Inline Process –
Dow Corning Silicone Encapsulation Solution

*Striving for Higher Efficiencies **and** Bringing Down Costs*

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7/2009

Solar Solutions

DOW CORNING

We help you invent the future.™

Our Topics

- Dow Corning's Commitment to Solar
- Importance of Raw Materials
- Why a Silicone Encapsulant?
- Increasing Efficiency **&** Reducing Costs

  … Not always a paradigm …
- Q&A

Dow Corning Corporation

A Leader in Si-based Chemistry

- Founded in 1943
- 50/50 joint venture between *The Dow Chemical Company* and *Corning, Inc.*
- Purpose is to develop, manufacture and market Si-based material solutions
- Majority owner in Hemlock Semiconductor

Dow Corning Solar Solutions

A Material House for the solar industry

- Active 9 years; now a corporate priority
- Perfect fit between Si and Solar applications
- Goal: to help the industry accelerates its penetration of Solar Energy in the Global Energy Market
- Offer advanced silicon-based solutions through the entire solar chain

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Importance of Raw Materials

Selection is critical for the long term success of the Solar Industry

- Supply Guarantee
  - The Solar Industry is a large, growing materials consumer
- Manufacturing Cost
  - Raw material cost is >50% total module cost
  - Integration of materials and manufacturing process
- End-User Cost & Revenue
  - Impact on module efficiency
  - Impact on module durability

= Cost per kWh!

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Why Silicones in PV Modules?

Where conditions are extreme, silicone has the upper hand

- Proven performance in Construction, Electronics and Solar Industries
- Property Advantages
  - Durability to UV exposure
  - Wide temperature range
  - Corrosion resistant
  - Ultra transparency
  - Electrically insulating

Why Silicones in PV Modules?

Where conditions are extreme, silicone has the upper hand

- Supply Chain Advantages
  - Global availability
  - Ease of delivery
  - Not leveraged on petrochemicals
  - Flexible chemistry/mass production

Time Warner Building, New York

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Silicone Encapsulation

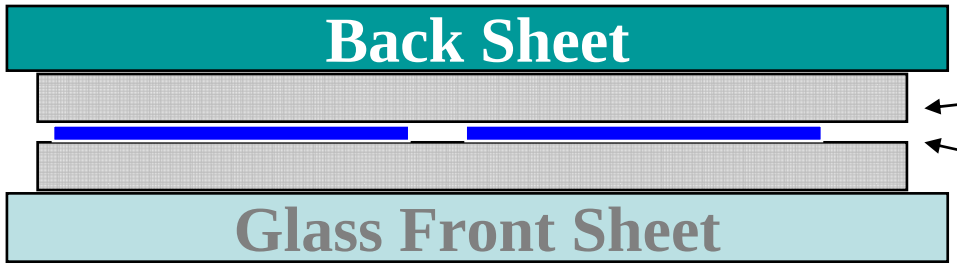
Significantly reducing the cost of ownership of solar modules

How Silicone Encapsulation reduces costs:

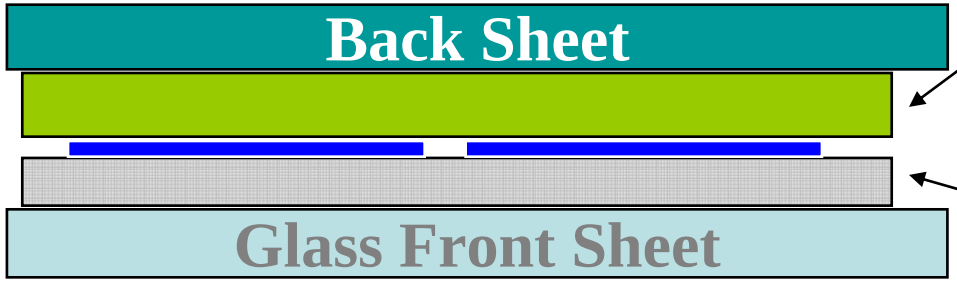
- Silicones are inherently stable in UV, and can out-perform the durability of incumbent organics
- Silicones allow more light to reach the cell, and therefore increase module efficiency
- The conceptual liquid encapsulation process is less capital and labor intensive than incumbent EVA lamination
- Liquid encapsulants can deliver total cost of ownership savings in the value chain

