On-line Heater and Boiler Chemical Cleaning Technology
GTC’s fired heater cleaning solves common process feed heater problems

With rising pressure to reduce energy costs, GTC’s advanced fired heater/boiler chemical cleaning technology is an effective way to improve heater efficiency without shutting down plant operations. Our technology is designed to quickly remove deposits such as slag and other fouling materials that build up over time on tube fire side surfaces.

Fouling in the convection section caused by condensed and hardened ash can lead to lower efficiency and high temperature corrosion. In addition, slag in the radiation section caused by alkali metal compounds and molten ash can lead to higher fuel consumption, higher CO₂ emissions and lower throughput.

By implementing mechanical, operational and chemical measures, GTC can help clients eliminate slag buildup and other fire side fouling. Our technology is applicable for all furnaces that use residual or heavy fuel oil for firing. GTC uses chemical measures to significantly improve equipment throughput, lower fuel costs and reduce greenhouse gas emissions all without plant facility modifications. Additionally, our chemical fired heater cleaning technology can:

• Increase the melting point of vanadium oxide deposits
  – Creates alkali vanadates that have melting points in the range of 1,100 °C
  – Alters the V₂O₅ compounds on the tubes that are molten in the 600-800 °C range
• Create a slag that is easily broken up due to the creation of defects in the slag crystal structure and the introduction of point defects in the slag
• Improve and clean the tube fire-side surfaces by removing debris which extends the tube life
GTC Technology

GTC’s unique on-line heater cleaning technology

GTC Technology uses a high-performance, proprietary liquid chemical that has been consistently proven to protect heaters and boilers from damage. During the GTC fired heater cleaning process, the chemical is sprayed through specially designed nozzles, indirectly onto the radiant and convection tubes of the fired heater. The chemical vaporizes and covers the targeted exposed tube surfaces.

GTC’s process can also clean air preheaters (APH) through specially designed nozzles that inject additional proprietary chemicals into the flue gas. The chemicals vaporize and cover the surfaces of the air preheater, cleaning them in a similar manner as the firebox chemicals. This process can also be done without an APH bypass.

No physical, chemical, mechanical or thermal damages to our clients’ equipment have ever been observed or reported throughout the course of numerous fired heater cleaning services conducted. Higher efficiency rates have been recorded as a result of the proprietary GTC liquid chemicals utilized.

GTC’s liquid chemical process can significantly increase the heater efficiency rate compared to the use of solid blast cleaning methods. In addition, GTC’s injection velocity of material is lower than the solid blast cleaning technique. This is consistent with GTC’s commitment toward inherently safe processes. Our teams have had no safety incidents over the course of numerous furnace cleanings.

<table>
<thead>
<tr>
<th>Technology</th>
<th>Solid Blast</th>
<th>GTC</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chemical Type</td>
<td>Granule</td>
<td>Liquid</td>
</tr>
<tr>
<td>Injection Velocity</td>
<td>High</td>
<td>Low (4.5 Kg/cm²)</td>
</tr>
<tr>
<td>Cleaning Method</td>
<td>Phys/blast direct contact</td>
<td>Chemical gas flow</td>
</tr>
<tr>
<td>Coverage Area</td>
<td>Radiation section or limited convection section</td>
<td>Full coverage (convection and radiant sections)</td>
</tr>
<tr>
<td>Application</td>
<td>Small size</td>
<td>Small–large size</td>
</tr>
<tr>
<td>Heater Efficiency Rise</td>
<td>~3%</td>
<td>~4%</td>
</tr>
</tbody>
</table>
**Proven benefits of using GTC’s heater cleaning services**

GTC's fired heater cleaning services have been proven to be effective in a wide range of commercial applications at numerous refineries and plants. In addition to the rapid and efficient cleaning of fired heaters and boiler tubes, our technology helps plant managers extend time between major fired heater/boiler maintenance jobs and keeps plants operating at peak performance. Other benefits of GTC's fired heater cleaning services include:

- Enhanced equipment efficiency and increased feed throughput
- Increased processing capacity due to increased radiation/convection heat transfer
- No damage to equipment components such as refractory material, tube shields, supports or guides
- Reduced overall firebox temperature
- A quick cleaning procedure that lasts 2-5 days, depending on heater geometry, layout, operations and conditions
- Lower fuel consumption per unit of feed processed

**Economic advantages of advanced chemical cleaning**

A brief economic analysis is listed in the table below and reflects the substantial financial benefits our clients have gained by using GTC fired heater cleaning services. The typical payback ranges from 10-15 days for refineries through increased capacity.

