DEVELOPMENT ON CATALYTIC DEACTIVATION STUDY IN COMMERCIAL RFCC CATALYSTS

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AGENDA

• RFCC UNIT AT RUWAIS
• RFCC CATALYST
• COMMON CATALYST DEACTIVATION PROTOCOLS
• BASIS OF THE NEW APPROACH.
• SUMMARY
ADNOC REFINING RFCC UNIT

- Ruwais refinery, Abu Dhabi
- Resid to propylene technology, R2R technology
- 127,000 BPSD
- PetroRiser recycling LCN
- Atmospheric Residue,
  API=21,
  CCR=4.7 %, S = 1.7 wt%
  Nickel:7 ppmw
  Vanadium:11 ppmw
RFCC OPERATION

To Achieve max target of Product

Feed+Catalyst

Separate flue gas from cat

Separate Products from cat

Regenerate catalyst

Operating Conditions (T, C/O, Contact time)

Catalyst Formulation (Chemical & physical properties)

Catalyst flow Control (velocity, flow regime)
Hierarchical pore structure in a RFCC catalyst

ACTIVITY OF RFCC CATALYST

- Fresh activity
- Hypothetical activity
- Operating activity
- Equilibrium catalyst E-Cat

Activity level

F(Coke, Metal, SA)

Non active catalyst

Time
It is commonly practiced to increase the deactivation temperature to simulate the aging effect.

DEACTIVATION STEPS

Cracking step

Regeneration

Steaming

Feed Spiked with metals: Ni, V

Temperature °C

780

Air atmosphere

Steam

Time

End of deactivation
Findings:
At certain level of concentration catalyst can not take up the metals.
Clusters form at the inlet of the reactor.
DEACTIVATION

**Standard Protocol**
- Base catalyst Metallation at 780 °C and steaming at 800 °C for 6 hours
- Olefins Additives Steaming at 800 °C for 20 hours

**Modified Protocol**
- Base catalyst Metallation at 650 °C and steaming at 800 °C for 6 hours
- Olefins Additives Steaming at 800 °C for 20 hours

Deactivated catalyst for testing kinetics
EVALUATION OF CATALYST

Evaluation Unit
Advanced Cracking Evaluation

Evaluation Conditions

<table>
<thead>
<tr>
<th>Catalyst Bed</th>
<th>Fixed fluidized Bed</th>
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</thead>
<tbody>
<tr>
<td>Reaction Temp</td>
<td>550 °C</td>
</tr>
<tr>
<td>Cat/Oil</td>
<td>4-9</td>
</tr>
<tr>
<td>WHSV</td>
<td>8</td>
</tr>
<tr>
<td>Contact time</td>
<td>&lt; 3 seconds</td>
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</tbody>
</table>
TEMPERATURE EFFECT

CONVERSION VS CAT/OIL

Δ > 5%

Cat A @650 °C  Cat A @780 °C
SUMMARY

- Effect of cracking temperature is dominant in deactivating the catalyst.
- Wet metallation at low temperatures will give Lower deactivation effect. On the contrary increasing temperature too high will agglomerate metals.
- It is found that cracking at low temperatures better simulate metal distribution of E-Cat.
THANK YOU