Product Concept

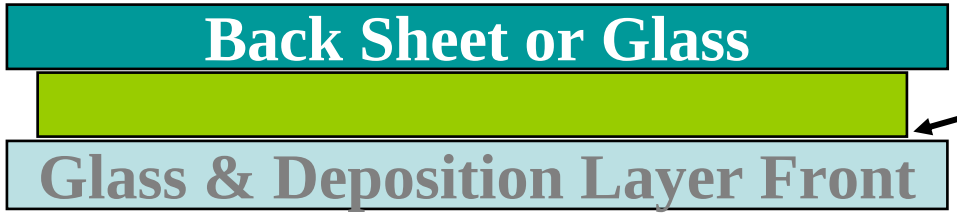
Incumbent Encapsulation System



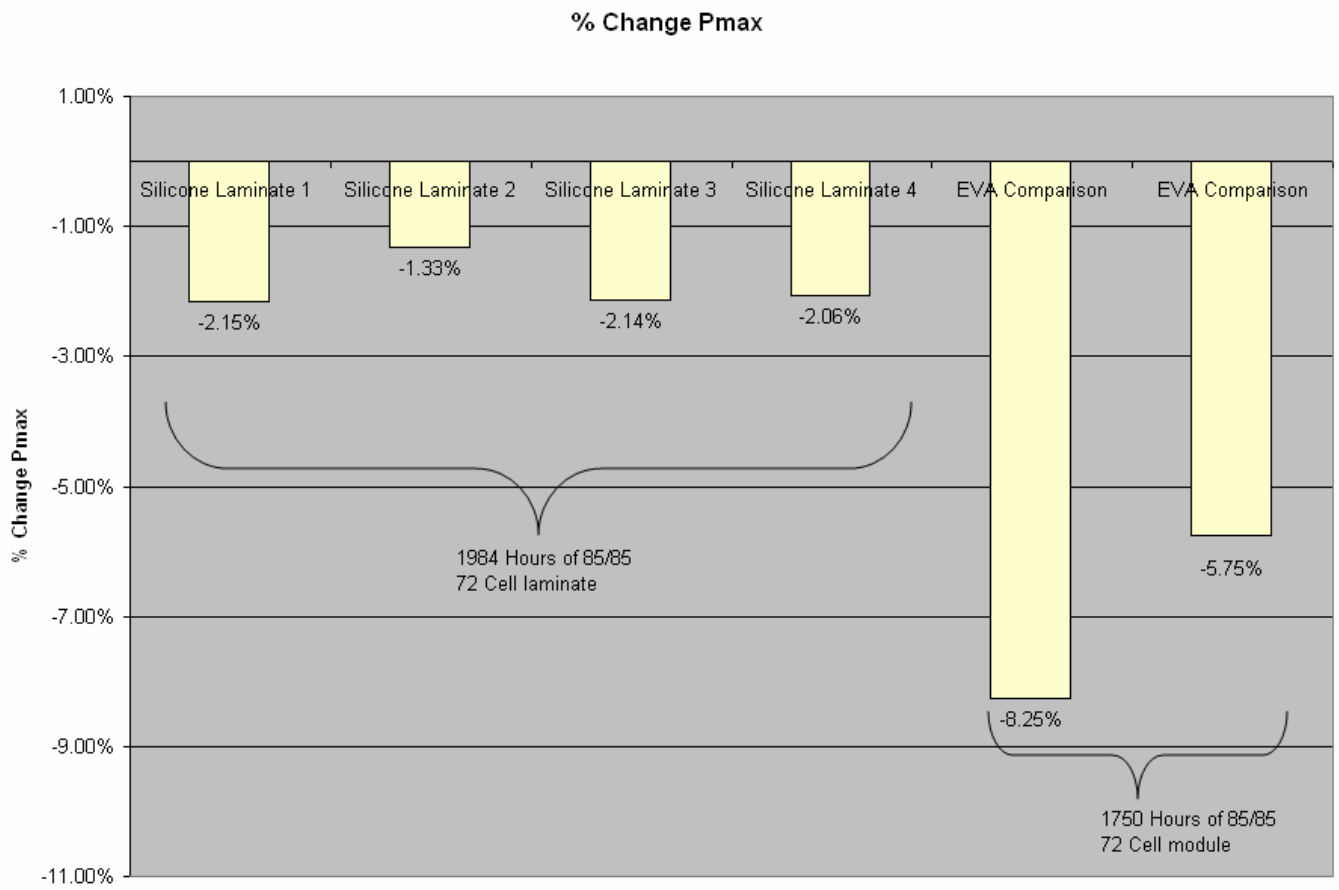
Crystalline Silicone Encapsulation System



