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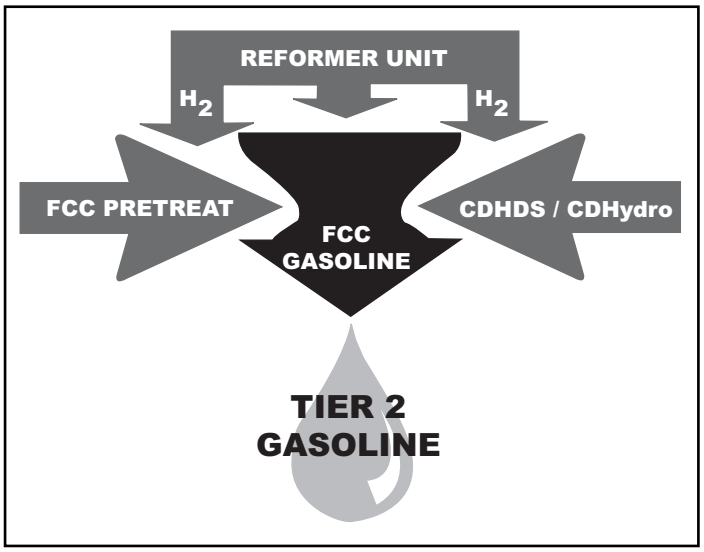
Tier 2 Gasoline Strategies: Add Up The Angles for the Most Profitable Answer

By Carol Cole, Editor, Octane Week

When developing a strategy to meet future demands for Tier 2 gasoline, it is tempting to rely strictly on the lowest-cost method for desulfurizing the Fluid Cat Cracker (FCC) gasoline. However, this approach can waste money in both the short- and long-term.

Criterion Catalysts & Technologies L.P. has a different strategy. An essential part of that strategy is to minimize the customers' capital investment by developing site-specific solutions that use existing assets as much as possible. To accomplish this, Criterion has developed a wide range of tools to help refiners attack the problem from a number of angles. This approach enables the customer and Criterion to create an integrated, refinery-wide solution that maximizes the customer's financial return.



"When preparing for the Tier 2 gasoline specifications, we encourage refiners to consider a number of options," said Vito Bavaro, FCC Pretreat business manager for Criterion. "First, the 30 ppm sulfur requirement can be addressed several ways: 100% pretreatment of the FCC feed, 100% post-treatment or a combination. Additionally, we want to work with the customer to squeeze all the octane barrels we can from sources like the reformer, hydrocracker and C_5/C_6 isomerization units.

"When the industry first considered whether it could meet 30 ppm gasoline sulfur specification with only FCC pretreatment, many suppliers said no," Bavaro commented. "Our experience gave us a different view. We haven't found a case where it isn't possible to produce a Tier 2-quality gasoline component solely with an existing FCC pretreater. And it doesn't take huge investments - just innovative catalyst design and better equipment utilization. We have learned that eliminating sulfur from FCC gasoline with pretreatment is not always straightforward. There are many variables, besides the feed's sulfur content, such as feed aromatics and nitrogen content, that determine how sulfur will distribute in the FCC gasoline." So, the choice of catalysts and the operation mode for the FDD pretreater are critical. Also, the effectiveness of the reactor internals and the fractionation play an important part in achieving the desired result. "Criterion has the skills, the experience and technologies to help the customer tackle all these issues to develop the most profitable solution," said Bavaro.

That's good news for refiners, because compared to other clean fuels strategies, FCC pretreatment provides the best opportunity to earn a positive return on investment despite its higher cost. Traditionally, FCC feed pretreatment was driven by reducing sulfur oxide emissions from the FCC regenerator. This is still important today to comply with stationary source emissions limits and prevent costly production losses or litigation. However, increasing the FCC unit's profitability is now another major driver for FCC feed pretreatment. The reactions that occur in the FCC pretreater produce significant increases in valuable lighter products and gasoline. Additionally, feed pretreatment enables refiners to take advantage of margin-enhancing opportunity crudes. Pretreatment also helps with the tricky light-cycle oil (LCO) cut, which is becoming a significant issue with the introduction of ultra-low sulfur diesel (ULSD) fuel regulations. While the LCO from treated feeds is

generally more aromatic than LCO from untreated feeds, pretreatment reduces the LCO volume as well as the sulfur content. This volume reduction more than offsets the impact of the LCO's lower cetane number (resulting from higher aromatic content) on the diesel blending pool.

