FCC ADDITIVES

ALBEMARLE®

SCAVENGER™ – Superior sulfur reduction in any FCC situation

Many streams contribute to the overall gasoline pool of a refinery, but naphtha from the FCC unit is, in most cases, the largest contributor of sulfur. Consequently, even small reductions in fuel sulfur levels from the FCC unit translate into large gains for refiners.

Fuel sulfur reduction (FSR) additives have undergone constant development since their introduction in the late 1990s. The first generations offered only modest sulfur reductions and only from the hydrogen-rich sulfur compounds in the lighter end of the gasoline range.

Subsequent efforts have focused on understanding the relationship between the catalytic composition of active additive components and the reaction pathways of the individual sulfur species present in the full range of FCC transportation fuel products.

A successful FSR additive reduces the entire spectrum of sulfur species in the FCC naphtha without detrimental effects on octane or selectivity. Non-capital alternatives, such as undercutting, significantly diminish the naphtha yield and the octane from the FCC unit. Capital-intensive FSR alternatives include feed hydrotreating and naphtha post-treating. Feed hydrotreating is quite effective; however, the capital expenditure associated with commissioning a feed hydrotreater is significant. Because post-treaters only need to process a fraction of the FCC feed volume, the associated capital expenditure is less, but not insignificant. The primary disadvantage of post-treaters is octane loss, typically two or more octane numbers.

SCAVENGER FSR additive works with paraffinic, aromatic, hydrotreated and non-hydrotreated feeds.

How SCAVENGER works

SCAVENGER removes fuel-range sulfur compounds by two primary routes (Figure 1). Mercaptans and alkyl-thiophenes are hydrogen-rich sulfur-containing molecules that occur in the lighter fractions of FCC-range gasoline. The additive selectively cracks the sulfur out of these and releases it as hydrogen sulfide (H_2S) in the riser. It also minimizes the recombination reaction of H_2S into mercaptans and thiophene.

Heavier, more hydrogen deficient, and aromatic naphtha-range compounds such as benzothiophene and alkyl-benzothiophenes are selectively captured and converted to coke. The sulfur-rich coke is transported into the FCC regenerator where it is burned. This selective coking does not affect the overall coke or delta coke make because the mass of the additional coke is insignificant relative to the mass of coke required by the heat balance of the FCC unit.

To combat potential increases in SOx from combustion of the sulfur-rich coke, SCAVENGER contains integral active SOx reduction sites. As a result, SOx emissions are often considerably lower than the base case through the use of SCAVENGER.

Take advantage of SCAVENGER

Refiners can realize the benefits of SCAVENGER by

- reducing the naphtha sulfur at constant endpoint
- increasing the FCC feed sulfur at constant product sulfur and endpoint
- increasing the product endpoint, which thereby increases the product volume at constant naphtha sulfur and feed sulfur levels
- any combination of the above.

It is important to understand how the benefits of SCAVENGER will be taken advantage of at your refinery. A change in how the benefit is realized is often mistakenly perceived as poor product performance.

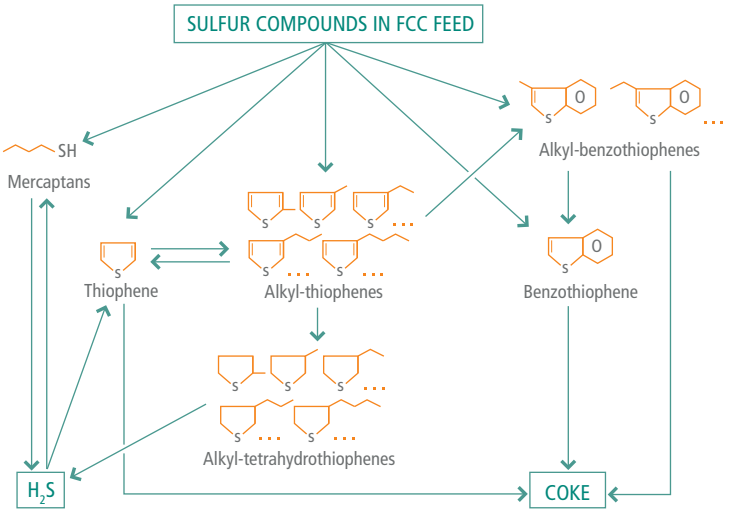

Figure 1: The mechanisms for FSR with SCAVENGER.

In conjunction with other FSR options

Refiners use SCAVENGER in two ways: as part of everyday operations (structural use) and to meet short-term criteria (opportunistic use).

Structural use

- As a low-cost alternative to large capital hydrotreating projects
- To delay or postpone the installation of feed hydrotreaters or post-treaters while maintaining regulatory compliance
- When installing a smaller feed hydrotreater or post-treater to offset total capital outlay
- For reducing hydrotreating costs, mainly hydrogen consumption
- For increasing the throughput through the FCC unit and the hydrotreater train

Opportunistic use

- To minimize the throughput impact during a hydrotreater outage
- To increase the run length of onstream hydrotreaters
- So higher sulfur feedstocks can be sent to the FCC unit while maintaining regulatory compliance
- To increase the refinery gasoline pool's octane by bypassing part of the FCC naphtha streams around post-treaters to make up for octane shortfalls

A structural user of SCAVENGER at 7% in inventory initially realized a 40°C increase in endpoint at constant product sulfur (Figure 2). This resulted in a significant naphtha volume gain. Then the refiner lowered endpoint to the base-case conditions. The result was a 30% reduction in naphtha sulfur at constant gasoline volume relative to the base case. This demonstrates the not only performance of the additive, it also shows two of the ways that refiners can take advantage of the benefits of the additive.

These just some of the ways refiners employ Albemarle FSR additives such as SCAVENGER to meet fuel sulfur regulations and drive up the profitability of the FCC unit. SCAVENGER can offer significant improvements relative to the base conditions at your refinery.

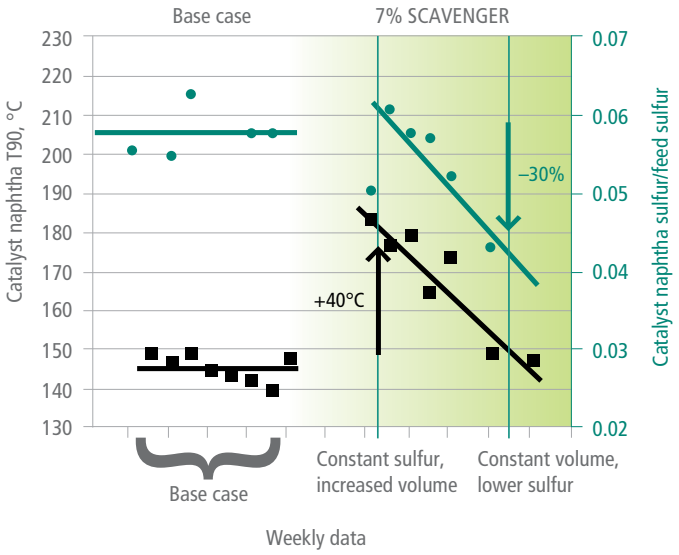

Figure 2: Commercial experience with SCAVENGER at 7% in the inventory shows a significant sulfur reduction.

Typical product properties	↘
Additive name	SCAVENGER
Application	Fuel sulfur reduction
Attrition index, wt%	2
Average bulk density, g/ml	1.00
Surface area, m^2/g	80
Particle size distribution (0–40), %	18

↘ For more information on this or other Albemarle products and technologies, please contact your Albemarle representative.

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