Thin-Film Silicone Encapsulation System



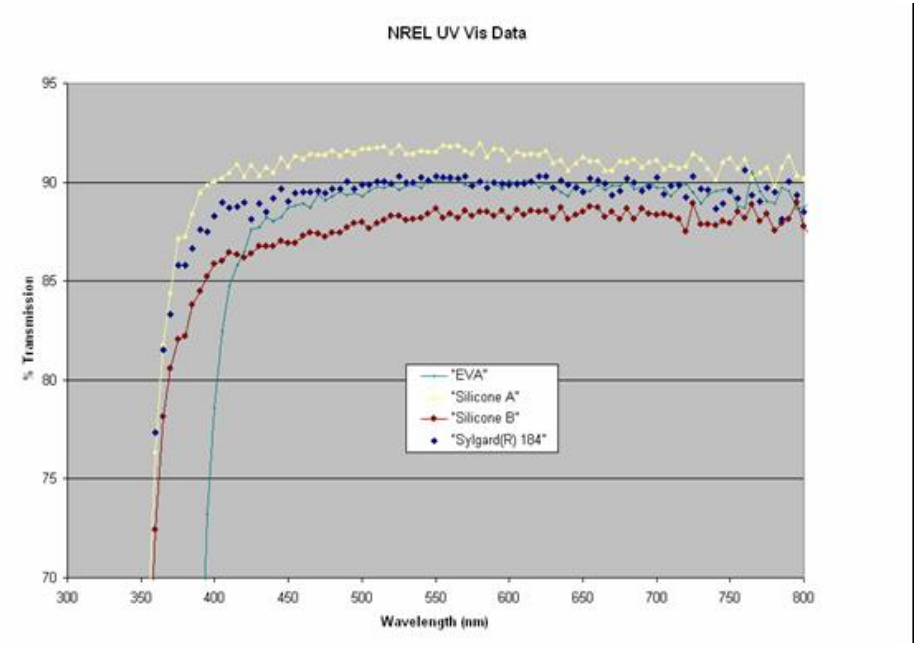
Durability- *Dow Corning*® brand silicone compared to EVA

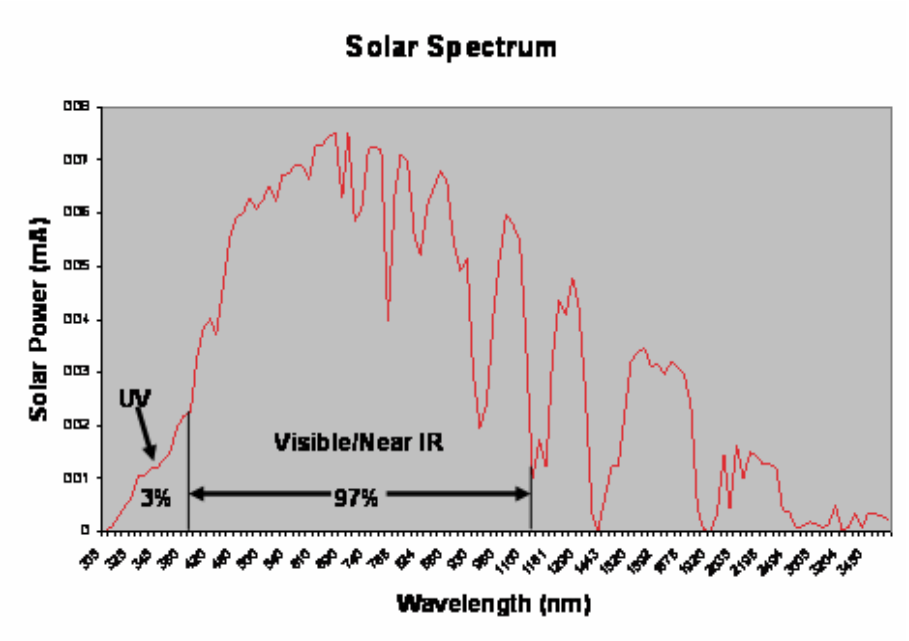


These silicone laminates also passed Wet Leakage testing after nearly 2000 hours of Damp Heat conditions

Efficiency - *Dow Corning*® brand silicone compared to EVA

- Gains in efficiency
  - Improved light transmission
  - UV and visible range
- EVA stabilization
  - Blocks UV
  - 3% of available light

