



# Ketjenfine 880 STARS®

The highest hydrogenation NiMo ULSD catalyst

## Today's ULSD objectives require top-performing catalysts

Diesel hydrotreating upgrades low-value refinery intermediates to high-value, on-specification transportation fuels. Two primary objectives of ultra-low-sulfur-diesel (ULSD) operations are maximum processing of distressed feedstocks and maximum product volume swell. And both lead to more barrels of ULSD for the market.

The introduction of new generations of catalysts is driven by the need for higher activity, better selectivity and lower costs. Refiners benefit from improved catalysts via higher throughput, increased processing of low quality feedstocks, improved product quality and/or reduced expense per unit of cycle length.

Albemarle's objective is to collaborate with our clients to maximize their operating profit. To achieve this, Albemarle utilizes STAX® optimization technology to develop new premium catalysts, the latest of which is KF 880 STARS®, Albemarle's top performing supported NiMo catalyst for medium- to high-pressure and high-pressure middle distillates hydrotreating.

## New from Albemarle R&D: KF 880 STARS® — A more intelligent catalyst

Employing STAX® kinetic technology, we fine-tuned the catalyst functionalities of KF 880 STARS® to deliver best-in-class hydrogenation activity (HYD RVA). Increased HYD RVA boosts conversion of nitrogen, sterically hindered sulfur and aromatics.

KF 880 STARS® catalyst delivers the highest HDS/N/A activity of all Albemarle's supported NiMo catalysts. The result is improved product quality via aromatics reduction leading to cetane uplift and volume swell.

The application sweet spot for KF 880 STARS® is in medium- to high-pressure and high-pressure operations with good hydrogen availability. Application benefits include increased distressed feedstocks upgrading, increased volume swell, increased feed rate or improved cycle length.



"KF 880 STARS® is the first catalyst we created utilizing our STAX® kinetic engine technology. STAX® technology enables fine tuning of catalyst formulations to optimize key kinetic functionalities. KF 880 STARS® is a breakthrough supported NiMo catalyst providing first-in-class performance in medium- to high-pressure and high-pressure ULSD service."

**Andrea Battiston**  
Senior Technical Specialist, HPC Catalysts

## KF 880 STARS® >125% RVA HDS

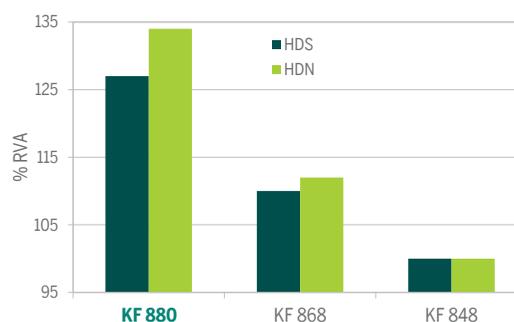


Figure 1: KF 880 STARS® RVA vs NiMo ULSD STARS®

## An extensive ULSD catalyst portfolio for any objective

Albemarle's ULSD catalyst portfolio contains an extensive array of catalyst functionalities that enable customizable catalyst system solutions to fit any possible combination of unit performance objectives and constraints.

Albemarle employs our STAX® technology (optimal catalyst system design technology) to generate tailored solutions for specific customer requirements.

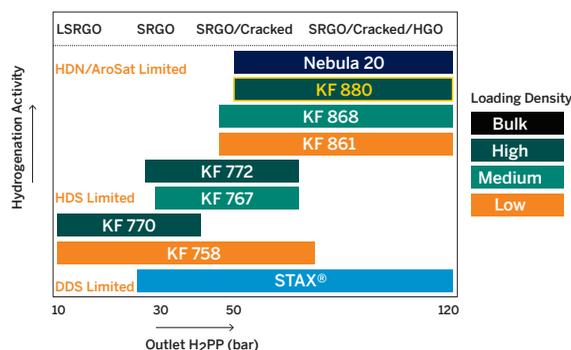


Figure 2: Albemarle's distillate hydrotreating portfolio

## Albemarle's ULSD STAX® concept

In the past, the traditional approach to diesel hydrotreating catalyst system design was to fill the first ~ 5-15% of reactor volume with guard/grading catalysts while the remaining reactor volume was filled with a single active catalyst.

