



Albemarle's low rare earth technology (LRT) products

Driven by its goal to provide customers with comprehensive, economic catalyst solutions and the surge in global rare earth prices, Albemarle has developed and commercialized a range of LRT products.

The catalysts available for the VGO market are

- GO™ LRT for maximum activity
- AMBER™ LRT for maximum transport fuels.

The catalysts available for the residue market are

- UPGRADER™ LRT for maximum bottoms conversion
- CORAL™ LRT for minimum delta coke.

BCMT-500™ LRT is an LRT additive for enhanced bottoms cracking and metals tolerance.

LRT-based catalysts are designed to contain low levels of rare earth but provide the activity and stability of a catalyst with a higher rare earth level. The yield selectivities and product qualities can be custom

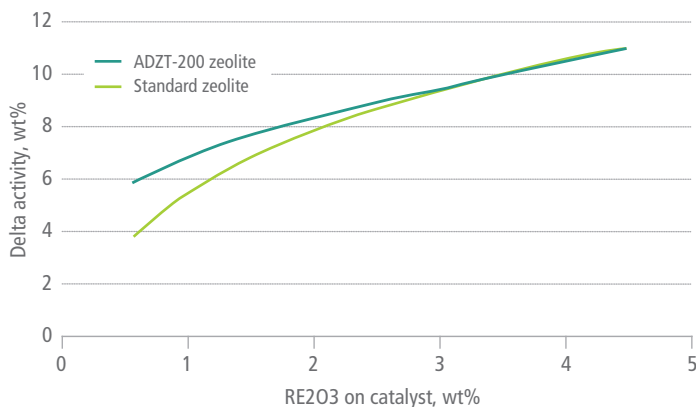


Figure 1: Albemarle's exclusive zeolite technology enhances activity at low rare earth levels.

tailored to meet refiners' objectives. LRT catalysts are successfully being used in several FCC units throughout the world. Moreover, Albemarle is a global leader in low rare earth products. Analysis of FCC Ecats from around the world indicates that units supplied by Albemarle operate, on average, at lower rare earth contents than those supplied by other companies. This is particularly impressive given Albemarle's industry-leading residue product portfolio.

The excellent activity and performance obtained from LRT catalysts are the result of the integration and optimization of several commercially proven, well-established and proprietary Albemarle catalyst technologies:

- A unique low rare earth zeolite enhancement treatment, ADZT-200™, maximizes the zeolite activity, thereby further reducing the need for rare earth content, see Figure 1.
- Albemarle's catalyst technologies enable the inclusion of very high amounts of selective matrix, which offers enhanced activity and performance with less rare earth, see Table 1.
- The high accessibility of Albemarle catalysts makes best use of the zeolite and matrix in the catalyst, see Table 1.
- Albemarle's catalyst technologies enable catalysts to be formulated with high zeolite levels for increased activity.
- Albemarle Y-zeolites have a high silica-to-alumina ratio (SAR), which results in superior zeolite stability and enables lower rare earth level to be used.
- Various metals tolerant and trapping technologies enhance catalyst performance and activity.
- Albemarle manufacturing technologies are optimized to maximize the effectiveness and flexibility of the features above.



ALBEMARLE IS A GLOBAL LEADER
IN LOW RARE EARTH PRODUCTS.

	Competitor	UPGRADER LRT
Operating conditions		
Feed rate, B/D	Base	Base + 300
Feed API	27.4	25.8
Conradson carbon residue, wt%	1.0	1.0
Vacuum tower bottoms, %	14	17
Preheat temperature, °C [°F]	245 [473]	238 [460]
Riser temperature, °C [°F]	529 [985]	529 [985]
Regenerator dense bed temperature, °C [°F]	723 [1334]	717 [1323]
Ecat properties		
Activity, wt%	65	65
RE203, wt%	2.30	0.85
Catalyst addition rate	Base	Base
Matrix surface area, m ² /g	37	83
Albemarle Accessibility Index (AAI)	2	7
FCC unit yields		
C2-, scf/B	406	330
LPG, vol%	20.8	19.6
C3=/TC3	0.75	0.76
C4=/TC4	0.56	0.64
Gasoline, vol%	52.9	62.5
LCO, vol%	19.4	20.9
Slurry, vol%	16.4	8.2
Slurry API	12.9	4.2
Conversion, vol%	64.2	70.9
Profitability	Base	>\$20 million/y

Table 1: The unique matrix and AAI of Albemarle LRT catalysts deliver exceptional performance at lower rare earth levels.

The appropriate application of these proprietary technologies is fundamental to the Albemarle LRT catalyst families. Moreover, our LRT catalysts and their advanced technologies are in use worldwide. The FCC unit examples shown in tables 1 and 2 show the superior performance obtained when Albemarle's technologies are incorporated into LRT catalysts.

Albemarle is a low rare earth technology leader and provides excellent performance from proprietary products aimed at offering cost-effective solutions. With the introduction of LRT products, we can help you to reduce your rare earth consumption even further. Please talk to your Albemarle representative to discuss what LRT catalysts and additives can do for your FCC unit and its profitability.

	AMBER LRT	UPGRADER LRT
Feed quality		
API	26.1	25.9
Conradson carbon residue, wt%	0.1	2.9
Ecat properties		
Activity, wt%	73	66
RE203, wt%	0.50	0.55
Ni, wppm	50	2145
V, wppm	125	4180
Operating conditions		
Riser temperature, °C [°F]	527 [980]	529 [985]
Regenerator dense bed temperature, °C [°F]	688 [1270]	727 [1340]
FCC unit yields		
C2-, wt%	2.4	5.0
LPG, vol%	31.9	22.6
Gasoline, vol%	60.9	51.7
LCO, vol%	16.9	26.1
Slurry, vol%	3.1	5.5
Conversion, vol%	80.0	68.4

Table 2: Examples of LRT catalysts in VGO (AMBER LRT) and residue (UPGRADER LRT) operations.

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

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