

## QUANTIFYING THE BENEFITS: A GO-ULTRA ECONOMIC CASE STUDY

To demonstrate the commercial advantages of GO-ULTRA, an economic case study was performed for a 70,000 bpd VGO FCC unit running in mode against a maximum regenerator temperature constraint of 1355°F. See Table 2.

FEED PROPERTIES	
API	25.0
S (wt%)	0.5
Total N (wt%)	1000
ASTM D1160 T5 (°F)	577
ASTM D1160 T50 (°F)	748
ASTM D1160 T95 (°F)	980
Microcarbon residue (MCR)	0.7
ECAT PROPERTIES	
MAT activity	70.0
Ni (ppm)	500
V (ppm)	1000
FCCU BASE CONDITIONS	
Feed rate (bpd)	70,000
Catalyst to oil ratio (CTO)	5.2
CAR (tpd)	7
Catalyst inventory (t)	400
Reactor T (°F)	970
Regenerator T (°F)	1355
430 °F + conversion (vol.%)	72.3

**Table 2:** Feed and Ecat properties and base case FCCU conditions

The table below summarizes the results of the case study. In Case 1, the liquid yield improvements alone of GO-ULTRA translate to US \$28,000/day improved margin. (Note that this case does not take full advantage of the coke benefits of GO-ULTRA: the regenerator is loafing at 1355°F, fully 20°F below maximum.) In Case 2, riser temperature is increased to 995°F until the regenerator limit of 1355°F is again reached. This improves conversion to 75.6% and consequent liquid yields result in a margin improvement of US \$48,000/day. In Case 3, feed rate is increased to 82,000 bpd, again up to the maximum regenerator temperature of 1355°F. This scenario nets a total margin improvement of US \$68,000/day. Cases 2 and 3 assume other equipment in the FCCU complex is capable of handling higher liquid yields, higher air flows, etc.

Alternatively, instead of pushing unit performance, another option exists to substitute cheaper, poorer-quality feeds to improve FCC margins. Albemarle technical service engineers can evaluate this option on a case-by-case basis.

	Base	CASE 1 GO-ULTRA™ at base conditions	CASE 2 GO-ULTRA™ at higher RxT	CASE 3 GO-ULTRA™ at higher feedrate
Feed rate (bpd)	70 000	70 000	70 000	82 000
Catalyst to oil ratio (CTO)	5.2	5.5	5.8	5.1
Coke (wt%)	5.58	5.54	5.87	5.52
Delta coke (wt%)	1.08	1.01	1.01	1.07
Reactor T (°F)	970	970	995	970
Regenerator T (°F)	1355	1334	1355	1355
430 (°F) + conversion (vol.%)	72.3	72.7	75.6	71.0
Margin (US\$/bbl)	Base	Base + 0.40	Base + 0.68	Base + 0.10
Gross margin (US\$/d)	Base	Base + 28 000/d	Base + 48 000/d	Base + 68 000/d

**Table 3:** Economic case study

### What this means for you

Getting a higher quantity of desired yields is a goal of every refiner. Albemarle GO-ULTRA delivers breakthrough performance for cracking gas oil feeds, enabling:

- Greater gasoline yields, unit profitability and operational flexibility;
- Significant reductions in coke and LPG formation; and
- Markedly improved bottoms cracking capabilities.

Your Albemarle representative can make projections specific to your unit, feed and product slate, as well as recommend options to maximize your FCC unit profit using GO-ULTRA. **Call us today.**

Albemarle is experienced and equipped to provide high-quality products and services to customers worldwide. To learn more about the products featured here or our diverse line of polymer additives, catalysts or fine chemicals, contact your nearest regional office.

