. Vichit-Vadakan (2010). "Superabsorbent Polymer Structures", in: O. M. Jensen, M. T. Hasholt, S. Laustsen, Eds, Pro 74 Proceedings from the International RILEM Conference Use of Superabsorbent Polymers and Other New Additives in Concrete, pp. 253-262.

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Swelling Behavior

Type of SAP	In $Ca(OH)_2$ solution At 1 h	At 24 h
Solution polymerized SAP	21.5 + 0.6	28.5 + 1.2
Microemulsion polymerized SAP	17.6 + 0.1	22.9 + 0.3
Ratio of microemulsion polymerized SAP: Solution polymerized SAP (%)	82	80

Type of SAP	Initially in $Ca(OH)_2$ solution and transferred into Na(OH) At 1 h	At 24 h
Solution polymerized SAP	60.1 + 1.6	62.4 + 4.3
Microemulsion polymerized SAP	46.7 + 0.5	50.3 + 4.0

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Swelling Behavior

Type of SAP	In NaOH solution At 1 h	At 24 h
Solution polymerized SAP	24.7 + 0.4	54.1 + 1.5
Microemulsion polymerized SAP	19.4 + 0.6	44.3 + 1.6
Ratio of microemulsion polymerized SAP: Solution polymerized SAP (%)	79	82

Type of SAP	Initially in Na(OH) solution and transferred into $Ca(OH)_2$ solution At 1 h	At 24 h
Solution polymerized SAP	31.6 + 0.2	33.4 + 4.5
Microemulsion polymerized SAP	24.9 + 2.1	23.0 + 0.6

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Ion Filtration Behavior

Type of SAP	Initially in $Ca(OH)_2$ solution and transferred into Na(OH) Ca^2 + (%)	Na + (%)
Solution polymerized SAP	0	81
Microemulsion polymerized SAP	0	80

Type of SAP	Initially in NaOH solution and transferred into $Ca(OH)_2$ solution Ca^2 + (%)	Na + (%)
Solution polymerized SAP	77	0
Microemulsion polymerized SAP	85	0

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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

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