KMG Rompetrol & Grace: Increase FCC Profitability by Operating in Propylene Maximization Mode

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Poll Question

• European refineries which are integrated with petrochemical facilities will be better positioned for the future market challenges.

a) True
b) False
c) It depends
Refining and petrochemicals is one of the main business units of KMG International

- It has two Production facilities: Petromida consisting of a Refinery and Petrochemical Complex and Vega Refinery.
- The refinery operates integrated petrochemical production facilities, making propylene a key product for the refinery.
- The fluid catalytic cracking (FCC) unit is the main contributor to the refinery’s production of light olefins, especially propylene.

<table>
<thead>
<tr>
<th>Nelson Complexity Index</th>
<th>10.5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Crude processed are typically URAL with blend to other opportunity crudes like Kirkuk, Azeri, Siberian, CPC</td>
<td></td>
</tr>
<tr>
<td>Unit design</td>
<td>UOP SBS</td>
</tr>
<tr>
<td>Unit capacity, bbl/day</td>
<td>24100</td>
</tr>
<tr>
<td>FCCU unit process</td>
<td>100 % hydrotreated feed</td>
</tr>
</tbody>
</table>
Increase FCC profitability by Operating in Propylene Maximization Mode

KMG Rompetrol

Refining and petrochemicals is one of the main business units of KMG International.

- It has three production units – Petromidia refinery (in Navodari), Vega refinery (in Ploiesti) and the Petrochemicals division.
- Petromidia is the most efficient refinery in Romania and the 9th out of 250 refineries in Europe and Africa.
- The refinery operates integrated petrochemical production facilities, making propylene a key product for the refinery.
- The fluid catalytic cracking (FCC) unit is the main contributor to the refinery's production of light olefins, especially propylene.

<table>
<thead>
<tr>
<th>Annual Refining Capacity (MTmn)</th>
<th>Nelson Complexity Index</th>
<th>FCCU process hydrotreated feed</th>
<th>Unit design</th>
<th>Typical feed process</th>
</tr>
</thead>
</table>
|                                 | 9.7                     | 100%                          | UOP SBS     | URAL/CPC/Kirkuk 76%/6%/20-

- 30%
Global Cumulative Growth in Petchem Demand

- 2016 - Petchem make up 12% of crude oil market.
- 2035 - Petchem will make up almost 50% demand of crude oil growth
• Yields of over 12 wt% have been achieved with Grace’s latest generation of propylene maximization technology.
• KMG Rompetrol is among the 5 highest FCCU propylene yields in EMEA.

Refineries in EMEA are utilising Grace solutions to achieve excellent propylene yields.
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ACHIEVE® – Five steps to success

Continuous analysis of ACHIEVE is being conducted to validate the increased profitability of the KMG Rompetrol FCCU.

Internal screening by Grace before offering ACHIEVE - screening study using the ACE® pilot plant to identify most suitable formulation – July 2015

New technology proposed – September 2015

Grace Management of Change presented and discussed – September/December 2015

First delivery of new catalyst to KMG Rompetrol refinery – July 2016

ACHIEVE results are showing the expected benefits in propylene yield and C4’s selectivity – test run January 2017
Key Unit Objectives

- Maximum Propylene Yield (min. 10 wt% of FF)
- Maximum Iso-Butylene Yield
- Maximize LCO
- High RON
- Higher dcoke
- Minimize dry gas

**ACE Performance Deltas**

- iC4/=LPG
- iC4/=total C4
- total C4
- iC4= C3=
- HCO
- LCO
- Gasoline
- LPG
- Dry Gas
dcoke
Coke
C/O

**Key objectives**

Improved performance with selected FCC catalyst tested by Grace’s pilot plant
ACE Ecat results confirm improved olefins yields
ACHIEVE catalyst formulation provides significant bottoms upgrading
Achieve – Unit Performance

Key refinery objectives of increased propylene and isobutylene yields have been achieved

Increase FCC profitability by Operating in Propylene Maximization Mode | October 2-4, 2018

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Compared to the Base catalyst system,

the ACHIEVE catalyst:

- provided higher iso-butylene and propylene yields as expected.
- 11.0 wt% propylene yield is achieved

<table>
<thead>
<tr>
<th>Performance</th>
<th>ACHIEVE vs. Base</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dry Gas, wt%</td>
<td>0.29</td>
</tr>
<tr>
<td>C\textsubscript{3}=, wt%</td>
<td>1.26</td>
</tr>
<tr>
<td>iC\textsubscript{4}=, wt%</td>
<td>1.05</td>
</tr>
<tr>
<td>LPG, wt%</td>
<td>1.68</td>
</tr>
<tr>
<td>Total Naphta, wt%</td>
<td>-1.77</td>
</tr>
<tr>
<td>LCO, wt%</td>
<td>2.03</td>
</tr>
<tr>
<td>Slurry, wt%</td>
<td>-2.10</td>
</tr>
<tr>
<td>Coke, wt%</td>
<td>-0.13</td>
</tr>
</tbody>
</table>

**Operating conditions:**

- Unit throughput, t/h: 142
- ROT, °C: 541
- FPH temperature, °C: 215
- Specific Gravity: 0.885
- ZSM- Additive (OlefinsUltra HZ), %: 7
- Operation Mode: Full Burn

**ECAT Properties:**

- Activity, wt%: 73.5 - 75.0
- UCS, Å: 24.26
- SA, m\textsuperscript{2}/g: 182 - 192

**ACHIEVE test run results at maximum unit throughput and max. severity demonstrate higher refinery profitability for 2.3 M$/y**
The most profitable refineries are the ones that leverage their flexibility to capture market opportunities.

Increased profit of 2.3M $/y is calculated using refinery PIMS model.

Rompetrol could even further optimize performance and improve profitability through additions of Grace’s latest generation ZSM-5 additive, OlefinsUltra® XZ.

Refinery plan is to increase downstream petrochemical unit capacity for additional 15-20% to further increase LPG production.
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