

The background of the slide is a grayscale microscopic image showing a dense field of irregular, translucent, crystalline particles. These particles vary in size and shape, with some appearing as flat, thin plates and others as more rounded, angular fragments. The overall texture is granular and porous, characteristic of aerogel.

Enova Aerogel Additives for Next Generation Coatings

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Agenda

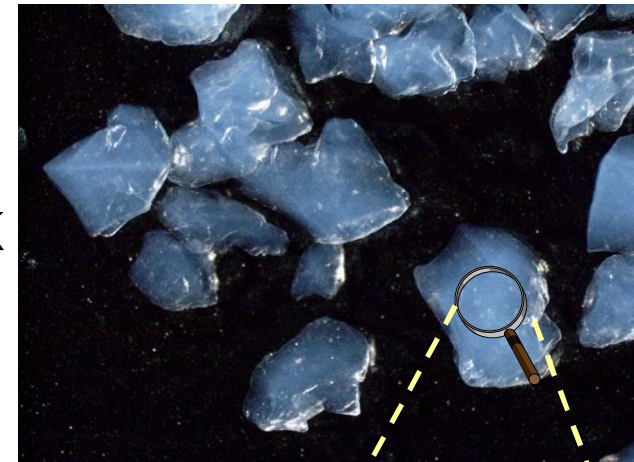
- What is Cabot aerogel: science behind the particle
- How Cabot aerogel is used today
- Enova™ particles in insulative coatings
- Possible benefits that IC's can provide

Aerogel - World's Best Insulating Solid

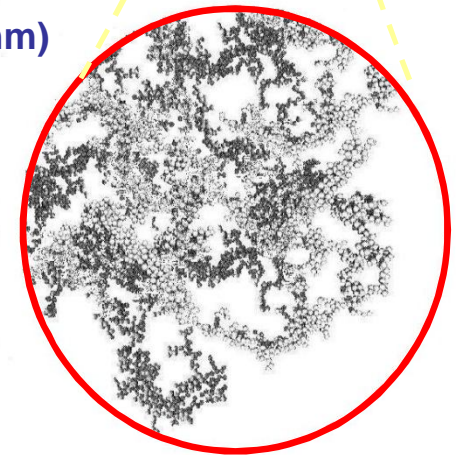


Cabot aerogel - A Unique Material from Cabot Corporation

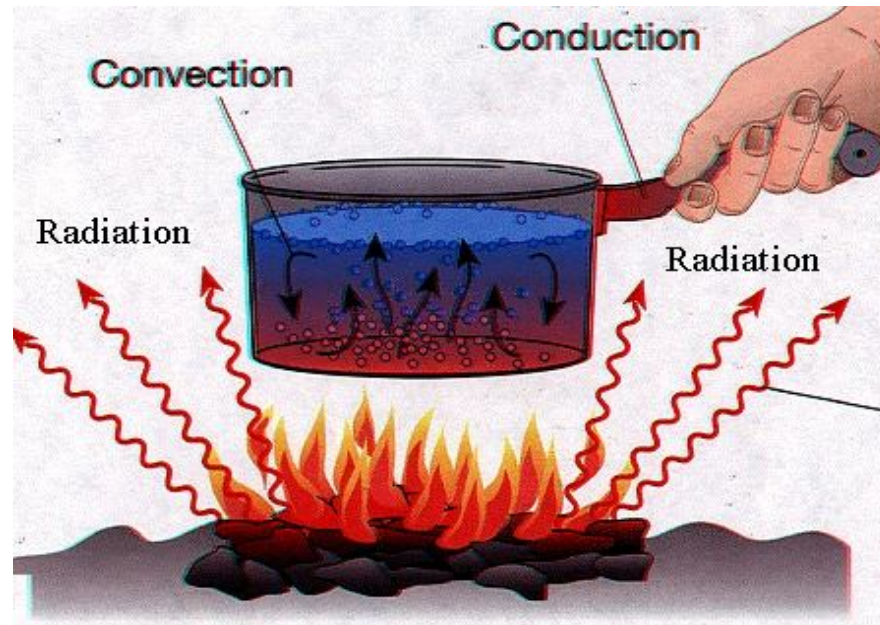
- **Amorphous silica aerogel**
- **Particle sizes** microns to millimeters
- **Low thermal conductivity** 12mW/mK
- **High porosity** >90% air
- **Nanoporous** 20-40nm pores
- **Lightweight density** ~140 kg/m³
- **Water repellent** contact angle ~150°
- **Long and consistent service life**



(scale in mm)



