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

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- 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.



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Nelson Complexity Index	10.5	
Crude processed are typically URAL with blend to other opportunity crudes like Kirkuk, Azeri, Siberian, CPC		
Unit design	UOP SBS	
Unit capacity, bbl/day	24100	
FCCU unit process 100 % hydrotreated feed		

FCC Yield Gaps 2016 Study – Worldwide, 303 Units





(1) 0.15 × Log (feed N/10) + Second Order Conversion ÷ (wt % coke – 0.84 × feed wt % ConCarbon) © 2017 HSB Solomon Associates LLC



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



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- 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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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

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

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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



Improved performance with selected FCC catalyst tested by Grace's pilot plant

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Ecat comparison BASE vs. ACHIEVE

ECAT Propylene Yields (wt%) □ ACHIEVE ◇ Base catalyst 11.00 10.50 10.00 Propylene yeild, wt% п 9.50 9.00 8.50 8.00 7.50 Ò 0 7.00 6.50 ECAT Iso-butylene, wt% 6.00 71.0 72.0 73.0 74.0 75.0 76.0 3.300 Conversion, wt% 3.100 2.900 П 2.700 2.700 2.500 **4** 2.300 2.100 2.100 Ô 1.900 1.700 1.500 71.0 72.0 73.0 74.0 **Conversion**, **wt%** 75.0 76.0

ACE Ecat results confirm improved olefins yields

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ACHIEVE – Unit Performance





ACHIEVE catalyst formulation provides significant bottoms upgrading

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ACHIEVE – Unit Performance





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

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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

Performance	ACHIEVE vs. Base	Operating conditions:	
Dry Gas, wt%	0.29	Unit throughput, t/h	142
C ₂ = wt%	1 26	ROT, ° C	541
	1.20	FPH temperature, ^o C	215
iC ₄ = , wt%	1.05	Specific Gravity	0.885
LPG, wt%	1.68	ZSM- Additive (OlefinsUltra HZ), %	7
Total Naphta, wt%	-1.77	Operation Mode	Full Burn
	2 0 2	ECAT Properties:	
LCO, WI%	2.05	Activity, wt%	73.5 -75.0
Slurry, wt%	-2.10	UCS, Å	24.26
Coke, wt%	-0.13	SA, m2/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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