RUBY—a novel FCC catalyst for vacuum gas oil cracking

A number of refiners around the world are reporting major benefits to their fluidized catalytic cracking operations after applying RUBY—Albemarle's new high-accessibility FCC catalyst. Designed specifically for vacuum gas oil (VGO) or heavy vacuum gas oil (HVGO) applications, RUBY catalyst is already in use in more than 13 FCC units worldwide.

Albemarle also offers other high-accessibility catalysts, CORAL and CORAL SMR, for resid FCC applications. Applied in plants worldwide, these catalysts are optimizing lower-bottoms yields, improving metals resistance, and increasing conversion levels.

Enhancing selectivity, maximizing yield

RUBY catalyst enhances selectivity, as it increases the rate at which primary reaction products diffuse out of the catalyst particles. Figure 1 shows how the increased Albemarle Accessibility Index (AAI) of RUBY results in enhanced olefinicity of the FCC products. The improved diffusion of feed molecules into the catalyst particle accelerates the primary cracking reaction. Faster diffusion of the cracked products reduces the residence time in the catalyst particle and thus suppresses secondary reactions. Yields of primary products, such as olefins, are therefore maximized.

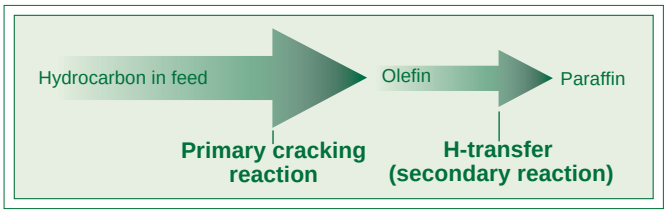

Figure 1: With its higher catalyst accessibility, RUBY catalyst accelerates primary cracking reactions and suppresses secondary reactions to maximize the yield of primary products.

Traditionally, refiners have been forced to compromise between gasoline yield and octane number. For instance, an increase in the rare earth content of conventional FCC catalysts enhances gasoline yield, but at the expense of octane. Albemarle's high-accessibility catalysts, however, provide a valuable breakthrough. RUBY simultaneously enhances both gasoline yield and octane number, as shown in Figure 2. Over-cracking and hydrogen transfer of gasoline components are prevented by the preservation of primary products.

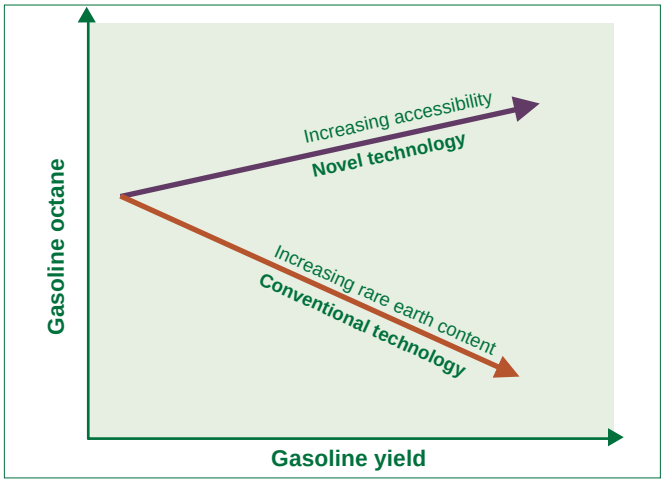

Figure 2: The development of high-accessibility catalysts enables refiners to simultaneously increase gasoline octane and yield.

Test data on VGO feeds

A series of tests was performed to determine the differences in yields between RUBY (with high AAI) and conventional catalyst samples (with normal AAI).

Twenty-eight catalyst samples were prepared, using 14 catalyst formulations. Each catalyst formulation was made with

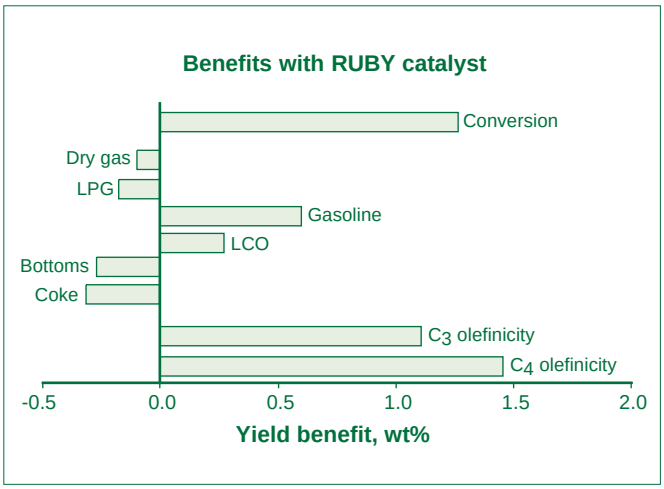

Figure 3: Tests showed the across-the-board yield improvements obtained with RUBY catalyst.

