Maximize Distillate Yield to Meet Growing Market Demand

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Despite a mild winter thus far, industry analysts forecast ULSD demand growth in the second half of 2012. This is in part due to global demand growth for middle distillates and in part due to new sulfur regulations set to take effect later this year. In 2012, the State of New York will become the first state to require that all oil used for heating meet ULSD standards, which means that No. 2 heating oil sulfur levels will have to be reduced to 15 ppm. Other Northeast states have announced dates to phase-in ULSD for heating oil. The pending regulations could raise regional ULSD demand by 20%. Over the last 6 months, over 50% Northeast refining capacity has been idled as well as the HOVENSA refinery in the Virgin Islands, which was a major importer of transportation fuels into the Northeast. The loss of refining volume serving the Northeast coupled with bottlenecks in the transportation network from the Gulf Coast could potentially result in high prices and potential shortages of ULSD in New York, Pennsylvania, and New England.

**FCC and ART Synergy**

Refiners with additional sulfur removal capacity can increase profitability by maximizing the refinery yield of ULSD. If you have room to process additional FCC LCO in your diesel hydrotreaters, Grace® and Advanced Refining Technologies® technical service can work with you to help maximize your refinery profitability by enhancing both the yield and quality of your diesel and heating oil blending streams. We’ve published numerous articles on the topic, which illustrate that the greatest challenge in a max LCO operation is managing the incremental bottoms yield that accompanies a reduction in unit operating severity. Positive yield impact can be achieved via an optimization of key operating variables discussed below.

<table>
<thead>
<tr>
<th>Competitive Catalyst</th>
<th>GENESIS® 1 (Max Gasoline) relative to base</th>
<th>GENESIS® 2 (Max LCO) relative to base</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gasoline, lv.%</td>
<td>Base</td>
<td>+3.0</td>
</tr>
<tr>
<td>LCO, lv.%</td>
<td>Base</td>
<td>+1.5</td>
</tr>
<tr>
<td>Bottoms, lv.%</td>
<td>Base</td>
<td>-1.5</td>
</tr>
</tbody>
</table>

**TABLE 1: GENESIS® Catalyst Delivers Flexibility to Shift Between Gasoline and LCO Operating Modes**
Maximizing LCO from the FCCU

In general the following process changes should be made as a refinery moves from a maximum gasoline/conversion operation to a maximum LCO operation:

- Remove diesel range material from the FCC feedstock
- Reduce gasoline endpoint
- Reduce FCC conversion by
  - Reducing riser outlet temperature;
  - Raising feed temperature and;
  - Lowering Ecatalytic activity
- Initiate HCO or slurry recycle
- Optimize catalyst formulation

Increased slurry cracking and maintaining both the C₃+ liquid yield and gasoline octane are key requirements of a maximum LCO catalyst system. In general, a maximum LCO catalyst is a low zeolite/matrix surface area catalyst with low to moderate activity and excellent slurry cracking qualities.

Grace has several low Z/M catalyst options to help you increase LCO yield. The workhorse high MSA catalyst in our portfolio is MIDAS®, which is well suited for any refiner seeking deep bottoms conversion. MIDAS® has been applied in over 100 refineries (Figure 1), alone or as part of a GENESIS® catalyst system. MIDAS® can increase FCC LCO yield and profitability by as much as $1.50/bbl.

Any refiner can take advantage of short term economic opportunities with a GENESIS® catalyst system. By simply adjusting the blend ratio of two complete FCC catalysts, we can shift the Z/M ratio of the total blend and deliver a significant selectivity shift in a short period of time. The refinery in Table 1 was able to improve profitability by shifting the catalyst formulation as well as operating conditions to match current market demand.

New Additions to the Portfolio

We are also pleased to offer two new choices for maximizing LCO and bottoms conversion the FCC. REBEL™ is the only 100% rare-earth-free high matrix FCC catalyst solution available in the marketplace. Introduced in the wake of the rare-earth crisis of 2011, REBEL™ utilizes Z-21 zeolite technology and is in nine commercial applications at press time. In testing, REBEL™ has been shown to have equivalent activity relative to MIDAS® in low to moderate metals environments. These yield shifts have been confirmed by several third party laboratories. Figure 2 demonstrates how without rare earth, REBEL™ achieves the similar activity (cat-to-oil ratio) as the rare-earth exchanged MIDAS® catalyst. In commercial testing, REBEL™ retained bottoms conversion and helped to maintain catalyst addition levels at baseline.

Another challenge of a max LCO operation is maintaining total liquid volume. LPG and gasoline may still be important products from the FCC even when diesel pricing is at a premium. In order to maximize total yield (and dollars) it is important to appropriately balance zeolite, matrix and activity. For those units that want to drive to maxi-
mum total fuels (gasoline + distillate) yield, but still require activity to stay within unit constraints, we recommend ALCYON® M technology. ALCYON® M combines the high activity zeolite of ALCYON® with the proprietary matrix architecture of MIDAS® in a single FCC catalyst that is primed to deliver deep selective bottoms conversion while maintaining total liquid yield. High hydrogen transfer activity in ALCYON® M facilitates conversion of the bottom of the barrel of aromatic feedstocks, such as those derived from coker gasoils and Canadian heavy crudes. If you still require more LPG, Grace’s light olefins additives such as OlefinsUltra® and OlefinsUltra® HZ can be pre-blended with your fresh catalyst to maintain LPG olefinicity despite reduced FCC severity.

In summary, Grace has multiple catalyst solutions in order to maximize LCO yield in your FCC. MIDAS® is our benchmark bottoms conversion catalyst, with commercial success well documented in over 100 refineries around the world. The same conversion capability can now be achieved without rare earth, which is available in the new Grace REBEL™ catalyst technology. Now in nine applications and growing, REBEL™ delivers similar activity and bottoms cracking conversion as MIDAS®. Lastly, for those units desiring deep bottoms conversion, but without sacrificing in-unit activity to get there, we can offer ALCYON® M catalyst. Designed for short contact time units desiring deep bottoms conversion, ALCYON® M will crack the bottom of the barrel without giving up activity or violating unit constraints such as circulation rate.

Contact your ART and Grace technical service reps to understand just how much more LCO you can produce and treat to maximize ULSD yield and profitability in 2012.

References


