Hyvahl™ & RFCC Synergy

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Agenda

- Synergy
- Focus on Hyvahl™ Technology
- Focus on (R)FCC Technology
- Conclusion
The Place of the Hyvahl™ / RFCC in the Conversion Scheme
**Hyvahl™ Process: Prime Objectives**

**Hyvahl™ prepares the feed to the RFCC unit**

**Main Target:**
- HDS/HDA/HDN

**Metals & CCR Removal**
- DAO
- AR, VR

**Metals removal:**
- Reduced RFCC Catalyst Consumption

**Output Streams:**
- **SOx / NOx**: Reduced Emissions
- **LPG**: Improved FCC Yields
- **Propylene**: More Propylene
- **Gasoline**: Low Sulfur Gasoline
- **LCO**: Decreased Slurry Yield
Hyvahl™ Process: RFCC Gains

- Know-how of RDS + RFCC synergy
- Key for Global Profitability Optimization

Hyvahl™ Feed

HDT Resid to RFCC

Propylene/Gasoline Potential

RFCC C3= or gasoline yield gain

Hyvahl™ unit profitability: RFCC product slate improvement
ARDS / VRDS: Hyvahl™ Technology

- **Hyvahl™**: Fixed bed process with HDM and HDS Sections in series

Main operating parameters:
- Total pressure ~ 100 to 200 bar
- LHSV ~ 0.4h⁻¹ down to 0.1h⁻¹
- Op. Temp ~ 350°C up to 410°C
RFCC Project Profitability…
linked to Hyvahl™ stream factor

- Frequent shutdowns = loss of production
- Hyvahl™ reliable operation is a must

Key factor to maximize profitability: Hyvahl™ on-stream factor

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<th>AL</th>
<th>AH</th>
<th>IL</th>
<th>IH</th>
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<tbody>
<tr>
<td>Sulfur, wt%</td>
<td>3.4</td>
<td>4.5</td>
<td>2.3</td>
<td>3.2</td>
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<td>Nitrogen, ppmwt</td>
<td>1954</td>
<td>3074</td>
<td>2826</td>
<td>4809</td>
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<tr>
<td>Ni+V, ppmwt</td>
<td>39</td>
<td>148</td>
<td>92</td>
<td>269</td>
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<tr>
<td>CCR, wt%</td>
<td>9.5</td>
<td>14.0</td>
<td>8.4</td>
<td>12.9</td>
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<tr>
<td>C7 asphalt., wt%</td>
<td>3.4</td>
<td>7.1</td>
<td>1.4</td>
<td>4.5</td>
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Iranian crudes:
- High metal content
- Refractory feedstock

Reliable operation thanks to Axens’ Patented PRS™ Technology
Hyvahl™ Reactor Configurations

- **By-Passable Reactors**
  - 1st Reactor bypassed if dP increases
  - Not possible to add catalyst to the system
  - Minimum CapEx option

- **PRS_{1R}: Re-Loadable Reactors**
  - 1st reactor can be bypassed and reloaded while unit in operation
  - Good protection from metals/dP issues
  - Compromise between cost and cycle gain

- **PRS_{2R}: Permutable Reactor System**
  - 2 first reactors can permutate in lead/lag
  - Well suited for high metal content
  - Complete protection from metals/dP issues

**PRS™ systems ideal for Iranian crude**
RFCC Challenges in Processing Resid Feed

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<th>VGO</th>
<th>Resid</th>
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<tr>
<td>Sp Gr</td>
<td>0.88 - 0.92</td>
<td>0.90 – 0.95</td>
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<tr>
<td>CCR</td>
<td>&lt; 3 wt%</td>
<td>&gt; 3 wt%</td>
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<tr>
<td>Metals</td>
<td>&lt; 5 wtppm</td>
<td>20-25 wtppm</td>
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**Performance Issue**
- Poor Yields
- Coke deposit Rx & Ovhd

**Catalyst Issue**
- Poor Yields
- Catalyst deactivation

**Mechanical Issue**
- High coke production
- High Regenerator Temp.
- High metal content
- Detrimental catalyst effect
- Catalyst deactivation

2020 Bunker Fuels: A Way to Boost Profits

- Take advantage of the 2020 market: Bunker fuel production coupled with secure high-value products

- Bunker Fuel production should be a means to maximizing profit, not a primary objective

- High-value products from conversion/refining should remain the focus of refiners

- RFCC preferable to secure project profitability from bunker fuel price uncertainty
To conclude...

- **Axens: Licensor of Hyvahl™ and RFCC**
  - Strong Know-how of each technology to provide each customer the *optimized solution*

- **Hyvahl™**
  - Pretreatment adapted to *maximize RFCC yields*
  - **PRS™ system** for smooth operation and long cycles
  - Allows to produce *Bunker fuels* meeting IMO 2020 spec

- **RFCC**
  - Large experience: *leader* in processing of resid feed.
  - High performances with reliable and properly selected technology features

- **Maximum profitability** thanks to Hyvahl™ & RFCC synergy
Thank you! And see you on Axens’ Blog
axens.net/blog