



## PROvantage™ – Operate in higher propylene mode without changing your base catalyst

PROvantage olefin/octane enhancement additive provides refiners with the flexibility to operate in a high propylene mode without the activity dilution of the base catalyst inventory normally associated with high levels of traditional ZSM-5 additives.

### Why PROvantage works

PROvantage contains several different types of active acid site components all in close proximity. The proper balance of these sites efficiently cracks fresh feed, slurry and naphtha into the desired product proportions, depending on the goals and challenges of the individual FCC unit.

Each active component in PROvantage is specifically designed to provide maximum activity retention. The additive aims to minimize hydrogen transfer reactions, thereby increasing the FCC naphtha octane and the amount of light olefin precursors in the FCC naphtha.

Not only have the active sites in PROvantage been specially tailored for optimal performance, the pore architecture also reflects properly balanced micro-, meso- and macroporosity. The appropriate blend of

all three pore size types enables the feed molecules to diffuse into the PROvantage particle to maximize subsequent cracking reactions and provide the highest liquid product yield at minimum bottoms. The high accessibility of Albemarle cracking catalysts has been leveraged to help set PROvantage apart from traditional ZSM-5 technology.

PROvantage additive offers all these benefits coupled with excellent coke selectivity.

### Examples of PROvantage successes

Figure 1 highlights the improvements PROvantage offers relative to standard olefin/octane enhancement additives. The base catalysts used in this comparison are Albemarle OPAL™ and CORAL™ catalysts. OPAL catalysts are highly accessible, industry-leading residue processing catalysts that exhibit excellent bottoms upgrading, coke and gasoline selectivity. Refiners aiming to maximize naphtha yield through using a high zeolite content catalyst choose CORAL.

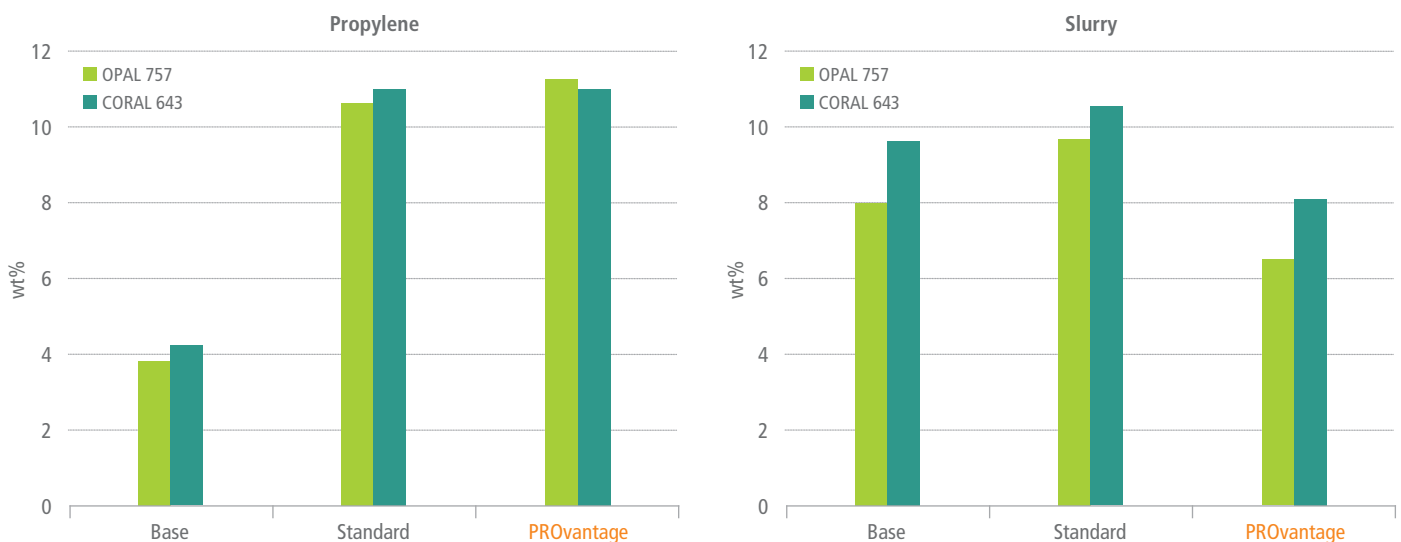


Figure 1: PROvantage offers both enhanced propylene and reduced slurry over the base case and compared with a standard ZSM-5 additive.

For each catalyst, a corresponding matching feed (residue for OPAL, gas oil for CORAL) was processed. PROvantage can be seen to provide significantly less slurry yield when compared with a standard ZSM-5 additive on a constant propylene basis, regardless of the base catalyst technology.

Furthermore, in both cases, the bottoms yield with PROvantage was lower than the base conditions. The additive's unique ability to maintain high propylene yields while mitigating the dilution effects encountered when using high concentrations of additive is clearly visible.

PROvantage has been applied in place of competitive olefin/octane enhancement additives in several commercial units. Data from one commercial user is given in Table 1.

This refiner processes a 3% concarbon residue type feed in its FCC unit with 3500-ppm nickel and 4000-ppm vanadium on a 68 MAT activity equilibrated catalyst. In both cases, the refiner used 15% additive.

The reduction in regenerator temperature is evidence of PROvantage's excellent coke selectivity. At constant propylene yield, the refiner was able to increase the feed throughput of the FCC unit and realize a significant improvement in the transportation fuel and petrochemical feedstock yields without any increase in bottoms. These gains significantly improved profitability for the refiner, even at a lower addition rate on a per-barrel feed basis.

Albemarle anticipates that PROvantage could offer a significant yield improvement relative to the base conditions at your refinery in a similar way to the example above.

	Competitor's additive	PROvantage additive
Regenerator temperature, °C	Base	-14
Feed rate	Base	+13%
Dry gas, wt%	Base	-0.8
Propylene, wt%	Target (8.0)	Target (8.0)
C3=/LPG ratio	0.32	0.34
C3 – LCO, wt%	Base	+1.4
LCO/slurry ratio	1.22	1.47
Slurry, wt%	Base	Base
Additive addition rate	Base	-11%

Typical product properties	
Additive name	PROvantage
Application	Olefin/octane enhancement
Attrition index, wt%	2.6
Average bulk density, g/ml	0.71
Surface area, m <sup>2</sup> /g	175
Particle size distribution (0–40), %	12
Particle size distribution (0–20), %	1

Table 1: Data from a commercial user of PROvantage.

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

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