NEBULA-20

The next step into deep space

NEBULA

NEBULA-1 was introduced at an international catalyst symposium in 2001 in Noordwijk, the Netherlands. It was a true breakthrough development.

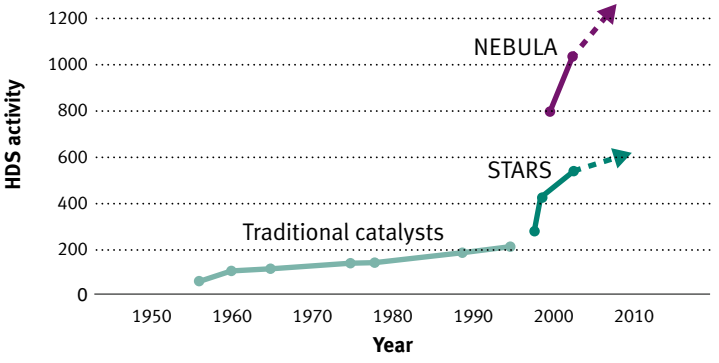

Figure 1: 50 years' development in activity

In subsequent years, we have learned from the first commercial experiences and developed NEBULA further. The objectives of this development program were to

- further enhance the activity
- increase the range of feeds for which it can be applied
- make it a more robust technology.

The result is NEBULA-20, which was introduced to the market in early 2004. It has a significantly lower loading density and equal or higher activity, depending on the feed type, when compared with NEBULA-1.

Applications

Today, NEBULA is used in four different applications: production of ultra-low-sulfur diesel (ULSD); hydrocracker pretreatment; kerosene processing; and in a proprietary lubricants operation. In one of the units, the cycle time is expected to reach three years. Future applications are expected for heavier feeds as well as in cracked naphthas.

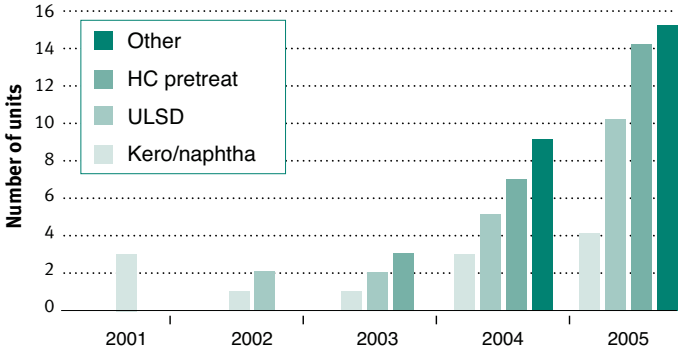

Figure 2: Number of units using NEBULA

Ultra-deep desulfurization

One of the key applications of NEBULA today, is the production of 10-ppm-sulfur diesel. The activity advantage over the conventional hydroprocessing catalysts can be so large that this type of catalyst can be used as a drop-in solution to produce ultra-low-sulfur diesel in medium- and high-pressure units without further investment. Two of the three first applications are of this type.

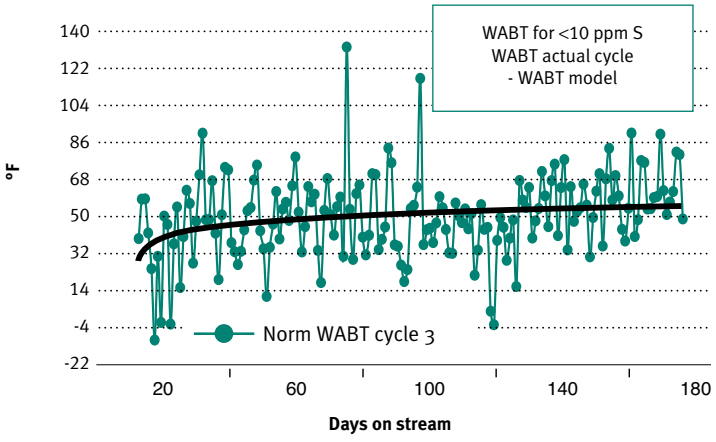

Figure 3: Stable operation at 10-ppm-sulfur, ultra-low-sulfur diesel

Figure 3 shows the stable operation at 10-ppm-sulfur of a medium pressure ultra-low-sulfur-diesel unit. The STARS/NEBULA system made it possible that a large revamp and expansion of the reactor volume could be avoided.