#### AMERICAS

2625 Bay Area Blvd  
Suite 250  
Houston, TX 77058 USA  
Tel: +1 281 480 4747  
Fax: +1 281 283 1519  
albsales@albemarle.com

#### EUROPE, MIDDLE EAST, AFRICA

Parc Scientifique de LLN  
Rue du Bosquet 9  
B-1348 Louvain-la-Neuve Sud Belgium  
Tel: +32 10 48 1711  
Fax: +32 10 48 1717  
emasales@albemarle.com

#### ASIA PACIFIC

Room 2208  
Shui On Plaza  
No. 333 Hua Hai Zhong Road  
Shanghai 200021 China  
Tel: +86 21 6103 8666  
Fax: +86 21 6103 8777  
apsales@albemarle.com



www.albemarle.com

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CAT-C2-0001 rev nc (02-2010)



**GO-ULTRA™**  
The FCC catalyst  
born to perform.



# Get more from gas oil feeds with our new GO-ULTRA™ FCC catalyst.

Facing today's economic challenges, refiners worldwide are seeking to restore margins and increase profits by maximizing yields from their operations. For the gas oil market, Albemarle's research and development team has created a breakthrough fluid catalytic cracking (FCC) catalyst that offers impressive benefits and higher value than existing market offerings.

**Albemarle's GO-ULTRA™ FCC catalyst**—based on the company's innovative new ONYX™ manufacturing technology—was designed specifically for application to gas oil feeds. Compared to conventional gas oil catalysts, GO-ULTRA offers better gasoline selectivity (up to almost four percent [4%] greater naphtha yields) while significantly reducing coke formation. GO-ULTRA also provides marked bottoms conversion improvement.

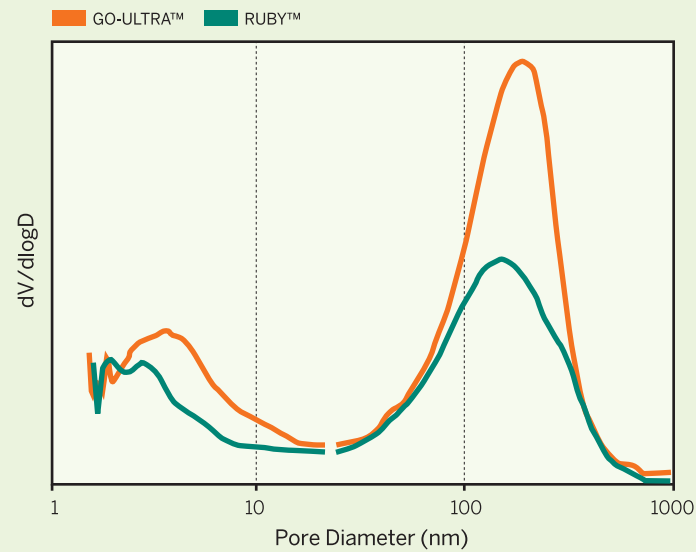


Figure 3: Pore Size Distributions (PoSDs)

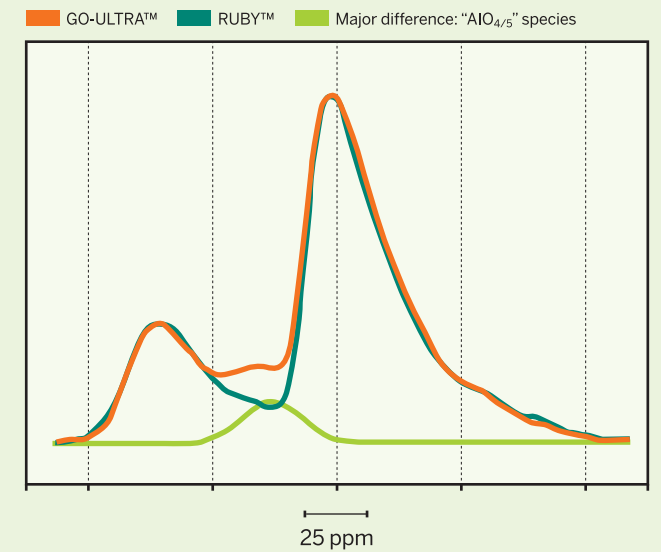


Figure 4: <sup>27</sup>Al MAS NMR Spectra

## An innovation made possible by ONYX™

To achieve GO-ULTRA's breakthrough performance profile, Albemarle researchers developed ONYX™, a new catalyst technology platform that features a unique combination of two important catalyst design elements: **pore size distribution** (PoSD) and **ADM-25**, the company's newest matrix component.