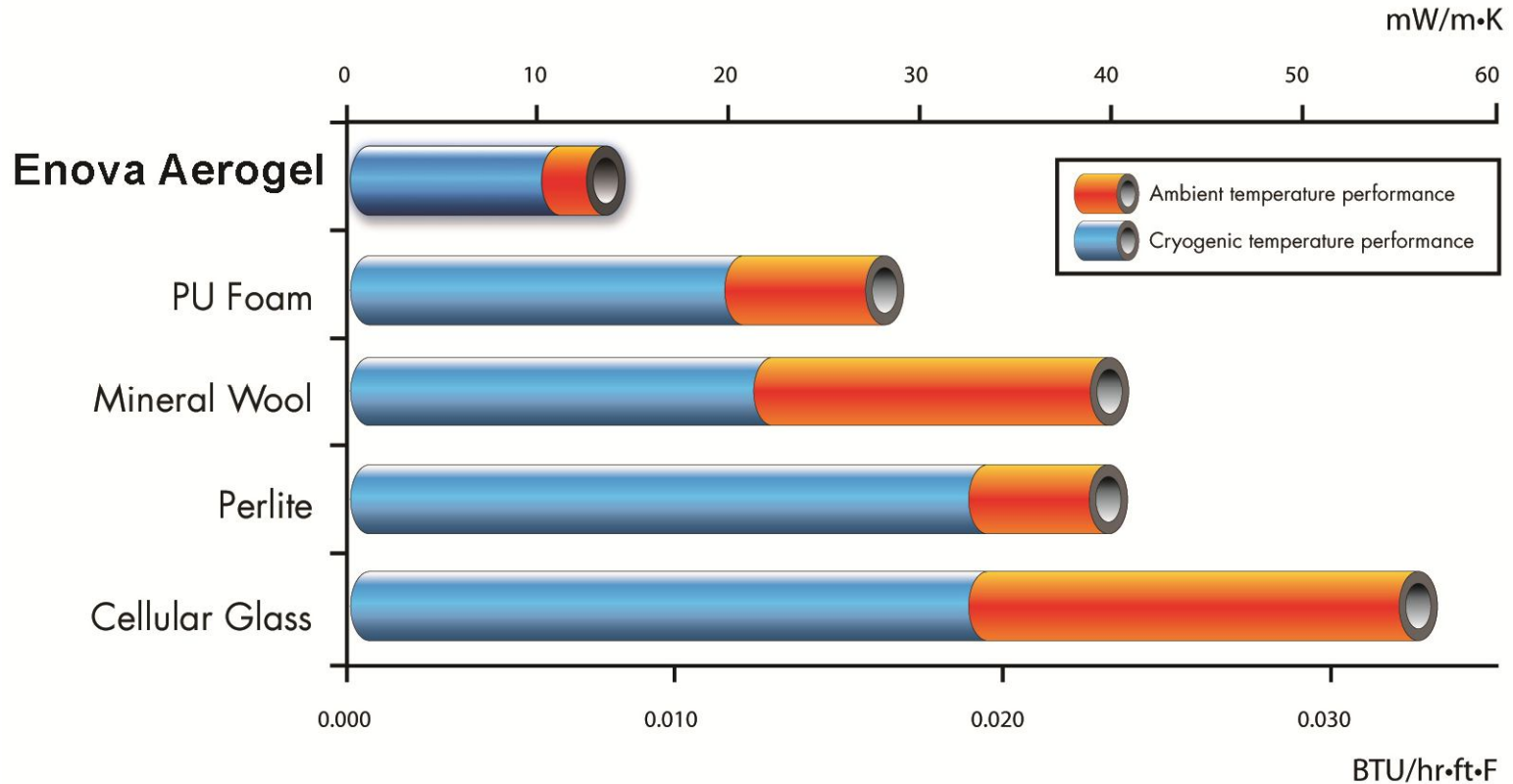
Three Modes of Heat Transfer



Overall = Convection + Conduction + Radiation

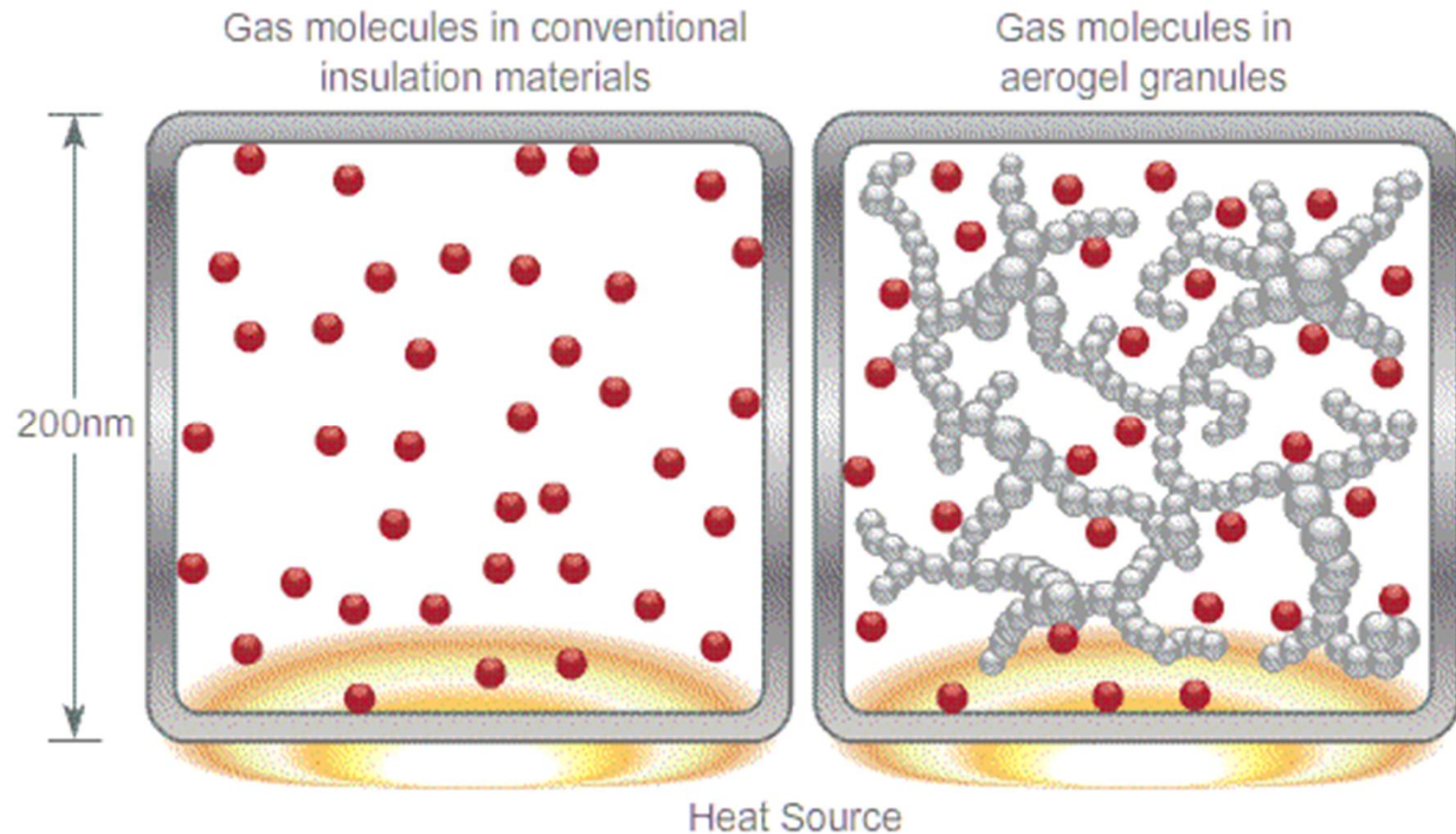
- Gas phase
- Solid phase

Ultra-Low Thermal Conductivity at Ambient Conditions



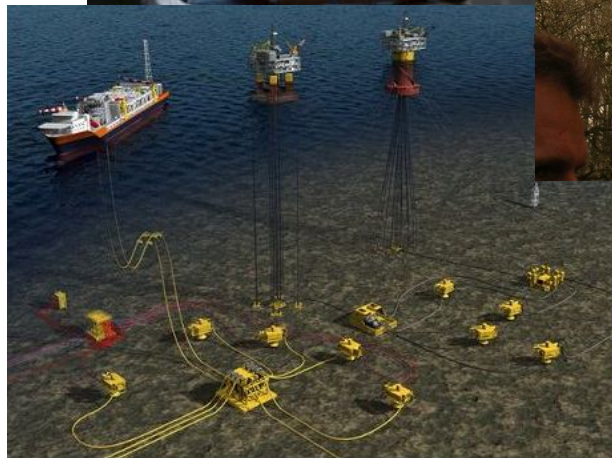
Notes: Assumes atmospheric pressure and room temperature
Source: Various sources; Cabot analysis