Hydrocracking pretreatment

Hydrocracking pretreatment is another interesting application for NEBULA for two reasons. First, very high HDN and HDA activities provide the opportunity to debottleneck activity limited units. HDN activity is, in these cases, the limiting factor. Figure 4 compares the activity of KF 848 with NEBULA-1 for a typical US hydrocracker feed (LCO boiling range). It should be noted that for VGO types of feed, the activity advantage is less. The activity difference amounts to about 32°F (18°C) compared with KF 848, which equals 45°F (25°C) when compared with KF 846.

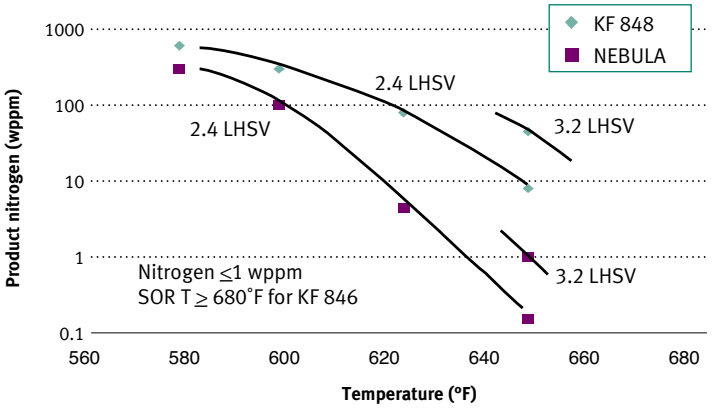

Figure 4: R-1 hydrocracking pretreat activity 2000 psig, 5000 SCF/B

Second, NEBULA can be an excellent choice for hydrocracking pretreatment because of its super-high HDS activity. Traditionally, HDS activity was never a limiting factor in hydrocracking. In fact, product sulfur levels in the hydrocracked products were always far below the specifications, and, hence, hydrocracked diesel was an excellent blending component for reducing sulfur in the pool.

With today's sulfur in diesel and gasoline moving to levels below 10 ppm, it clearly can become problematical meeting these specifications. NEBULA can then provide a solution, as illustrated in Figure 5. The S–N parity plot indicates that both HDS and HDN are equally boosted.

Currently, NEBULA-1 and NEBULA-20 are used in hydrocracking pretreatment operations in two units, and a third unit will follow soon. In all these units, the feed is an AGO/LCO blend. Performance is in line with expectations and stability is excellent.

NEBULA

- The biggest step forward in 50 years of hydroprocessing.
- Drop-in technology for ultra-low-sulfur diesel in medium- and high-pressure units.
- Debottlenecks hydrocrackers.
- Drop-in solution for production of ultra-low-sulfur kerosene.
- Number of units using NEBULA will exceed 10 by end of 2004.
- Longest running unit—2.5 years and still running.

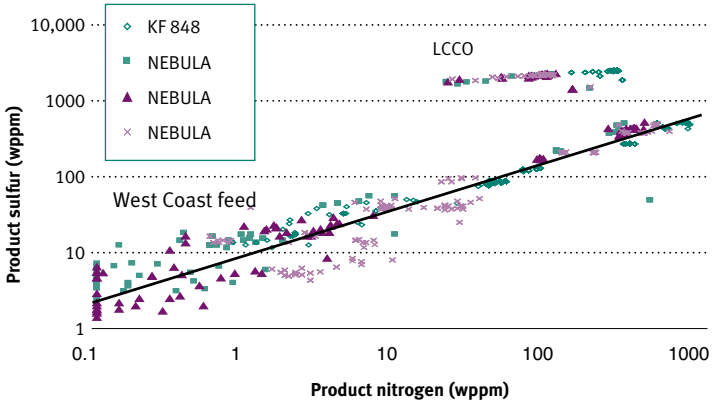

Figure 5: Sulfur/nitrogen selectivity

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

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