Praxair’s Refinery Gas Processor: Can Process Almost Any Refinery Gas Stream

Unique Technology to Address Refinery Operating Issues
Improving refinery processing energy efficiency and environmental emissions (CO₂ and SOx) is often limited by the production and quality of refinery fuel gas. Praxair’s refinery gas processor (RGP) is a proprietary technology that can alleviate refinery fuel gas constraints and allows refiners to convert almost any refinery fuel gas stream to an acceptable steam methane reformer (SMR) feed. An alternative application of RGP involves conversion of organic sulfur to hydrogen sulfide which, when combined with conventional amine treating technology, removes organic sulfur from refinery gas and allows refiners to meet sulfur dioxide emissions requirements at a significantly lower cost than other hydrotreating options. This makes RGP a unique technology for refiners since it can address two separate and major operating issues.

Relieve Refinery Fuel Gas Constraints
Today, in choosing gas as a feed to SMRs, refiners select a gas that is preferably high in hydrogen and low in olefins. The high-hydrogen gas can be routed directly to the PSA and the low-olefin content allows treatment with natural gas pre-treatment technologies. But, these feed-gas attributes can limit the ability of the refinery to use the SMR to consume excess refinery fuel gas. Praxair’s RGP can convert almost any refinery fuel gas stream to acceptable SMR feed. **If a refinery replaces 25% of the natural gas feed with refinery fuel gas, this equates to ~5 billion BTUs for 50 million standard cubic feet of hydrogen.**

Beyond relieving fuel gas constraints with SMRs, feeding refinery fuel gas to cogeneration facilities to replace natural gas can be a valuable tool that the refinery can use in dealing with fuel gas, surplus issues. RGP technology can condition refinery gas so it can be used as fuel in gas turbines with low NOx combustors.

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<table>
<thead>
<tr>
<th>Refinery Fuel Gas</th>
<th>Olefins mol%</th>
<th>Hydrogen mol%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Coker Off-Gas</td>
<td>4%</td>
<td>8.5% to 9%</td>
</tr>
<tr>
<td>Segregated FG Drum (predominately FCC)</td>
<td>8 to 11.5%</td>
<td>9% to 15%</td>
</tr>
<tr>
<td>Segregated FG Drum (without FCC)</td>
<td>0.5 to 3%</td>
<td>20% to 30%</td>
</tr>
<tr>
<td>FCC Off-Gas¹</td>
<td>15% to 23%</td>
<td>9% to 20%</td>
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</tbody>
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¹ Will likely require hydrogen or steam addition
Meet SO₂ Emissions Requirements

Higher levels of organic sulfur and carbonyl sulfide (COS) in the FCC, visbreaker and coker units off-gas are not effectively removed with conventional amine treating. Caustic treating is effective, but operating and disposal cost can be prohibitive. To be effective at the low pressures, conventional hydrotreating requires high residence time, resulting in bigger, more expensive equipment and potentially higher capital costs. Praxair’s RGP can cost effectively convert organic sulfur and COS to H₂S at typical coker off-gas pressures with a significantly lower capital cost than other hydrotreating options.

How it Works

The RGP is a patented Praxair technology based on a novel short contact time catalyst capable of operating at residence time that is an order of magnitude lower than conventional hydrotreating technologies (space velocity of at least 50,000 hr⁻¹⁻¹). This catalyst has an extended temperature window of operation (300°-1600°F) which permits operation with levels of olefins previously unachievable without feed dilution. The unique catalyst and short residence allow for all types of refinery gas to be treated. In addition, for most applications low reactor inlet pressures are acceptable.

Praxair demonstrated the technology over a three-year period (2007-2009) and was able to show that the technology is uniquely capable of treating refinery gas. The unit operated with 17% olefins and 450 ppm organic sulfur in the feed.

Low Capital with Minimal Downtime

The low residence time reaction system and simple, flexible configuration options make the refinery gas processor a low-capital-cost, extremely flexible tool for the refinery to use in its fuel gas optimization program. The system requires no downtime to install and unlike conventional hydrotreaters, the Praxair’s RGP system would be delivered in two to three modules on skids.

Why Praxair

Praxair has more than 50 years of experience operating hydrogen supply systems around the world. We currently operate over 40 hydrogen production facilities and have a deep understanding of hydrogen and refinery operations. Praxair’s dedicated refinery team is continuously working to provide refiners with practical approaches to real industry issues.

To learn how Praxair fuel gas management applications can benefit your facility, visit us at www.praxair.com or call 1-800-PRAXAIR (or 716-879-4077 from outside the U.S.).