**Economic Analysis* of GTC's Heater Cleaning Technology**

<table>
<thead>
<tr>
<th>Source of Benefit</th>
<th>Annual Benefit (M$)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reduced fuel consumption</td>
<td>$218</td>
</tr>
<tr>
<td>Avoidance of equipment shutdown</td>
<td>$1,250</td>
</tr>
<tr>
<td>Capacity increase</td>
<td>$1,825</td>
</tr>
<tr>
<td><strong>TOTAL ANNUAL BENEFIT</strong></td>
<td><strong>$3,293</strong></td>
</tr>
</tbody>
</table>

*Basis: For a crude distillation unit (CDU) with a capacity of 50,000 bbl/day, using a fuel oil price of $40/bbl, unit throughput capacity increase of 2% and a feed stock margin of $5/bbl.
Commercial Data on Temperature Reduction* and Capacity Increase

<table>
<thead>
<tr>
<th>Case #</th>
<th>Unit Type</th>
<th>Arch Temperature Drop in (°C)</th>
<th>Post-Cleaning Increase in Capacity, bbl/Day</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>CDU</td>
<td>120</td>
<td>2,600</td>
</tr>
<tr>
<td>2</td>
<td>CDU</td>
<td>129</td>
<td>8,000</td>
</tr>
<tr>
<td>3</td>
<td>CDU</td>
<td>117</td>
<td>8,000</td>
</tr>
<tr>
<td>4</td>
<td>CDU</td>
<td>117</td>
<td>8,300</td>
</tr>
<tr>
<td>5</td>
<td>CDU</td>
<td>108</td>
<td>6,800</td>
</tr>
<tr>
<td>6</td>
<td>VDU</td>
<td>102</td>
<td>4,500</td>
</tr>
<tr>
<td>7</td>
<td>VDU</td>
<td>120</td>
<td>8,300</td>
</tr>
<tr>
<td>8</td>
<td>VDU</td>
<td>88</td>
<td>6,800</td>
</tr>
</tbody>
</table>

*Commercially realized reduction in arch temperature and the accompanying increase in processing capacity.

Typical Case of Fuel Savings Observed Commercially*

<table>
<thead>
<tr>
<th>Key Metrics</th>
<th>VDU</th>
<th>CDU</th>
</tr>
</thead>
<tbody>
<tr>
<td>Increase in efficiency</td>
<td>2%</td>
<td>3%</td>
</tr>
<tr>
<td>Heater fired duty (MMkcal/hr)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Before cleaning</td>
<td>13.9</td>
<td>50.9</td>
</tr>
<tr>
<td>After cleaning</td>
<td>13.6</td>
<td>49.1</td>
</tr>
<tr>
<td>Saving in fired duty (MMkcal/hr)</td>
<td>0.3</td>
<td>1.8</td>
</tr>
<tr>
<td>Saving from lower fuel consumption</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Kg/hr</td>
<td>31.6</td>
<td>188.4</td>
</tr>
<tr>
<td>Tons/year</td>
<td>270</td>
<td>1,630</td>
</tr>
<tr>
<td><strong>ANNUAL SAVINGS</strong></td>
<td><strong>$54,570</strong></td>
<td><strong>$325,600</strong></td>
</tr>
</tbody>
</table>

*Typical fuel savings observed commercially in vacuum distillation units (VDU) and atmospheric crude distillation units (CDU).

Engineered to innovate

To learn more about GTC Technology’s advanced fired heater technology and the many ways we can help improve your operations and profitability, call us today at +1-281-597-4800, e-mail us at inquiry@gtctech.com, or visit our Web site at [http://www.gtctech.com](http://www.gtctech.com).
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