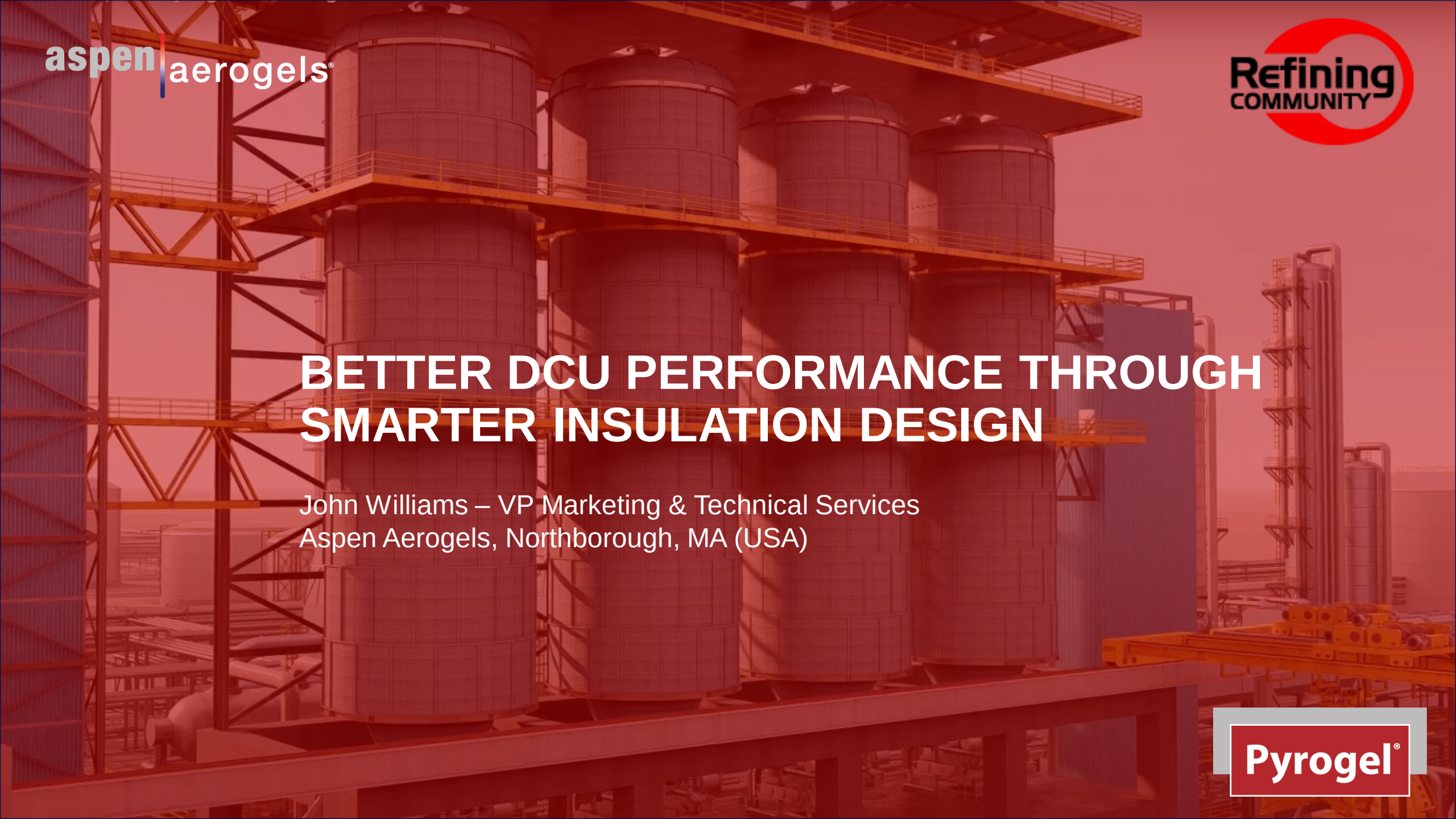


BETTER DCU PERFORMANCE THROUGH SMARTER INSULATION DESIGN

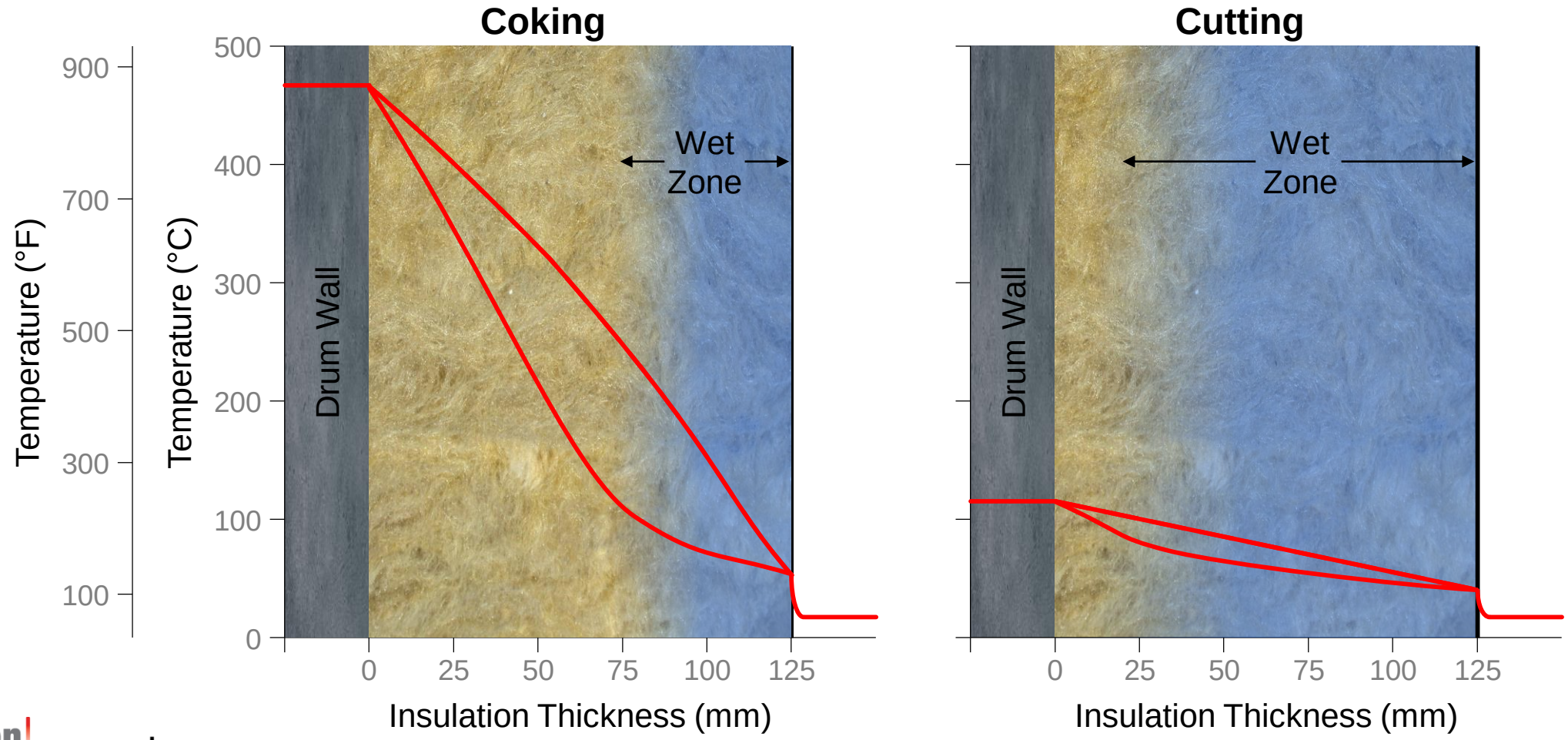
John Williams – VP Marketing & Technical Services
Aspen Aerogels, Northborough, MA (USA)

AGENDA

- Why DCUs are so hard to insulate
- Pyrogel HPS – Engineered for DCU service
- Insulation and the DCU life cycle – Five case studies
  - Maintenance, repair, and operations (MRO)
  - Re-insulation
  - New drums / new build
- Facilitated Q&A via Slido