Superior Thermal Performance Driven by Nano-sized Pores



Aerogel is an Excellent Material For High-Value Applications

- Construction
- Oil and Gas
- Cryogenic
- Daylighting
- Specialty Chemicals

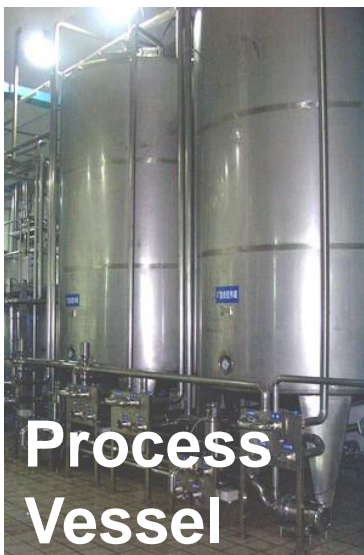


Cabot aerogel Based Insulative Coatings

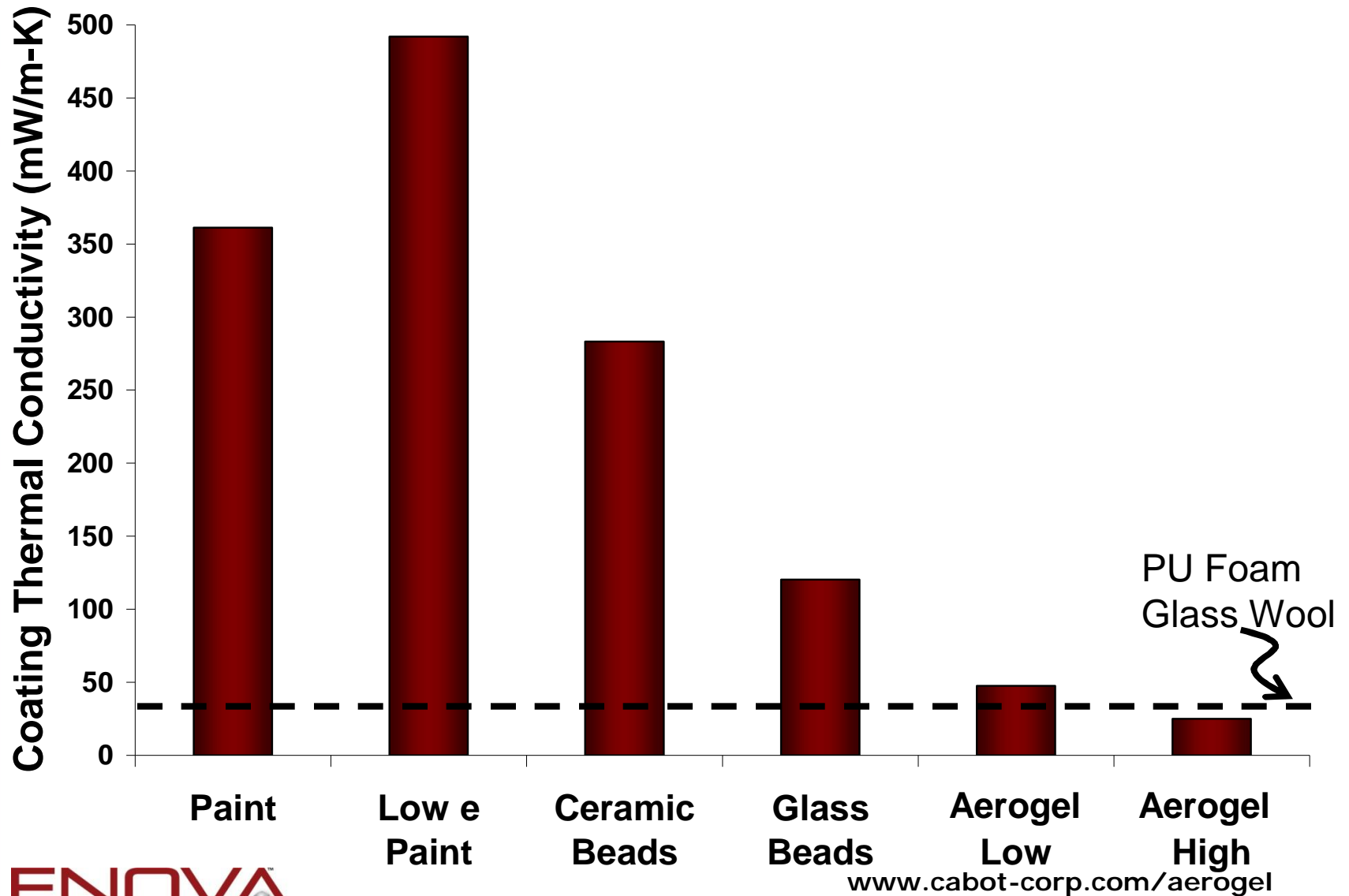


www.cabot-corp.com/aerogel

Superior Insulation Performance Benefits in a Wide Range of Applications



7-10x More Insulative Than Typical Paint



Two distinct sub segments for IC's

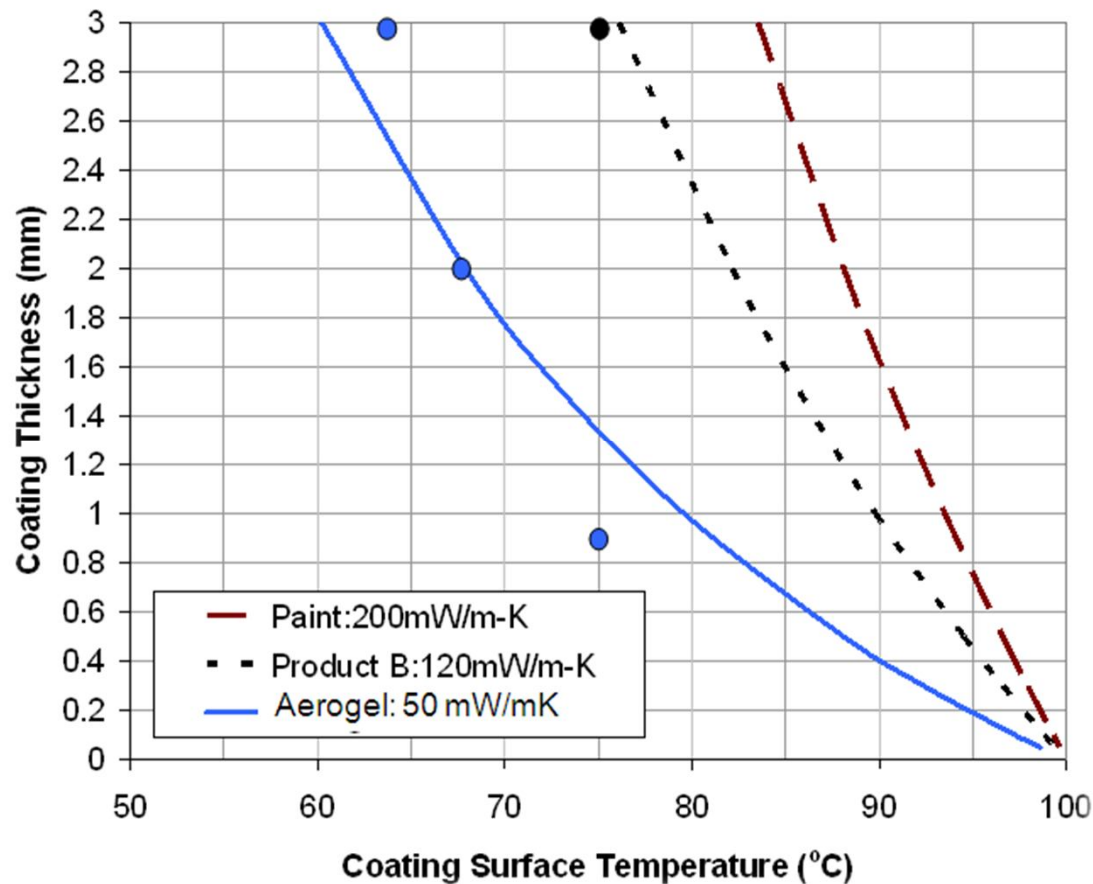
- Safety
 - Reduce the chance of getting burns on hot surfaces

