Energy optimization for maximum energy saving with optimal modification in Continuous Catalytic Regeneration Reformer Process

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\textbf{A B S T R A C T}

The heat integration retrofit analysis of the Continuous Catalytic Regeneration Reformer Process (CCRRP) was conducted to determine the major opportunities for maximum energy saving via optimal modifications of the process design. Process data used from a real existing CCRRP were extracted, which are applicable in the pinch analysis technique (PAT). The present investigations of analysis showed a great opportunity for reducing energy consumption and costs at an optimum minimum approach temperature of 40 °F. Retrofit analysis of current process to achieve the optimal modifications of process included three additional heat exchangers with shells tube of two heat exchangers according to reduction in \( \Delta T \text{min} \) from 87 °F to 40 °F. The evaluation of maximum energy savings as new design indicated the reduction of utilities by about 32%, which led to reduce of the total cost index (Cost/s) in the process of approximately 4.5%.

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and environmental effect of fuels combustion recently has forced the operation of energy-intensive process in economical and efficient good approaches. The process operations are a main part of an economy, which always strives to develop its performance in order to provide the best solutions to reduce energy utilization, decreasing greenhouse gases emissions as well as by-products of industry combustion. Thus, high percentage of the operating cost in any process industry is considered by the fuel constitutes. All efforts towards minimising of consumption have corresponded not only to reduce hazardous gases emissions but also to increase profitability associated with energy savings [8,9].

One of the approaches for considering heat integration and improving of heat exchanger networks design is pinch analysis method. The pinch analysis of chemical process uses thermodynamics heuristics and concepts. The pinch analysis concept has been applied to design a new process with reduced costs of energy and capital as well as for improving current processes efficiency.

The modification of heat exchanger network design often added

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Stream name</th>
<th>Supply temperature Ts (°F)</th>
<th>Target temperature Tt (°F)</th>
<th>Heat capacity flow rate CP (MMBtu/h °F)</th>
<th>Enthalpy (MMBtu/h)</th>
</tr>
</thead>
<tbody>
<tr>
<td>HS-1</td>
<td>Reactor purge effluent</td>
<td>977</td>
<td>308</td>
<td>0.000658</td>
<td>0.44</td>
</tr>
<tr>
<td>HS-2</td>
<td>Reactor effluent</td>
<td>977</td>
<td>130</td>
<td>0.491145</td>
<td>415.99</td>
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<tr>
<td>HS-3</td>
<td>Debutanizer bottom</td>
<td>413</td>
<td>120</td>
<td>0.225255</td>
<td>65.99</td>
</tr>
<tr>
<td>HS-4</td>
<td>Spillback cooler</td>
<td>277</td>
<td>130</td>
<td>0.012000</td>
<td>1.76</td>
</tr>
<tr>
<td>HS-5</td>
<td>Net gas cooler</td>
<td>198</td>
<td>130</td>
<td>0.329118</td>
<td>22.38</td>
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<tr>
<td>HS-6</td>
<td>First stage net gas</td>
<td>177</td>
<td>130</td>
<td>0.422553</td>
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<tr>
<td>HS-7</td>
<td>Debutanizer overhead condenser</td>
<td>150</td>
<td>118</td>
<td>0.843750</td>
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<tr>
<td>CS-1</td>
<td>Feed naphtha</td>
<td>243</td>
<td>1020</td>
<td>0.718147</td>
<td>558</td>
</tr>
<tr>
<td>CS-2</td>
<td>Recycle gas</td>
<td>232</td>
<td>951</td>
<td>0.000612</td>
<td>0.44</td>
</tr>
<tr>
<td>CS-3</td>
<td>Debutanizer re-boiler</td>
<td>413</td>
<td>480</td>
<td>0.164030</td>
<td>10.99</td>
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<tr>
<td>CS-4</td>
<td>Platformer product</td>
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<td>324</td>
<td>0.270531</td>
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</tr>
<tr>
<td>CS-5</td>
<td>Recycle gas heater</td>
<td>100</td>
<td>300</td>
<td>0.012000</td>
<td>2.4</td>
</tr>
</tbody>
</table>
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