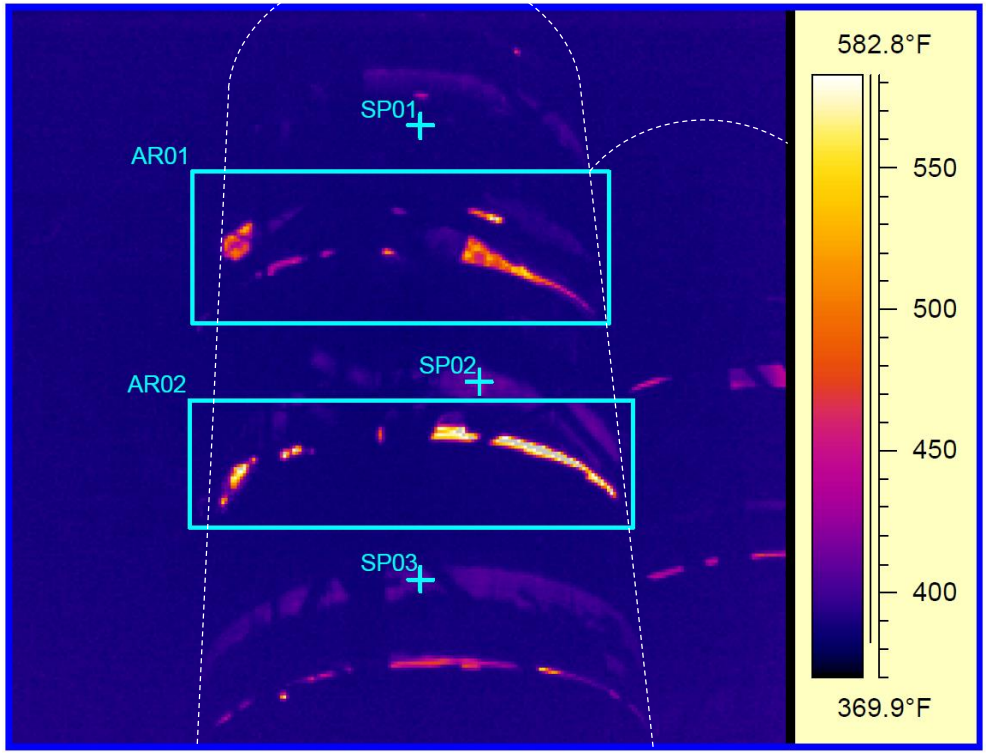
WHY ARE DCUs SO HARD TO INSULATE?

