Outline

UOP Unity™

Hydroprocessing Catalyst Portfolio

- Unity™ Case Story 1: Hydrotreating catalyst enabling ULSD production
- Unity™ Case Story 2: Hydrotreating catalyst in Hydrocracking pretreat service
- Unity™ Case Story 3: Successful commercialization of HYT 4118 (Co-Mo Catalyst) in ULSD service

Introducing ULTIMet™
Honeywell UOP

Unity

Hydrotreating and Hydrocracking
Unified approach
Universal compatibility
Unity Means...Hydroprocessing Technology You Can Rely On

- Naphtha Hydrotreating
- Coker Naphtha Hydrotreating
- Gasoline Selective Desulfurization
- Kerosene Hydrotreating
- Distillate Hydrotreating
- VGO (Cat Feed) Hydrotreating
- Fixed-Bed Resid Hydrotreating

New Unit Design, Revamp, Process, Technology & Equipment Capabilities
## Unity Hydroprocessing Catalysts

Innovation Built on **50 Years** in Hydroprocessing

### UNITY HYDROTREATING

<table>
<thead>
<tr>
<th>DEMETALLIZATION</th>
<th>CLEAN FUELS</th>
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**ULTIMet™ Now Available**
UOP Unity Hydrotreating Catalysts Can Help Refiners Meet Market Demands

CASE STUDY

01
HYT-6219 in ULSD Service

02
HYT-6119 Hydrocracking Pretreat Service

03
HYT-4118 Commercialization in ULSD Service
Unity Case Story 1: Enabling On-Spec ULSD Production

**Cycle Objectives**

- Achieve cycle length
- Successfully produce 10ppm
- No revamp

**Operating conditions:**

- 70 bar(g) Reactor Inlet H₂ PP
- 740 Nm³/m³ H₂ to Oil,

**UOP Catalyst solution:**

![UOP Unity Hydroprocessing Catalysts]

<table>
<thead>
<tr>
<th>Feed Details</th>
<th>Blend</th>
</tr>
</thead>
<tbody>
<tr>
<td>Source</td>
<td>Imported</td>
</tr>
<tr>
<td>Blend</td>
<td></td>
</tr>
<tr>
<td>45% LCGO</td>
<td></td>
</tr>
<tr>
<td>27% CN</td>
<td></td>
</tr>
<tr>
<td>15% SRD</td>
<td></td>
</tr>
<tr>
<td>13% LCO</td>
<td></td>
</tr>
<tr>
<td>API</td>
<td>43</td>
</tr>
<tr>
<td>Specific Gravity</td>
<td>0.81</td>
</tr>
<tr>
<td>Sulfur, Wt-%</td>
<td>0.3</td>
</tr>
<tr>
<td>Nitrogen, wt-ppm</td>
<td>1100</td>
</tr>
<tr>
<td>Bromine Number</td>
<td>35</td>
</tr>
<tr>
<td>150°C+ (300°F+) Content, Wt-%</td>
<td>85*</td>
</tr>
</tbody>
</table>

Feed Composition

* Est from Naphtha Yield
UOP Service and Sales Support Unit Troubleshooting

ULSD Case Story #1

Product Sulfur

- Base
- Base - 5
- Base - 10
- Base + 5
- Base + 10
- Base + 15
- Base + 20

Operating Days Since Start of Run

Product Sulfur, wppm

- Reactor Bypass Closed
- Target Operation

Gasoline, Sulfur, wppm
Diesel Sulfur, wppm

High activity of HYT-6219
Allowing Customer to Increase Feed Rate 10% Above Design & Still Make ULSD product

HYT-6219 Allowing 10% Increased Unit Throughput
**Unity Case Story 1:**
**HYT-6219 Enables Meeting ULSD Specifications**

<table>
<thead>
<tr>
<th>Product Quality</th>
<th>Before usage</th>
<th>After Reload with HYT-6219</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sulfur, wt-ppm</td>
<td>50 – 150</td>
<td>3 - 8</td>
</tr>
<tr>
<td>Cetane Index</td>
<td>46 – 51</td>
<td>48 – 53</td>
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- Achieved diesel quality is better than EURO V
- Unity catalyst and UOP sales support/service key for this achievement
UOP Unity Hydrotreating Catalysts Can Help Refiners Meet Market Demands

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01
HYT-6219 in ULSD Service

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CASE STUDY
03
HYT-4118 Commercialization in ULSD Service

Catalysts Meeting Expectations At All Units
Unity Case Story 2:
Upgrading Petrochemical Feedstocks

*Cycle Objectives*
- Achieve cycle length
- Improve naphtha quality and yield for downstream petrochemical production

*Type of hydrocracking technology*
- Non-UOP hydrocracking unit design

*Feed Composition*
- VGO/LCGO/HCGO

*Conversion:*
- 90% vol

*UOP Catalyst solution:*
- HYT-6119
- Naphtha HC
Reactor Temperatures

Pretreat Reactor Temperatures

- **HYT-6119 delivers improved stability**

Graph showing Pretreat Reactor Temperatures over Operating Days Since Start of Run.