"Faster diffusion of the cracked products reduces the residence time in the catalyst particle and thus suppresses secondary reactions."

standard and with increased accessibility (our manufacturing technology enables us to vary the AAI without changing the catalyst formulation). These 14 sets of catalysts were deactivated and tested with different protocols. Cyclic deactivation with low metals levels or steaming was applied, followed by a conventional micro-activity test (MAT), and tests in small-scale fluidized bed reactors: the Fluid-bed Simulation Test (FST) and the Short Contact Time Resid Test (SCT-RT). Each deactivated sample was tested at various catalyst-to-oil ratios to enable selectivity comparisons at constant conversion levels. Figure 3 shows the average results of these tests. The conversion is compared at a constant catalyst-to-oil ratio; the various yields are compared at constant conversion levels. These test data demonstrate that RUBY catalyst provides:

- Higher catalyst activity
- Better bottoms cracking
- Higher gasoline selectivity
- Better coke selectivity
- Lower dry gas levels
- Higher LPG olefinicity
- Higher gasoline octane numbers

Commercial success

Feedback from 12 commercial units has confirmed the test data. As shown in Figure 4, RUBY catalyst on average reduced bottoms yield by 1.7 wt%. Figure 5 shows that the improvement in bottoms cracking resulted in enhanced conversion levels in each case, with an average conversion increase of 1.9 wt%. RUBY has proved its ability to maximize bottoms conversion and optimize the product slate. This breakthrough, high-accessibility FCC catalyst is setting new standards for refiners in dramatically performance improvements and enhanced margins.

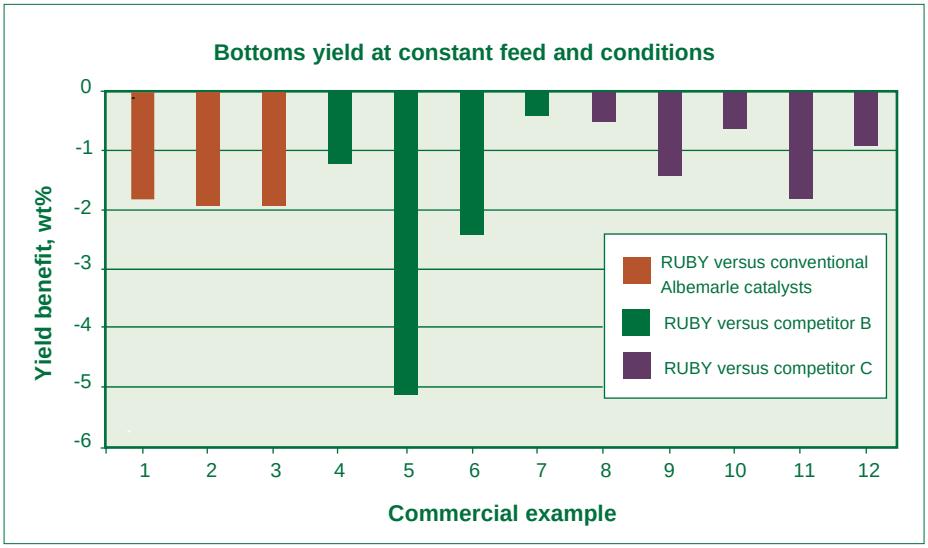

Figure 4: Customer data show substantially reduced bottoms yield with RUBY catalyst.

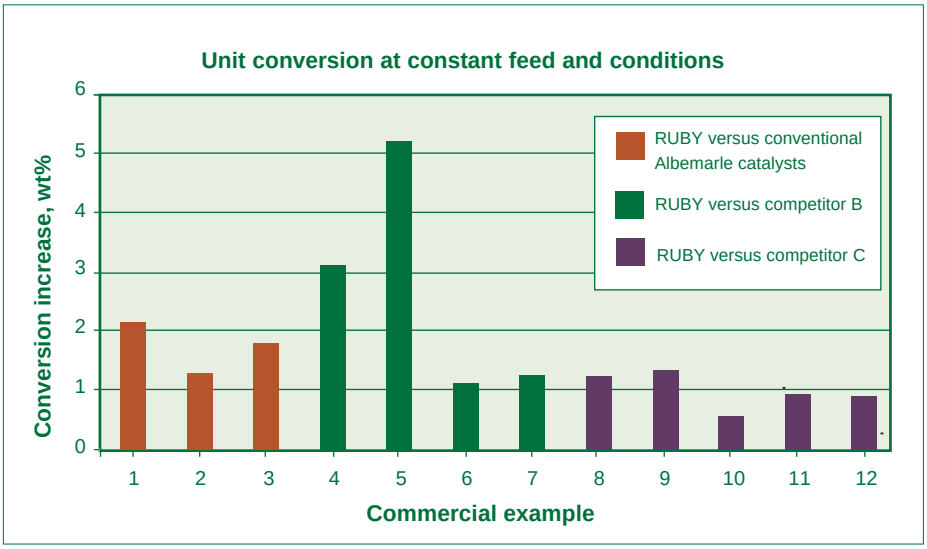

Figure 5: Customer data show major improvements in conversion levels with RUBY catalyst.

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