LATEST ADVANCES OF THE SYDEC DELAYED COKING TECHNOLOGY

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Principal Process Engineer

XII FORUM ON ADVANCES IN THE OIL REFINING INDUSTRY

Mexico City, September 2006
• Delayed Coking Process

• Advantages / Benefits of Delayed Coking

• Foster Wheeler In the Delayed Coking Industry

• Latest Advances on SYDEC™ Delayed Coking
Residue Upgrading – Drivers & Routes

Increasing Light Crude - Heavy Crude Price Spread
Declining Markets for HSFO
Increased Demand for Distillates
Need for Higher Profitability

Residue Upgrading & Conversion

Catalytic
RFCC
Ebullated Bed Hydrocracking
Slurry Phase Hydrocracking

Non-Catalytic
Coking
Visbreaking
Solvent Deasphalting
Fluid/ Flexicoking
Partial Oxidation
## Typical SYDEC<sup>SM</sup> Yields

<table>
<thead>
<tr>
<th></th>
<th>Orinoco Heavy</th>
<th>Merey Blend</th>
<th>Maya</th>
<th>Mixed Arabian</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gas, LV% FOE</td>
<td>5.36</td>
<td>5.52</td>
<td>5.58</td>
<td>5.20</td>
</tr>
<tr>
<td>C&lt;sub&gt;3&lt;/sub&gt;/C&lt;sub&gt;4&lt;/sub&gt;, LV%</td>
<td>7.04</td>
<td>7.66</td>
<td>7.08</td>
<td>6.64</td>
</tr>
<tr>
<td>Naphtha, LV%</td>
<td>14.07</td>
<td>16.71</td>
<td>13.50</td>
<td>12.64</td>
</tr>
<tr>
<td>LCGO, LV%</td>
<td>28.38</td>
<td>31.69</td>
<td>28.77</td>
<td>27.09</td>
</tr>
<tr>
<td>HCGO, LV%</td>
<td>28.48</td>
<td>20.79</td>
<td>20.81</td>
<td>31.24</td>
</tr>
<tr>
<td>Coke, wt%</td>
<td>32.44</td>
<td>35.77</td>
<td>39.80</td>
<td>30.91</td>
</tr>
</tbody>
</table>

**HCGO**

<table>
<thead>
<tr>
<th></th>
<th>Orinoco Heavy</th>
<th>Merey Blend</th>
<th>Maya</th>
<th>Mixed Arabian</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gravity, °API</td>
<td>16.56</td>
<td>16.55</td>
<td>14.27</td>
<td>13.86</td>
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<tr>
<td>Ni + V, ppmw</td>
<td>0.5</td>
<td>0.7</td>
<td>0.6</td>
<td>0.4</td>
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<tr>
<td>CCR, wt%</td>
<td>0.31</td>
<td>0.53</td>
<td>0.55</td>
<td>0.41</td>
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**Coke**

<table>
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<tr>
<th></th>
<th>Orinoco Heavy</th>
<th>Merey Blend</th>
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</thead>
<tbody>
<tr>
<td>Sulfur, wt%</td>
<td>4.65</td>
<td>3.96</td>
<td>6.02</td>
<td>6.39</td>
</tr>
</tbody>
</table>
Advantages and Benefits of Delayed Coking

Full conversion of resid to valuable products
   Full range of lighter products
   Complete decarbonization of residue feed and metals removal

Maximum yield of clean liquid products
   Low pressure coking / ultra-low recycle coking

Marketable Coke Product
   High Sulfur coke (>4%) priced for its heating value in power plants, cement kilns & gasification
   Low/medium sulfur coke (1 – 3%) priced for heating value and carbon content in calcining & metallurgical coke making

Relatively low CAPEX & OPEX

Proven, Safe & Reliable
   First Unit Built in 1929
   Some 150 Units Built Since Then – 56 in the US Alone
   Five Years Between Turnarounds Common

Supported by Vendors, Contractors & Operators

A Cash Generator
Examples of Cash Generation

MOL
Asphalt Upgrading
Budapest, Hungary
20,500 BPSD DCU
with gas plant
Started up in 2000

Added $49 Million per Year to Refinery’s Profit
Examples of Cash Generation

Valero, Texas City
Crude Conversion Project
45,000 BPSD four drum DCU with gas plant

Started Up in 2003

Added $100 Million per Year to Operating Profit
FW Experience - Delayed Cokers

• SYDEC\textsuperscript{SM} Technology
  – Over 2.5 Million BPSD Capacity
  – 52 new units built (5k to 122k BPSD)
  – 24 new units in last 5 years
  – 62 major projects since 1990

• Strong Execution
  – The Standard for execution, schedule and operation; independent benchmarking
  – Currently have 15+ projects in-house: new and revamp
  – Continuous work, strong execution teams
  – Operations Support
### Foster Wheeler SYDEC<sup>SM</sup>