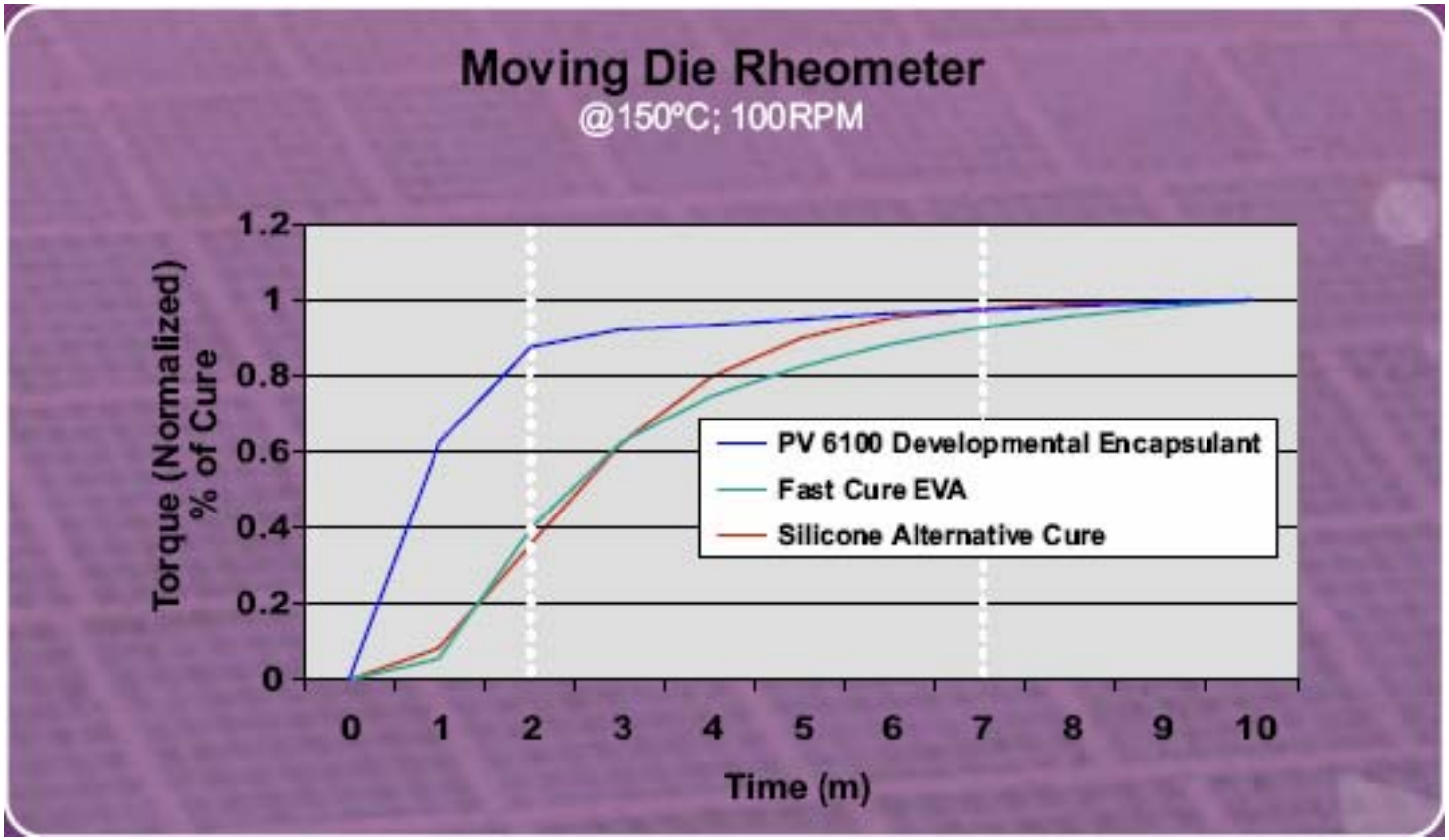




Silicone Encapsulants Throughput

- Improved throughput using developmental *Dow Corning*® PV-6100 Encapsulant Series
  - Very fast cure
  - Small manufacturing floor plan
  - Target < 2 module/min
  - Low capital
  - Continuous processing
  - Lower energy use

Silicone Encapsulants Throughput



Silicone Encapsulants Throughput

Other Savings Potential

- Capital & Floor Space
  - Less equipment/Mw due to higher throughput & simpler process
  - Less floor space required
  - Building facility cost savings

- Energy & Environmental Savings
  - EVA laminators @ 150^{o}C
  - Silicone process @ ~ 100oC
  - No cure by-products and no solvents
  - Total decreased electrical load due to less equipment

Silicone Encapsulants Throughput

Other Savings Potential

- Labor
  - Reduction in labor due to automation
  - Simpler material handling due to drums of silicones vs. rolls and sheets of EVA
  - Changeover of drums/totes less frequent than changeover of rolls, and in-line capable

Dow Corning PV Encapsulation Pilot Line

Laminate Made on Dow Corning Pilot Line

Summary

- Dow Corning is committed to become a material house for the industry
- Materials selection and the subsequent process design is key to realizing decreased cost/kWh in the PV industry
- Silicon-based, and specifically **silicone** materials are a unique fit for improving efficiency and durability PV modules
- We will soon launch a new silicone encapsulant solution that enables module manufacturers to increase the performance of their device and to reduce their total cost or production.

Thank You!

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