- Energy efficiency
 - Lessen energy needed to keep something hot or cold



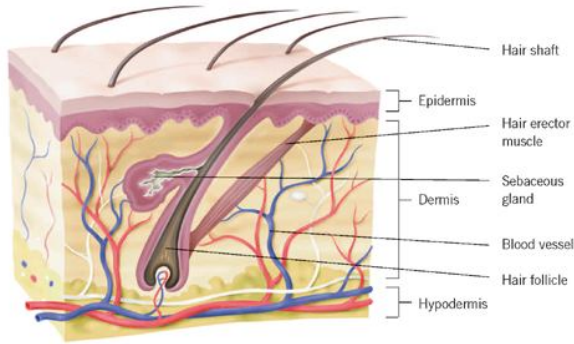
Significant Reduction in Coating Surface Temperatures with aerogel Based Coatings

Theoretical model for insulative coatings



- Assumptions:
- *Paint* $e = 0.93$
- *Paint* $\lambda = 200\text{mW/m-K}$
- *Cold Side Temperature* = 20 °C
- $h = 10$

ASTM C1057: Safe Touch isn't about Surface Temperature



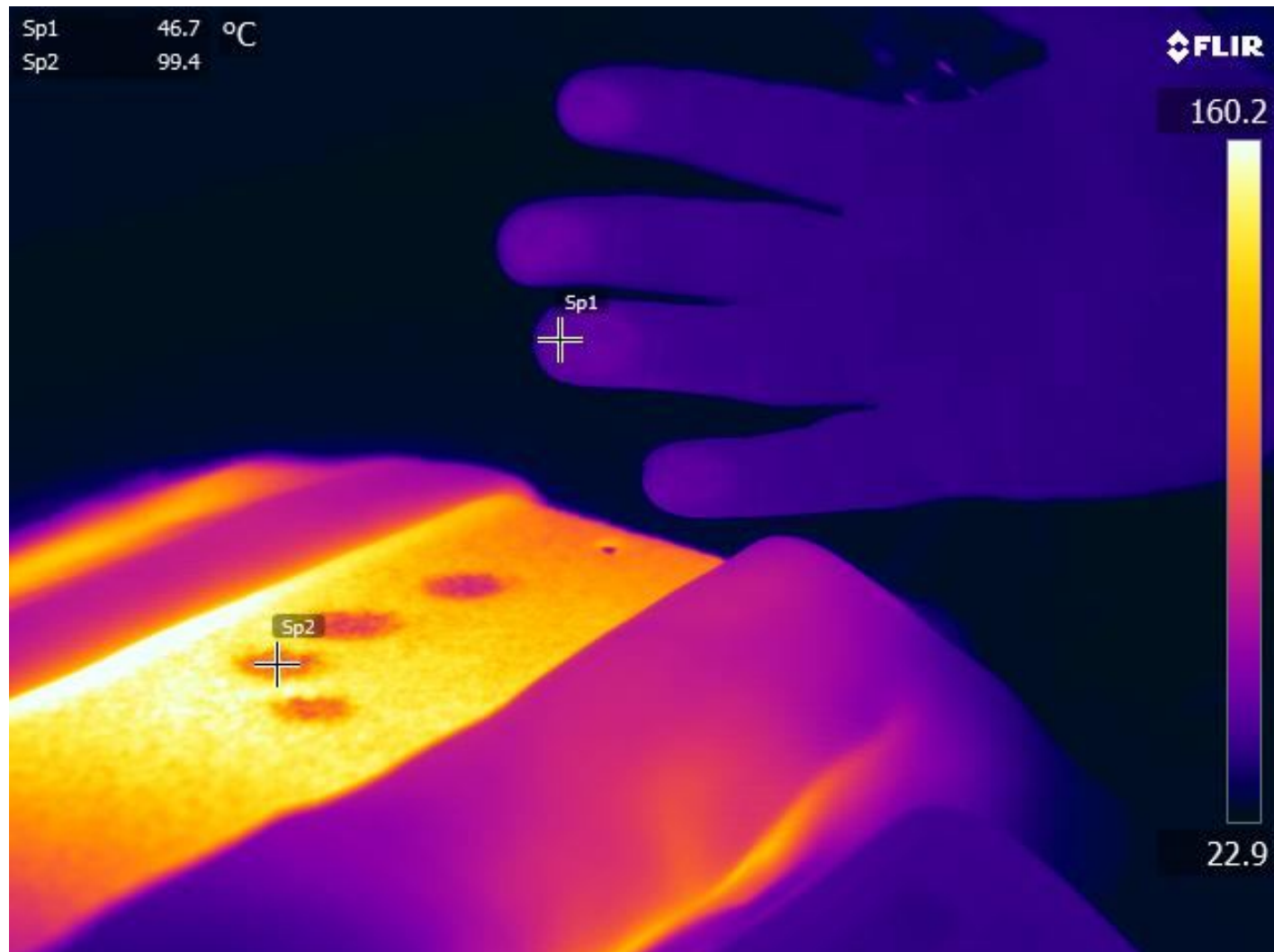
Your skin protects you against chemicals, bacteria and radiation, helps you maintain a stable body temperature, and stops you from losing fluid and vital body chemicals.