Today, Albemarle utilizes a state-of-the-art proprietary catalyst system design approach known as STAX® technology. This technology is continuously being refined based on our 15+ years of ULSD R&D and our experience with over 2,000 ULSD commercial cycles. This body of knowledge enables the STAX® approach to be markedly different from the traditional approach.

The underlying principle of STAX® is that the chemistry is continuously evolving as the hydrocarbon phase travels axially through the reactor volume. The reactor volume can thus be segmented into zones based on primary chemistry similarities and then the catalyst with the best selectivity for each zone can be applied.

Albemarle's approach to catalyst design for ULSD hydrotreating segments the reactor volume below the guard/grading layers into three zones (Figure 3). Depending on the feed quality and specific operating conditions these zones can vary in length and location.

1. In Zone 1, the inhibition effect of basic-N and PNAs is very significant and primarily easy sulfur species are converted by the direct desulfurization (DDS) route. For high-pressure ULSD, Albemarle recommends KF 861 STARS®, a low density, high metal dispersion catalyst with low affinity for coke precursor adsorption.
2. In Zone 2, refractory sulfur species are converted via the two-step hydrogenation desulfurization (HYD) route. This route is inhibited by organic N and aromatics which compete for the same HYD sites. High HYD/HDN activity is thus crucial in Zone 2. For maximum HYD/HDN performance in high-pressure ULSD, Albemarle recommends our highest hydrogenation NiMo catalyst, KF 880 STARS®.
3. In Zone 3, the absence of organic N boosts HYD route HDS as well as HDA of mono aromatics. For high-pressure ULSD units with ample H2 availability, we recommend KF 880 STARS® with maximum HYD activity. When extraordinary performance is desired, Albemarle recommends its highest activity bulk base metal catalyst, NEBULA 20 (figure 4).

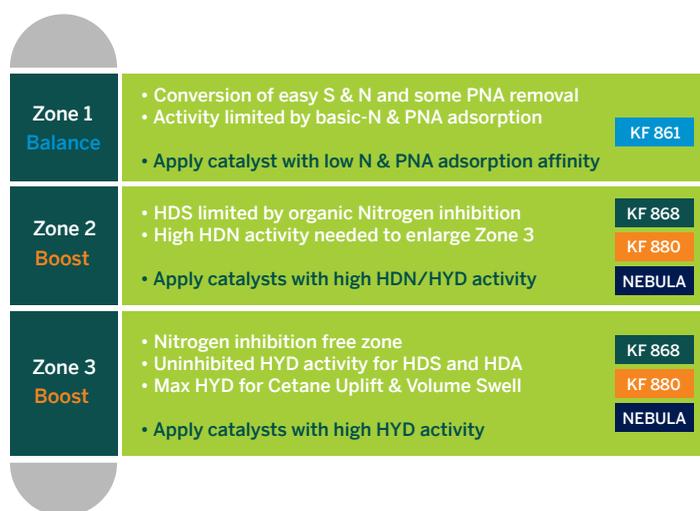


Figure 3: Concept behind DHT STAX Technology

## High-pressure ULSD STAX® solutions to exceed your unit's objectives

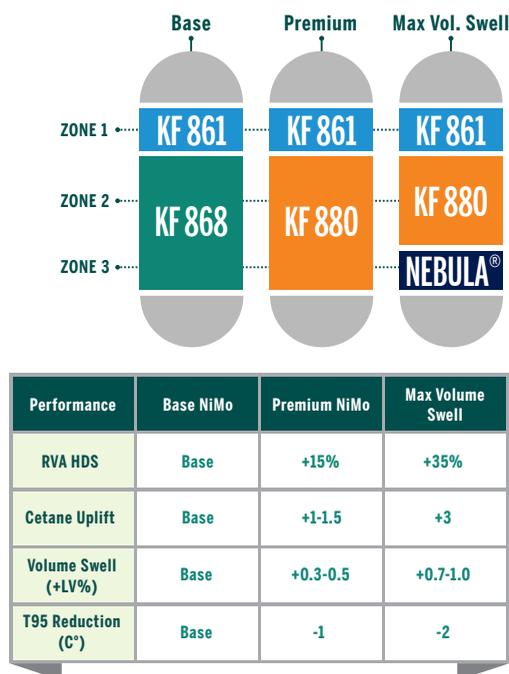


Figure 4: High-pressure ULSD STAX® solutions & benefits

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

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