- Heat + water + mechanical abuse = Rapid insulation failure



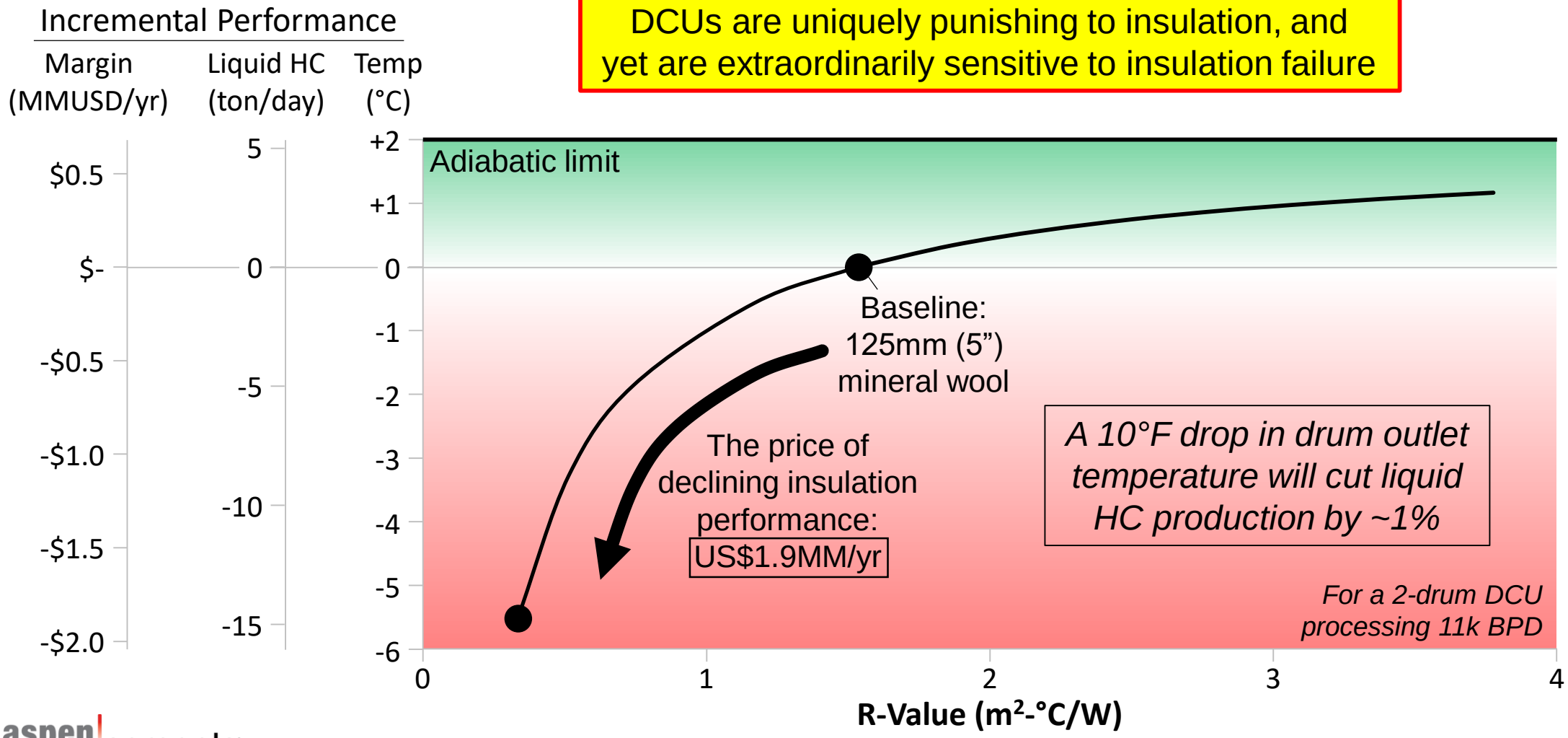
WHY ARE DCUs SO HARD TO INSULATE?

- As the insulation gets wet, it gets heavy, sags, and opens up seams
- Within 3-5 years, heat loss from the drums can increase by 2-4X



SENSITIVITY OF LIQUID YIELD TO INSULATION FAILURE

DCUs are uniquely punishing to insulation, and yet are extraordinarily sensitive to insulation failure



PYROGEL HPS: ENGINEERED FOR DCU SERVICE

Property	Mineral Wool	Calcium Silicate	Pyrogel HPS
Composition	Basalt fiber + resin binder	Cementitious	Aerogel + glass fiber
Form Factor	 Rigid block	 Rigid block	 Flexible blanket
Thickness mm (in)	125 (5.0)	140 (5.5)	50 (2.0)
Weight kg/sqm (psf)	~3X water weight 14 (3.0)	~2X water weight 35 (7.0)	10 (2.1)

Pyrogel HPS was designed specifically for service in delayed cokers:

- **THIN**: Exceptionally low *k*-value
- **TOUGH**: Resists mechanical abuse; reusable after exposure to high temperatures
- **DRY**: Enhanced water resistance

MAINTENANCE, REPAIR, AND OPERATIONS (MRO) WORK

MRO Work

Re-Insulation

New drums

- Reinsulate feedlines and overhead vapor lines
  - Prevent premature coking
  - Reduce pigging frequency
- Emergency repairs
  - Fast-to-install Pyrogel enables quicker unit restart
- Resolve frequent mechanical clashes
  - Delta valves: Pyrogel now comes standard on the bottom cone on all Foster-Wheeler (now Wood Group) designs
  - Nuclear gauges: Expensive and sensitive to overtemping, Pyrogel helps protect radiometric level detectors
  - Clashes with structure and platforms