A thermal burn occurs as a result of a rise in tissue temperature above a threshold value for a finite period of time.

It's how much and how fast



Now in Infrared

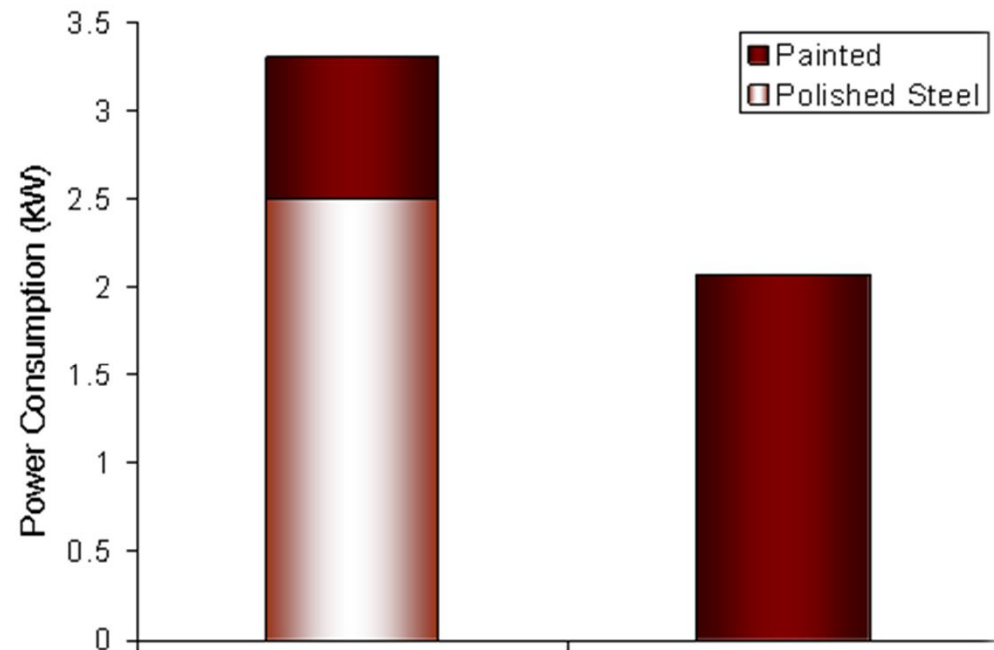


2mm Coating Delivers 30% Energy Savings