- **Normalized Average Bed Temperature, °C**
- **Operating Days Since Start of Run**
- **R-6101 WABT**
- **WABT Normalized to Average Conditions**
- **Proposal Predicted WABT at Design Conditions**
Nitrogen Slip from HC Pretreat Reactor

Effluent Nitrogen

Nitrogen, Wt-ppm

Calendar Days Since Start of Run

Target Operation

Excellent HDN Activity with HYT-6119 Catalyst
Hydrocracking Catalyst Performance

Unity Delivers Improved Heavy Naphtha for Petrochemical Use
Unity Case Story 2 - Hydrocracker Products Feed The Aromatics Complex:

Cycle Objectives

- Achieve cycle length
- Increase naphtha quality and yield for downstream petrochemical production

Results

- Unity portfolio delivers improved heavy naphtha product properties
- The achieved heavy naphtha properties enable extra $9 million per year of aromatics production
UOP Unity Hydrotreating Catalysts Can Help Refiners Meet Market Demands

CASE STUDY

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HYT-4118 Commercialization in ULSD Service

Catalysts Meeting Expectations at All Units
Cycle Objectives

- Meet or Exceed cycle length
- Diesel Sulphur of < 10 wt-ppm

Operating conditions:
- 29 barg Reactor Inlet (23 bara I/L H₂ PP)
- 250 Nm³/m³ H₂ to Oil,
- LHSV 1.8 – 2.3 h⁻¹

Our Catalyst solution:

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<tr>
<td>D-86 IBP, °C</td>
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<tr>
<td>D-86 50%, °C</td>
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<td>D-86 FBP, °C</td>
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</table>
Product Sulphur Target = 10 ppm

UOP Services helped to optimize unit operations

HYT-4118 delivers robust performance

HYT-4118 delivers excellent sulfur removal

Expected cycle to exceed target cycle length by 50%*

* Assuming operating conditions and feed properties and targets remain, based on HYT activity & stability

Unity Integrates Catalyst and Service for Cycle Improvements
Unity Case Story 3
Successful Commercialization of HYT-4118

Cycle Objectives:
• Meet or Exceed Cycle Length
• Diesel Sulphur of < 10 wt-ppm

Our Catalyst solution:

UOP Unity Provides Flexibility:
✓ Estimate 50% Cycle Increase
✓ OR 30% Higher Capacity
✓ Flexibility with More Difficult Feedstocks
Unity Means…Access to a Global Network of Experts

Understanding of the big picture behind refinery operations

Knowledge of upstream & downstream units and their interactions

Seamless technology transfer from unit design, to unit start-up and catalyst reload

Regional service team members collaborating with deep subject matter experts

Unmatched experience in servicing of hydroprocessing units worldwide
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**UNITY HYDROTREATING**

*Honeywell UOP*
Created to Help Refiners Be More Profitable While Meeting Shifting Market Demands

Refining customers tell us that they want a solution to:

- Get more profit from difficult feeds
- Go longer between catalyst change-outs
- Operate at higher feed rates to improve utilization
- Increase volume swell

A Customized Loading of ULTIMet and HYT-6219 Can Enable These Goals
Performance Testing With Heavy VGO

HYT 6219 + ULTIMet = Improved
- HDS Activity
- HDN Activity
- Aromatics Saturation

Tailored Catalyst Loading Specifically for Your Plant
ULTIMet

**Premium** Catalyst Solution that:

- Requires **higher hydrogen** availability
- Helps increase profits and margins from difficult feeds
- Provides additional catalyst loading flexibility
- Has the stability and durability for longer periods between change-outs
- Can be operated at higher feed rates
- Boosts volume sell

Or to Put It Simply, Use ULTIMet and **Achieve More**
Commercial Success of UOP Unity Hydrotreating Catalysts

- Operating with difficult feeds in high severity operations
- Activity and stability are on par or better than expectations
- Product quality enabling profitability
- Robust catalysts to handle operating upsets