As shown in Figure 3, GO-ULTRA's PoSD is optimized for gasoline selectivity and bottoms conversion, leading to improved molecule diffusion in the gasoline boiling range, as well as minimizing the secondary reactions that contribute to coke and liquefied petroleum gas (LPG) formation.

The PoSD also improves the access of active sites to large molecules, leading to improved bottoms conversion with low coke yield.

Incorporation of ADM-25 into the GO-ULTRA particle leads to the formation of a new type of active site in which aluminum is bound in a unique coordination state. Albemarle research has shown that these aluminum (Al) centers, termed AlO<sub>4/5</sub>, are effective at cracking very large molecules in bottoms while avoiding condensation and other side reactions that result in coke formation. Evidence for AlO<sub>4/5</sub> sites, in the form of <sup>27</sup>Al MAS NMR spectra, is presented in Figure 4.

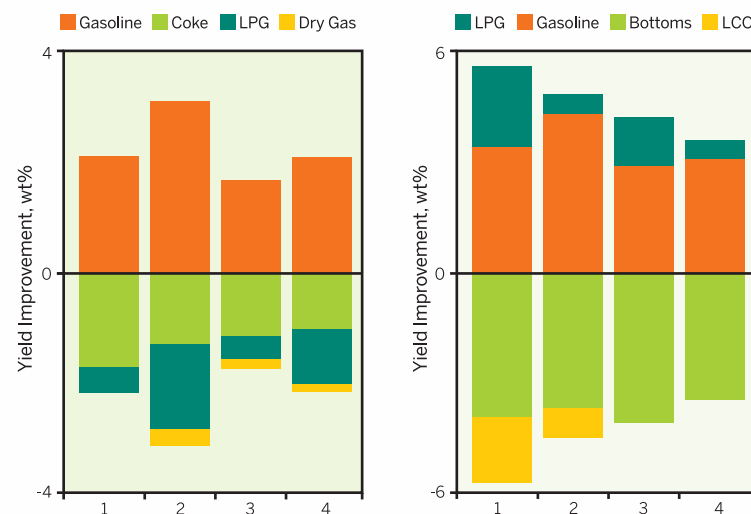


Figure 1: Typical Yield Improvements at Constant Conversion

Figure 2: Typical Yield Improvements at Constant Coke

## GO-ULTRA: Built to perform.

Multiple tests have consistently verified GO-ULTRA's performance advantages. In four different comparisons between GO-ULTRA and Albemarle's RUBY™ FCC catalyst (results shown to left), all samples were deactivated by mild CD (1000 ppm Ni, 1000 ppm V), followed by ACE testing using a typical VGO. At constant conversion (Figure 1), gasoline increases by two percent (2%) to almost four percent (4%) at the expense of coke and LPG. At constant coke (Figure 2), the trend is equally clear: up to four percent (4%) additional gasoline and a smaller amount of LPG created at the expense of bottoms (slurry).

	Competitor 1	Competitor 2	Competitor 3	GO-ULTRA
Coke @ constant conversion	4.45	4.73	3.60	<b>2.77</b>
Bottoms @ constant conversion	11.31	11.68	12.10	<b>12.32</b>
Bottoms @ constant coke	12.51	13.07	12.40	<b>10.80</b>
Gasoline @ constant conversion	45.61	45.46	45.25	<b>47.01</b>
Gasoline @ constant coke	44.97	44.95	*	<b>47.45</b>

Table 1: Comparison Study

When tested against leading FCC catalyst competitive products, GO-ULTRA continues to outperform. In the comparison study:

**COMPETITOR 1 CLAIMS Maximum gasoline yields**

**COMPETITOR 2 CLAIMS Superior zeolite activity**

**COMPETITOR 3 CLAIMS Superior coke selectivity**

As Table 1 demonstrates, GO-ULTRA showed the best coke and gasoline selectivities of the group. Because of its excellent coke selectivity, the isocoke comparisons are exceptional.