Fast ROI, plus safety and installation flexibility



300 Gallon SS Tank @ 70°C

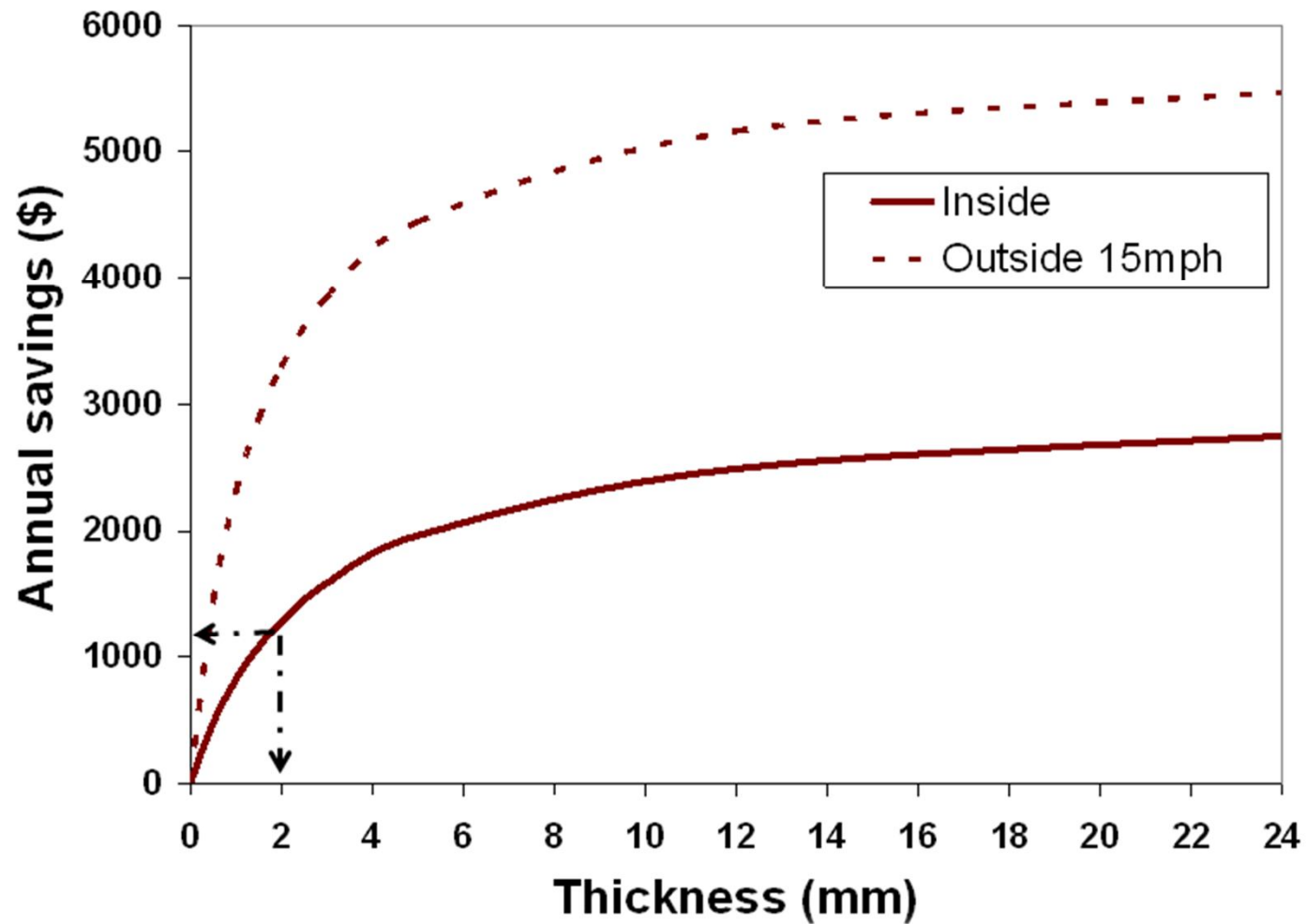


Steel Tank

2mm ENOVA

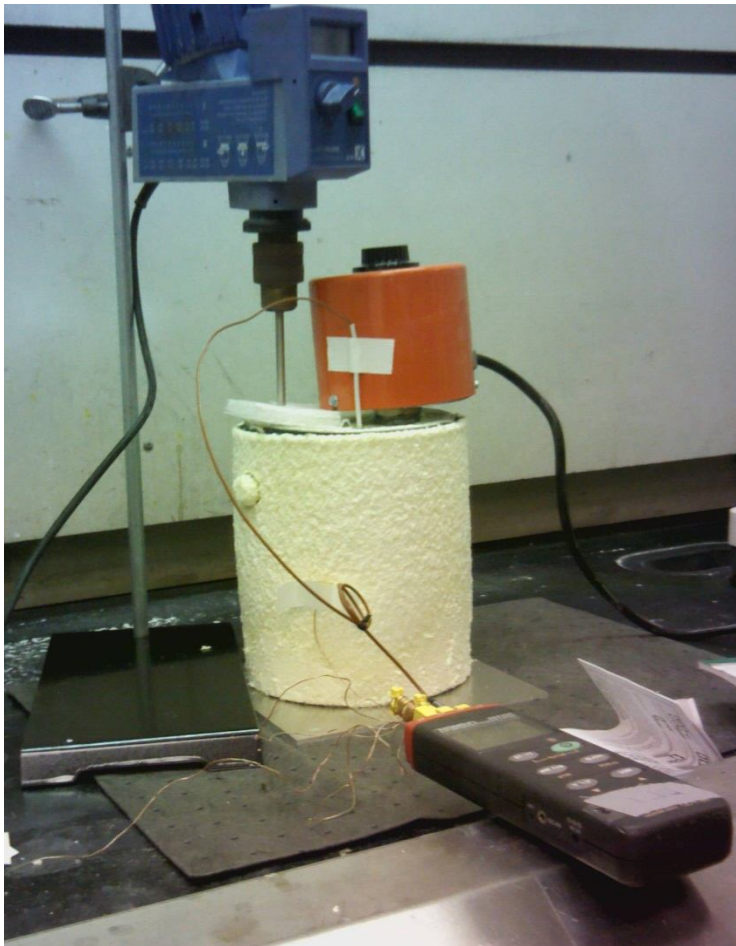
@10c/kW-hr, >1000\$/yr in savings per tank

