Albemarle understands that refiners today are faced with an array of challenges to profitable operation — in the form of difficult feeds, frequently changing market conditions, and increasingly stringent environmental regulations, all of which exert downward pressure on margins. Into this highly competitive environment, Albemarle introduces GRANITE™ technology, providing the most flexible, effective portfolio of tunable catalyst products available. Utilizing a newly developed matrix/binder system, GRANITE catalysts feature a wide and flexible formulation window with enhanced binding and improved zeolite stability, which allows us to formulate catalysts in a highly specific, focused manner, letting the FCC operator target that last drop of valuable product.

The GRANITE technology includes several new products. PEAK ACTION™ and EVEREST ACTION™, described below, are the first installments in this bold and innovative new technology. They represent step-out advances in Albemarle’s commercially proven and highly successful ACTION™ line of products.

**PEAK ACTION: Enhanced butylene and gasoline octane with superior bottoms upgrade**

Employing the newly unveiled ADM-80 binder technology, PEAK ACTION exhibits improved physical properties that open a wider catalyst formulation window, allowing for the inclusion of higher levels of premium active components. PEAK ACTION leverages ADZT-100, the shape-selective zeolite technology system associated with Albemarle’s commercially proven and highly successful ACTION product line, in conjunction with the enhanced binding of ADM-80 to deliver even better butylene yields and gasoline octane, incorporated in a highly active formulation for overall conversion and bottoms upgrade.

Table 1 shows deltas between PEAK ACTION and a conventional ACTION in an application with a full-burn unit processing a 2.5 wt% CCR feed, with combined ecat Ni + V above 5000 ppmw. PEAK ACTION features significant improvements in butylene yield, butylene selectivity with LPG yield, and gasoline octane, as well as a marked increase in the product LCO to bottoms ratio.

<table>
<thead>
<tr>
<th>ACTION</th>
<th>PEAK ACTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>C4 =, vol%</td>
<td>8.7</td>
</tr>
<tr>
<td>C3 =, vol%</td>
<td>9.6</td>
</tr>
<tr>
<td>Δ C4 = / Δ C3 (v/v)</td>
<td>base</td>
</tr>
<tr>
<td>C4 = / LPG (v/v)</td>
<td>base</td>
</tr>
<tr>
<td>LCO / bottoms (v/v)</td>
<td>base</td>
</tr>
<tr>
<td>RON</td>
<td>base</td>
</tr>
<tr>
<td>MON</td>
<td>base</td>
</tr>
<tr>
<td>CAR</td>
<td>base</td>
</tr>
</tbody>
</table>

Table 1: Comparison of PEAK ACTION to conventional ACTION in commercial operation

PEAK ACTION is clearly a powerful, effective option for the refiner seeking maximized octane barrels, high butylene yields, and highest possible bottoms conversion.

**EVEREST ACTION: Enhanced butylene and gasoline octane in a highly coke-selective catalyst**

EVEREST ACTION is built upon ADM-85, Albemarle’s novel matrix/binder system which, in addition to expanding the formulation window, also provides enhanced coke selectivity and zeolite stability. Catalysts formulated with ADM-85 consistently exhibit coke yields 15-20% lower than analogous formulations without ADM-85, and relative zeolite surface area retentions more than 30% higher in lab deactivations. EVEREST ACTION exploits the superior binding of ADM-85 to further raise the maximum level of ADZT-100 system in the formulation, providing an even higher ceiling on butylene yield. In addition, higher levels of other active components are
achievable, as well. The EVEREST ACTION described here takes advantage of this capability, along with the enhanced zeolite stability, to create a high-activity catalyst at significantly lower rare earth than would otherwise be possible, with the attendant butylene and octane bonuses that entails.

Results from ACE testing for EVEREST ACTION, referenced against a conventional UPGRADER™ catalyst, and compared to UPGRADER with ZSM-5 additive and a conventional ACTION formulation, demonstrate a remarkable increase in butylene yield (Figure 1).

EVEREST ACTION also represents step-out improvement in gasoline octane barrels. Figure 2 compares the octane gain per unit of gasoline lost for each catalyst relative to the UPGRADER reference. Both ACTION catalysts show a distinct benefit relative to the UPGRADER benchmark, both with and without ZSM-5 additive, but the EVEREST ACTION shows a marked improvement even relative to the conventional ACTION, itself widely recognized and employed as the premium gasoline octane catalyst.

Additionally, EVEREST ACTION yields 15% less coke relative to UPGRADER and conventional ACTION.

EVEREST ACTION is the catalyst of choice for targeting high butylene yields and octane barrels, while providing superior bottoms upgrade with excellent coke selectivity.

GRANITE: Improved economics, greater flexibility

PEAK ACTION adds premium value through the following benefits:

- Increased production of alky unit feedstock
- Superior butylene selectivity per LPG gain, critical for wet gas limited operations
- Higher octane with minimum gasoline loss
- Highest possible bottoms upgrade

EVEREST ACTION augments these advantages in the following way:

- An even wider formulation window, pushing attainable butylene yields even higher
- Highest octane barrels
- Excellent bottoms upgrade
- Enhanced zeolite stability
- Improved coke selectivity
- Improved attrition resistance at comparable formulation

For more information on these or other Albemarle products, contact your Albemarle representative.