BEST PRACTICE THERMAL INSULATION FOR DCU PERFORMANCE & LIFESPAN

NOVEMBER 13, 2019

REFCOMM
Mumbai 2019
Design Should Provide 60°C Surface Temperature
Actual Temperature 198°C Per IR Scan
SAME DRUM TOP HEAD

Top of Drum #5 West Side

<table>
<thead>
<tr>
<th>Label</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>SP01</td>
<td>215°F</td>
</tr>
<tr>
<td>SP02</td>
<td>15°F</td>
</tr>
<tr>
<td>SP03</td>
<td>510°F</td>
</tr>
</tbody>
</table>
WHAT IS THE IMPACT OF POOR INSULATION?

• High Temperature Impacts Instrumentation
  • Instrumentation Housing Damage
  • Misreading Bed Heights
  • Lost Production Potential
  • Safety Concern With Nuclear Devices
  • Other Maintenance Headaches

• Energy and Production Losses
  • Current Situation Heat Loss is 350% Greater Than Design
  • $ Impact Depends On $ of Energy $24K/Year
  • Greater Energy Loss = Lower Outlet Temp = Lower LHC Yield
  • 2.3 C Loss in Temperature Equates to > $2 Million USD/Year
  • Super Insulation Gives Up to 3.2 C Increase in Outlet
WHAT IS THE SOLUTION
SUPER INSULATION WITH PYROGEL HPS

Can Match Design Heat loss with 60mm of Pyrogel HPS
70mm gives >10% Improvement and Will Increase LHC Yield vs. Current
90mm Provides Cost/Performance Balance
150 mm Highly Effective Greatest Energy Savings and Yield Improvement
INCREASE PRODUCTION VS THICKNESS
PAYBACK FOR VARIOUS THICKNESSES

Incremental Payback For Various Pyrogel Thicknesses

<table>
<thead>
<tr>
<th>Thickness of Pyrogel HPS (mm)</th>
<th>Incremental Payback (yrs)</th>
</tr>
</thead>
<tbody>
<tr>
<td>60</td>
<td>0</td>
</tr>
<tr>
<td>70</td>
<td>0.5</td>
</tr>
<tr>
<td>80</td>
<td>1.0</td>
</tr>
<tr>
<td>90</td>
<td>1.5</td>
</tr>
<tr>
<td>100</td>
<td>2.0</td>
</tr>
</tbody>
</table>

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ESTABLISHED TRACK RECORD

- In 2012 a refiner replaced two drums in their six-drum unit, and insulated them with 60mm of Pyrogel.

- After a year in service, they noticed that new drums were running 10°F warmer than the four older drums that were still insulated with aging mineral wool.

- On their next new 4 drum unit they installed 100mm of Pyrogel.
  - The additional material cost was paid for by the unit’s higher production of liquid hydrocarbons.

- 8 years later this refiner continues to “Superinsulate” with Pyrogel. New Drums Contracted and in Fabrication are specified with 60 mm of Pyrogel HPS.

Pyrogel is now a the standard for every new DCU at a major global refiner.
DOES IT LAST?
CONE INSULATED SAME TIME AS DRUM AND HEAD BUT WITH PYROGEL INSTEAD OF MW

Bottom of Drum #5 East Side

<table>
<thead>
<tr>
<th>Label</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>SP01</td>
<td>124°F</td>
</tr>
<tr>
<td>SP02</td>
<td>90°F</td>
</tr>
<tr>
<td>SP03</td>
<td>178°F</td>
</tr>
</tbody>
</table>

Reflected temperature
DURABILITY OF THE MATERIAL
SUSTAINED PROTECTION

- In September, 2008, Category 4 Hurricane “Ike” tore through a Gulf Coast Refinery

- A 4-drum DCU was stripped bare of its insulation, rendering it inoperable & delaying the refinery’s re-start

- With no time re-insulate properly, they wrapped the drums with three layers of a then-new material, Pyrogel, as a temporary measure and left it exposed, with no jacketing

- 10 years later…
  - Still operating with the “temporary” Pyrogel, still with no jacketing

- 2019 drums being reinsulated with Pyrogel and proper Jacketing
WHAT ABOUT TRANSFER LINES
PROVEN BENEFITS OF LOWER HEAT LOSS AND INCREASED RUN TIMES

Refiner Experiencing 10C Drop From Furnance to Coker in Transfer Line Greater than original design Forcing them to Increase Furnace Temp

16” line 84 Meters Long

Insulated with 130mm of Mineral Wool

Looking to reduce furnace outlet from 491C back to 488 C
Pyrobel HPS The High Temperature Solution

All systems provide the same energy efficiency
## SOLUTIONS BEING CONSIDERED

### Table 1: Current Temperature Drop Comparison to Possible Solutions

<table>
<thead>
<tr>
<th>Insulation Type</th>
<th>Thickness (mm)</th>
<th>Calculated Temperature Drop (°C)</th>
<th>% Change Better than Current Temperature Drop</th>
</tr>
</thead>
<tbody>
<tr>
<td>Newly Installed</td>
<td>130</td>
<td>7.0</td>
<td>30%</td>
</tr>
<tr>
<td>Mineral Wool</td>
<td>190</td>
<td>5.3</td>
<td>47%</td>
</tr>
<tr>
<td></td>
<td>40</td>
<td>7.3</td>
<td>27%</td>
</tr>
<tr>
<td></td>
<td>50</td>
<td>6.0</td>
<td>40%</td>
</tr>
<tr>
<td>Pyrogel HPS</td>
<td>60</td>
<td>5.1</td>
<td>49%</td>
</tr>
<tr>
<td></td>
<td>70</td>
<td>4.5</td>
<td>55%</td>
</tr>
<tr>
<td></td>
<td>80</td>
<td>4.0</td>
<td>60%</td>
</tr>
<tr>
<td></td>
<td>90</td>
<td>3.7</td>
<td>63%</td>
</tr>
<tr>
<td></td>
<td>100</td>
<td>3.4</td>
<td>66%</td>
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</tbody>
</table>
After completing the feed line re-insulation with Pyrogel HPS, the duty rate on the DCU furnace reduced, we also increased time between spalling from weeks to months.

—Process Engineer on Mid West Refinery

User Feedback
LONG TERM ECONOMIC BENEFITS

- Increased Coker Outlet Temperature Leads to Higher LHC Yields

5.6°C ≈ 1%

Control & Flexibility of Process Temperature
- Feed & Overhead Lines
- Drums
- Better bottom coke formation
- Heat up cycle

Economic Benefits including
- Increased liquid yield
- Reduced Maintenance
- Lower Furnace Firing
- Reduced Drum Stress
THANK YOU FOR YOUR TIME
Please Visit Booth #14 For More Information