45% of the savings at 10% the thickness

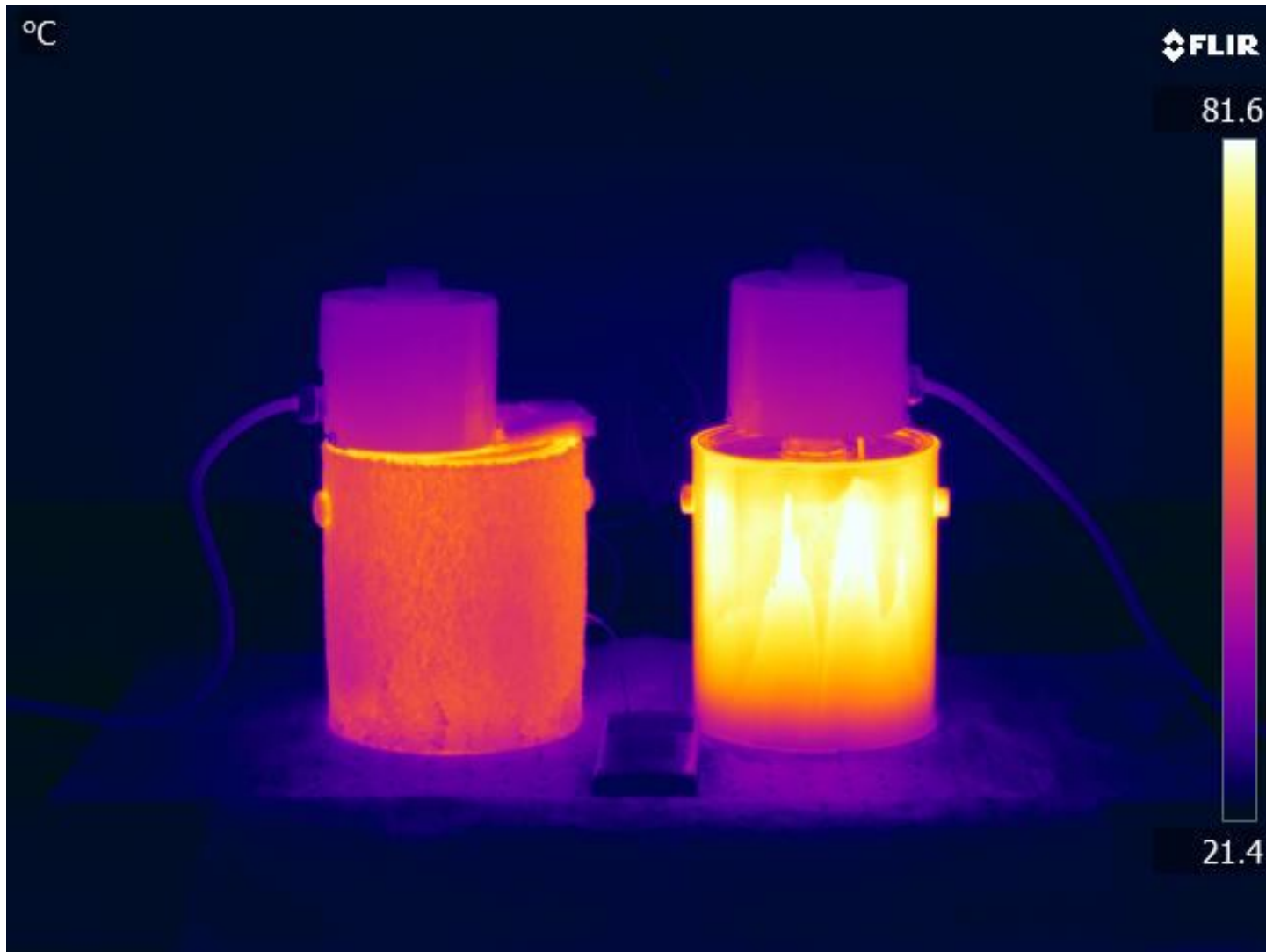


Energy efficiency test

- Suggested by large petrochemical company
- Used to compare different tank options and condition



IR Comparison



Why use an insulative coating?

- Space constraints
 - A little bit can go a long way
- CUI concerns
 - Aerogel Insulative coatings don't hold water
- Safe touch applications
 - Very thin layers can make a huge difference
- Low cost option
 - Doesn't require scaffolding, welding pins, cladding, etc
- Consistent performance needed
 - Doesn't experience degradation over time
- Potentially submerged environment
 - Once water recedes the insulation performance remains
- Speed to implement
 - Can be performed as a maintenance task
 - One size fits all

Easy insulation on not so easy surfaces

