



# CORAL™ SMR – Improving the fluidized catalytic cracking (FCC) profit potential of heavy feeds

## SMR technology features

The need to process heavy feeds in FCC units continues to grow.

Albemarle's innovative SMR catalyst technology addresses the three fundamentals of heavy feed cracking: coke and dry-gas selectivity; metals tolerance; and bottoms upgrading. Through its three innovative developments, SMR technology enables refiners to operate at higher metal levels or at higher severities while upgrading more heavy feed or bottoms to valuable products.

First, SMR catalyst technology greatly reduces the vanadium intra- and interparticle mobility, thereby protecting the zeolite from destruction by vanadium. And, as its matrix is also less exposed to vanadium attack, the catalyst retains its functionality longer, which enables it to do the high-level-performance job required when converting heavy feed molecules.

Second, in SMR catalyst technology, the catalyst can encapsulate nickel, which reduces metals coke and hydrogen. This exclusive development leads the industry, as it offers outstanding nickel encapsulation power with minimal dehydrogenation reactions.

Third, SMR catalyst technology features a stronger and more effective zeolite contribution to the cracking reaction. In addition to higher activity, the ratio of catalytic cracking to thermal cracking is enhanced, which reduces the kinetic coke and dry gas make.

Our CORAL™ catalyst, which was originally designed for heavy feed applications, was one of our first products to benefit from SMR catalyst technology. CORAL SMR, which is exclusively available from Albemarle, encompasses these three technology developments to enable refiners to make more money on the higher value products going out of their plant gates.

## Documented effectiveness

CORAL SMR addresses the different mechanisms of metals resistance and coke and dry-gas formation. It delivers state-of-the-art benefits in bottoms upgrading and coke selectivity to improve the profit potential of FCC.

Catalyst yield, wt%	CORAL	CORAL SMR	Delta
Conversion	73.0	75.0	2.0
Dry gas	1.9	1.6	-0.3
Hydrogen	0.64	0.47	-0.18
LPG	15.1	15.5	+0.4
Gasoline	49.0	50.9	+1.9
LCO	16.1	15.5	-0.6
Bottoms	10.9	9.5	-1.4

Table 1: Results of short-contact-time residue testing of CORAL and CORAL SMR after deactivation with 3000-ppm nickel and 7500-ppm vanadium.

## Metal resistance

One of our customers operates a residue cracker with nickel and vanadium levels exceeding 10,000 ppm on equilibrium catalyst. The feed consists of a residue with a Conradson carbon residue of 5 wt%. Catalyst metals tolerance was a major concern for the customer, along with maintaining or improving coke selectivity.

Using a two-step cyclic deactivation protocol, high levels of nickel (3000 ppm) and vanadium (7500 ppm) were deposited on the customer's CORAL catalyst and on CORAL SMR. The testing was conducted in our short-contact-time residue testing unit. The results showed that CORAL SMR exhibits superior metals tolerance and retains a high activity after deactivation with 7500-ppm vanadium (Table 1). These benefits were also confirmed by the lower coke yield and the reduction in hydrogen.

“**SMR TECHNOLOGY IMPROVES THE EFFECTIVE FUNCTIONALITY OF ALL CATALYST INGREDIENTS.**”

## Competitive edge

Another refiner was processing a blend of heavy vacuum gas oil and atmospheric residue on a competitor's catalyst. The unit was limited by dry gas and operating at its maximum regenerator temperature. Could we help them to increase the intake of residue and also to upgrade more bottoms to gasoline and LPG?

We carried out a testing program and deactivated the incumbent catalyst and CORAL SMR by cyclic propene steaming with nickel (1000 ppm) and vanadium (1500 ppm) in our fluid bed simulation test using the customer's feedstock. The tests showed lower hydrogen and dry gas, and better coke selectivity when using CORAL SMR (figures 1 and 2). The refinery is now at a higher residue intake while upgrading bottoms to more valuable products such as LPG with CORAL SMR.

Let our ingenuity and developments in heavy feed cracking work for you. SMR technology improves the effective functionality of all catalyst ingredients. Our exclusive CORAL SMR catalyst exhibits superior metals tolerance and excels in heavy feed operations while maintaining excellent coke selectivity and the lowest levels of hydrogen and dry gas.

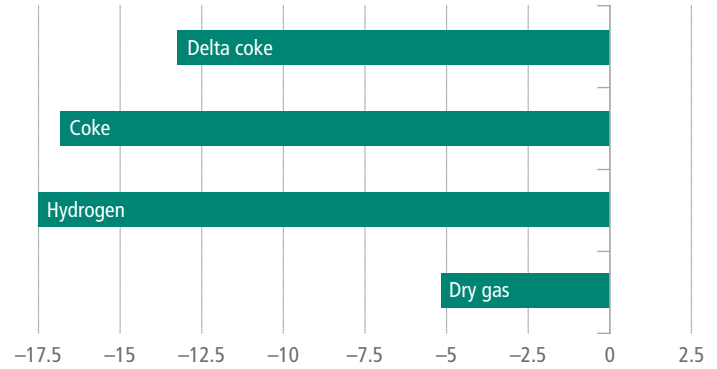


Figure 1: Relative changes when using CORAL SMR at constant conversion.

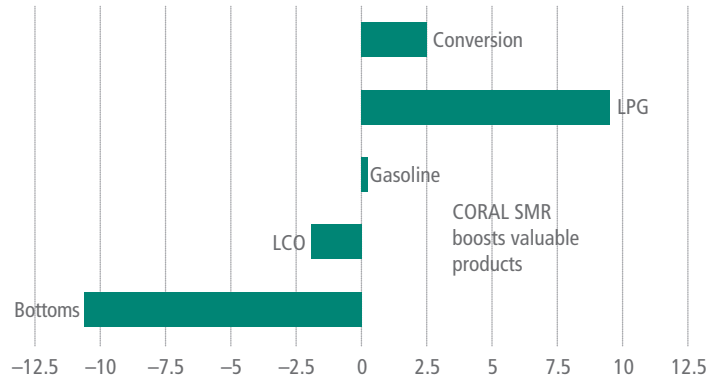


Figure 2: Relative changes when using CORAL SMR at constant coke.



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