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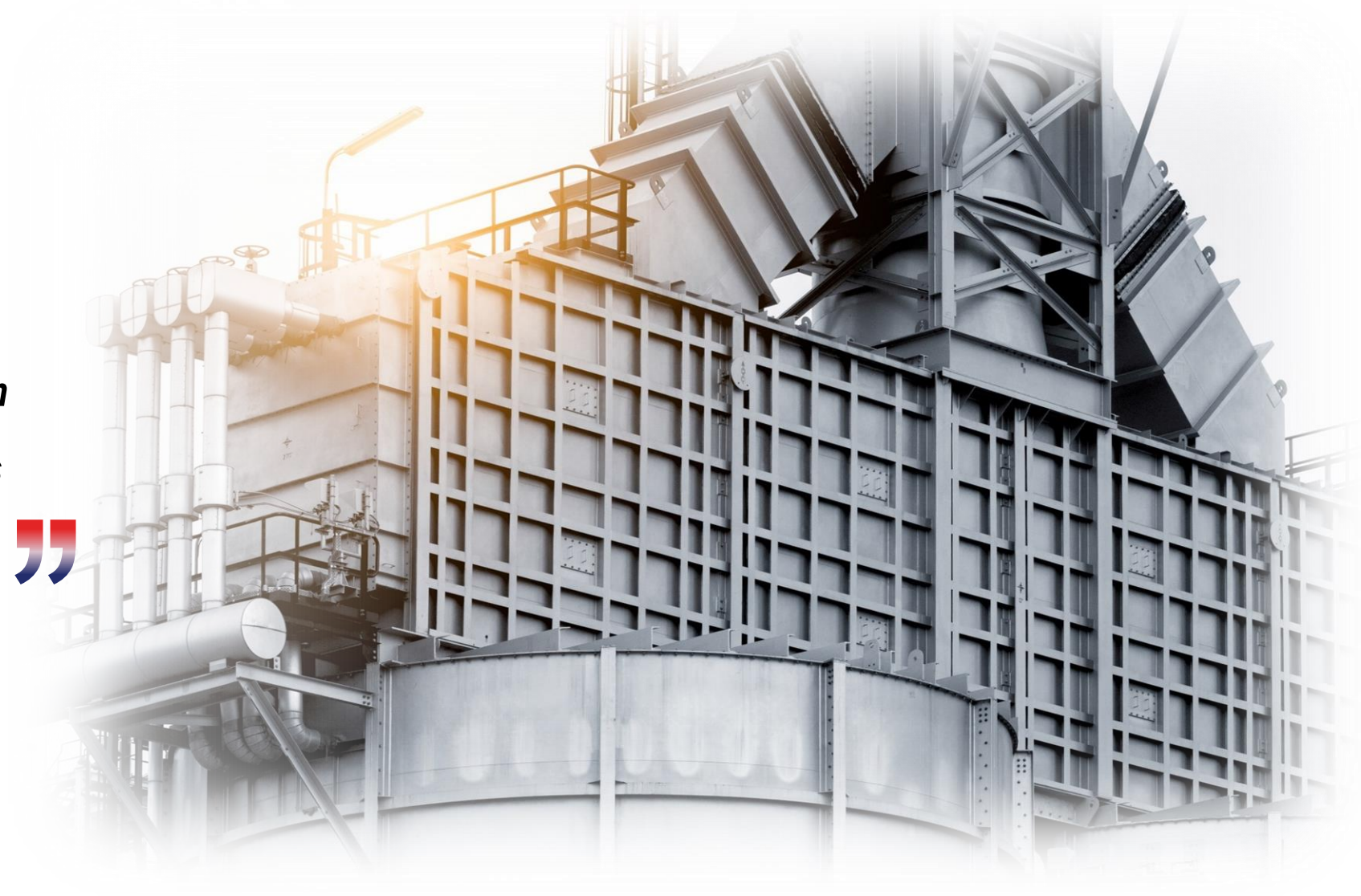