"The creed we live by," Bavaro said, "is, remove sulfur from the FCC as a public service: saturate aromatics for profit." This appears to be a philosophy more and more refiners are adopting. Currently, the amount of pretreatment in the U.S. is only 25% of FCC capacity even though 50% of FCC units have a pretreater. However, a large number of FFC pretreaters will be undergoing revamps over the next few years to expand capacity, and a significant number of new projects - grassroot units or resid unit conversions - are underway.

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For many refiners, post-treatment of the FCC gasoline will be a key part of the Tier 2 gasoline supply strategy. Here, Criterion can help refiners maximize the number of octane barrels using a unique approach developed by its affiliate CDTech. Building on its vast experience in catalytic distillation processes, CDTech created a novel post-treat process that enables refiners to achieve the highest desulfurization with the lowest octane loss. CDTech's design also increases the opportunity to reduce capital investment by using existing refinery equipment. Despite its unique, innovative design, CDTech's process has met original expectations from the start. Considering the number of other technology licensors who have had to redesign their post-treat processes to address commercial performance problems, CDTech's success rate is an impressive accomplishment.

"Our motto is 'get it right the first time,'" said CDTech manager Kerry Rock. And that is just what CDTech did when it designed and commissioned the CDHDS®, unit at Motiva's Port Arthor, Texas, refinery nearly two years ago, CDTech "got it right" again when its first combined CDHydro®/CDHDS was successfully commissioned 18 months ago at Irving Oil's New Brunswick, Canada, refinery. Coming on line now is a combined CDHydro/CDHDS unit at Texaco's Pembroke, UK refinery.

These three units are just the start for CDTech. Currently, licensed units in engineering and construction total over 7000,000 b/d at 24 refineries, according to Rock. More than half those units are desulfurizing gasoline well below the Tier 2 standard. Just to give an idea of the capability of the CDTech technology. Rock said those facilities are targeting 10ppm sulfur in the total gasoline pool.

Despite the skeptics, CDTech has shown that catalytic distillation does work, but commercial experience shows extremely stable catalyst performance that can meet or exceed the FCC cycle. "The catalytic distillation environment promotes long catalyst stability without diolefin pretreatment," Rock confirmed. "The refluxing nature of catalytic distillation removes precursors that normally coke the catalyst, and the high-efficiency CDModule catalytic distillation packing maintains efficient liquid distribution that supports catalyst activity and longevity. Refinery planners want five-year FCC cycles. Not having to interrupt that cycle to do a turnaround on the FCC gasoline post-treatment unit ia an important economic and operational consideration."

Using its many years of experience in reforming, hydrocracking and isomerization, Criterion can also identify strategies for increasing Tier 2 gasoline output from these refining units. In the case of naphtha reforming, Criterion's researchers have devoted substantial time and energy boosting the yields, activity and stability of its reforming catalysts. As a result, Criterion has catalysts that can significantly improve the performance of semi-regen, cyclic and CCR units. "Typically, Criterion has helped its customers realize 1-2 wt% greater reformate yields and 100-200 Scf/bbl more hydrogen by using improved catalysts and implementing better operating practices," said Sonny Phansalkar, Criterion's Reforming business manager. "So, this is an easy way for a refiner to quickly improve the quality of the gasoline pool." Wherever possible, Criterion has lowered the content of platinum on its reforming catalysts to keep cost down and accelerate the payout for new catalyst.

Criterion's research has focused upstream of the reformer as well to ensure the reforming catalysts achieve optimal performance, "We have developed leading-edge catalysts such as DN-200 and DN-140 to improve the naphtha hydrotreater's performance, especially when processing tough feeds like naphtha from a delayed coker, which has high nitrogen levels and contains silica that poisons the catalyst," stated Phansalkar. "DN-140, for example, can usually take on 20-25 wt% silica before performance deteriorates. With the increased capacity to process FCC and coker naphthas, these catalysts offer reliable protection of the reformer operation and potential to raise reformate production."