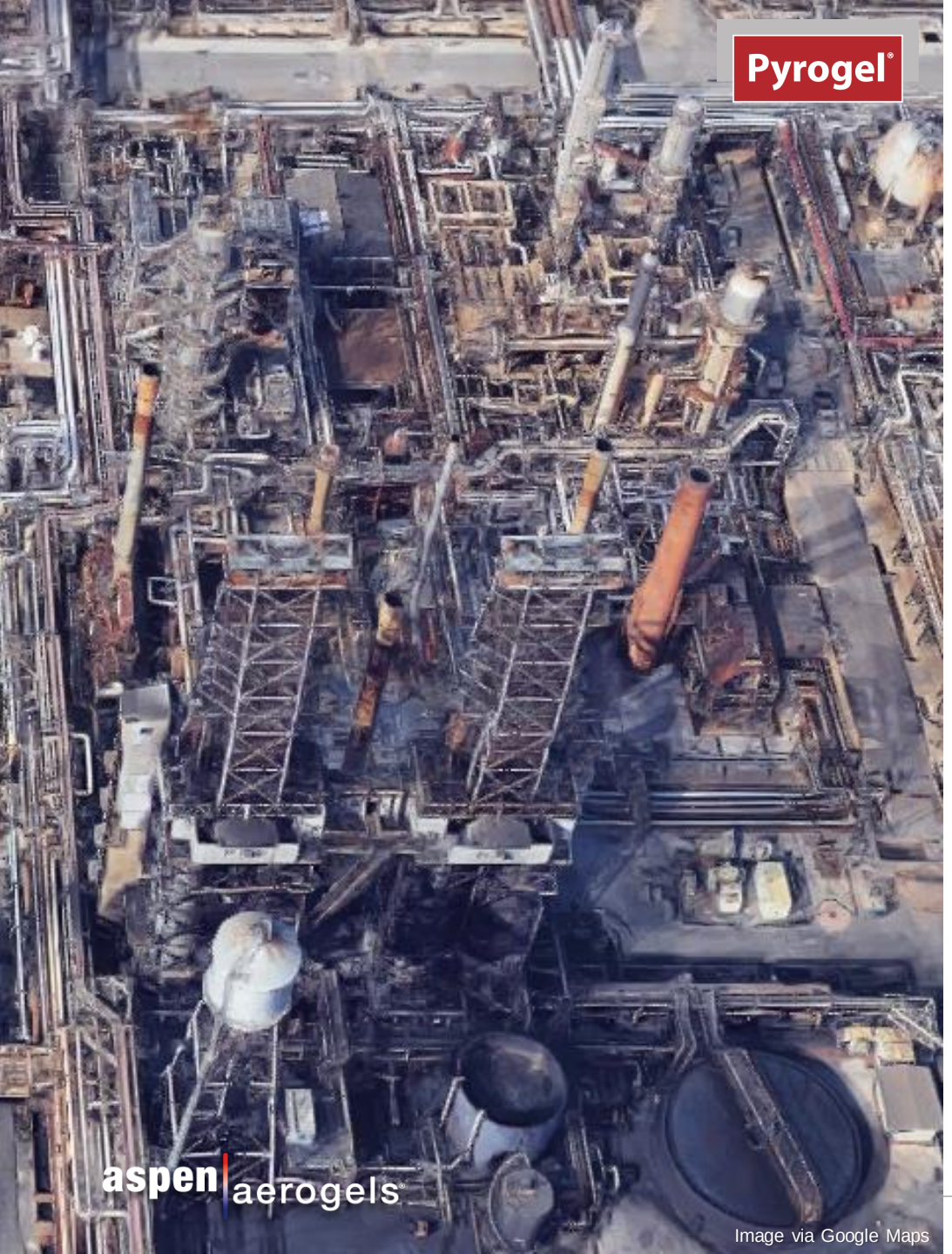
User Feedback

"After reinsulating the feedline with Pyrogel HPS, the duty rate on the DCU furnace reduced. We also increased the time-between-pigging from weeks to months … saving us $600k per year."

—Unit Manager on Mid West Refinery





EMERGENCY REPAIRS WITH PYROGEL = FASTER RESTART

CATEGORY 4 HURRICANE HITS REFINERY

In 2008, this facility's four-drum DCU was stripped bare of its insulation, rendering it inoperable and delaying the refinery's restart.

EARLIER RESTART WITH PYROGEL

As a temporary repair, the drums were wrapped with 30mm of Pyrogel and left exposed, with no metal jacketing.

"TEMPORARY" INSULATION LASTED 10+ YEARS

That "temporary" Pyrogel lasted more than *ten years* with no protection from the weather. Those drums have subsequently been reinsulated with a more permanent insulation system: Pyrogel + jacketing.

RE-INSULATING THE DRUMS

MRO Work

Re-Insulation

New drums

- Superinsulate with Pyrogel for better-than-new yields
  - Each 10°F increase in vapor line temperature increases gas and distillate production by ~1%
  - Pyrogel HPS fits 2-3X more insulation power, or “R-value”, into the same space
  - Achieve better-than-new yields by increasing the thermal efficiency of the drum
- Upgrade failing insulation while still in service
  - Substantial repairs and even complete replacement can be done while the unit is running, postponing costly turnaround work

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SENSITIVITY OF YIELD TO SUPERINSULATING THE DRUMS

Pyrogel HPS Thk (mm)	60	70	80	90	100	110	120
Incremental Payback (yrs)	0.6	0.9	1.1	1.4	1.8	2.2	2.6

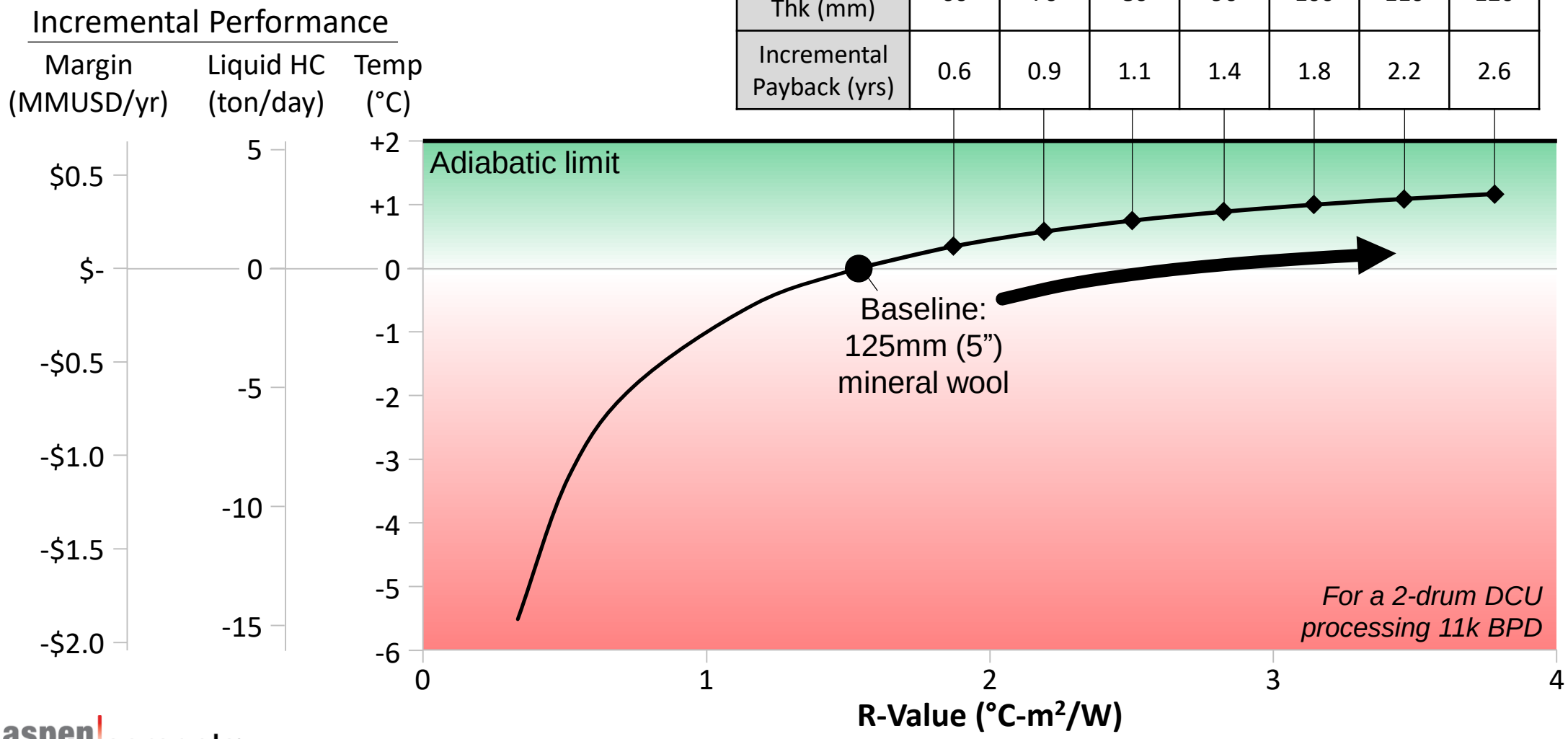


Image via Google Maps

LIQUID YIELD IMPROVEMENT

REFINERY ADDED TWO PYROGEL DRUMS NEXT TO SIX INSULATED WITH MINERAL WOOL

Facility added two new drums to their six-drum unit and insulated with 60mm of Pyrogel.

AFTER A YEAR IN SERVICE…

The team detected that the new drums were running 10°F warmer than the six older drums still insulated with aging mineral wool.

THE NEXT FOUR-DRUM SET WAS SUPER-INSULATED WITH 100MM OF PYROGEL

The additional material cost was quickly paid for by the unit’s higher production of liquids.

RE-INSULATE WHILE IN SERVICE

RE-INSULATE FOUR DRUMS WITHOUT DOWNTIME

Drum shells required re-insulation but the facility did not want to take unit offline. Pyrogel was installed on the shell while the unit was in service, during cutting operations. The top heads and bottom cones were completed during a subsequent turnaround.

HIGHER MARGINS IMMEDIATELY NOTICED

Upon completion of the work, the unit engineer noted lower VOCs and harder coke, both indications of higher liquid yields to the fractionator. They now estimate Pyrogel had increased DCU profits by $30-50K/month, and they expect even more once furnace temperatures and flow rates have been optimized.

Stock Image

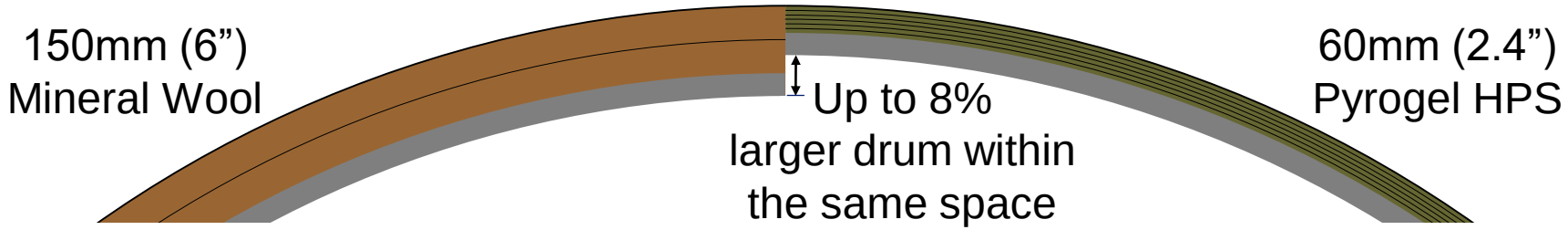
INSTALLING NEW DRUMS INTO EXISTING STRUCTURE

MRO Work

Re-Insulation

New drums

- Supersize the drum diameter within the existing cage
  - Boost internal volume and throughput by up to 8%
  - Increasing cross-sectional area also lowers the vapor velocity, *V*
  - Dynamic pressure / uplift drops by V^2 (16%), reducing the risk of foamovers
- Lift fully dressed drums into existing structure
  - Pyrogel's thinner profile reduces the risk of mechanical damage as pre-insulated drums are lowered through the structure



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BIGGER DRUMS IN THE SAME SPACE

6-DRUM REPLACEMENT INTO EXISTING STRUCTURE

To accelerate the replacement of six coke drums, the constructor wanted to insulate them on the ground prior to lifting. The existing insulation design – 150mm (6”) of mineral wool – was too thick to drop the drums through the existing structure.

PYROGEL’S THINNER PROFILE ENABLED PRE-INSULATION ON THE GROUND

Using Pyrogel shaved 75mm (3”) off the outside diameter of the fully dressed drums, enabling a flawless installation and on-time commissioning.

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THANK YOU

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