**Experience recent years**

<table>
<thead>
<tr>
<th>Client</th>
<th>Location</th>
<th>Capacity</th>
<th>Date</th>
<th>Client</th>
<th>Location</th>
<th>Capacity</th>
<th>Date</th>
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<tbody>
<tr>
<td>PetroCanad</td>
<td>Alberta Can</td>
<td>141,000</td>
<td>2010</td>
<td>Flint Hills</td>
<td>Corpus Christi</td>
<td>15,500</td>
<td>R 2008</td>
</tr>
<tr>
<td>Pemex</td>
<td>Salina Cruz</td>
<td>76,362</td>
<td>2010</td>
<td>Confid</td>
<td>US</td>
<td>102,000</td>
<td>R 2008</td>
</tr>
<tr>
<td>Repsol YPF</td>
<td>Argentina</td>
<td>28,000</td>
<td>2009</td>
<td>Confid</td>
<td>US</td>
<td>73,000</td>
<td>R 2008</td>
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<tr>
<td>Naftan</td>
<td>Belarus</td>
<td>23,000</td>
<td>2009</td>
<td>Sincor</td>
<td>Venezuela</td>
<td>120,000</td>
<td>R 2007</td>
</tr>
<tr>
<td>United</td>
<td>Pennsylvania</td>
<td>14,400</td>
<td>2009</td>
<td>BP</td>
<td>Spain</td>
<td>20,000</td>
<td>R 2007</td>
</tr>
<tr>
<td>Petronor</td>
<td>Spain</td>
<td>35,500</td>
<td>2009</td>
<td>FHR</td>
<td>Texas</td>
<td>15,500</td>
<td>R 2007</td>
</tr>
<tr>
<td>Idemitsu</td>
<td>Japan</td>
<td>35,000</td>
<td>2009</td>
<td>ExxonMobil</td>
<td>Beaumont</td>
<td>45,000</td>
<td>2006</td>
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<td>Cosmo</td>
<td>Japan</td>
<td>25,000</td>
<td>2009</td>
<td>Pemex</td>
<td>Minatitlan</td>
<td>55,794</td>
<td>2005</td>
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<tr>
<td>Petropower</td>
<td>Chile</td>
<td>18,200</td>
<td>R 2008</td>
<td>Emerol</td>
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<td>17598</td>
<td>R 2004</td>
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<td>CNOOC</td>
<td>China</td>
<td>77,000</td>
<td>R 2008</td>
<td>Premcor, 843</td>
<td>Port Arthur</td>
<td>105,000</td>
<td>R 2004</td>
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<td>FHR</td>
<td>Minnnesota</td>
<td>38,000</td>
<td>R 2008</td>
<td>Reliance</td>
<td>India</td>
<td>150,000</td>
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<td>Rompetrol</td>
<td>Romania</td>
<td>18,100</td>
<td>2008</td>
<td>RPC</td>
<td>Chile</td>
<td>20,000</td>
<td>R 2003</td>
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<td>Reliance#2</td>
<td>India</td>
<td>160,000</td>
<td>2008</td>
<td>Citgo</td>
<td>Corpus Christi</td>
<td>43,000</td>
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<tr>
<td>CHS</td>
<td>Montana</td>
<td>15,000</td>
<td>2008</td>
<td>Citgo Coker II</td>
<td>Lake Charles</td>
<td>69,300</td>
<td>R 2003</td>
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</table>
## Advantage FW – Experience

### New FW Units Built

<table>
<thead>
<tr>
<th>Client</th>
<th>Location</th>
<th>Date</th>
<th>Client</th>
<th>Location</th>
<th>Date</th>
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<tbody>
<tr>
<td>Pemex</td>
<td>Madero, Mexico</td>
<td>2003</td>
<td>Coastal Corp.</td>
<td>Corpus Christi, TX</td>
<td>1981</td>
</tr>
<tr>
<td>Valero</td>
<td>Texas City, TX</td>
<td>2003</td>
<td>Exxon</td>
<td>Baton Rouge, LA</td>
<td>1980</td>
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<tr>
<td>Pemex</td>
<td>Cadereyta, Mexico</td>
<td>2002</td>
<td>Rafinor</td>
<td>Mongstad, Norway</td>
<td>1975</td>
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<tr>
<td>Hamaca</td>
<td>Jose, Venezuela</td>
<td>2002</td>
<td>Chevron</td>
<td>Salt Lake City, UT</td>
<td>1973</td>
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<tr>
<td>Sincor</td>
<td>Jose, Venezuela</td>
<td>2002</td>
<td>Atlantic Richfield</td>
<td>Cherry Point, WA</td>
<td>1972</td>
</tr>
<tr>
<td>MOL</td>
<td>Szazhalombatta, Hungar</td>
<td>2001</td>
<td>Gelsenberg-Benzin A. Gelsenkirchen, Ger</td>
<td>1972</td>
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<tr>
<td>Premcor</td>
<td>Port Arthur, TX</td>
<td>2000</td>
<td>Clark Oil</td>
<td>Hartford, IL</td>
<td>1970</td>
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<tr>
<td>Shell Oil Company</td>
<td>Deer Park, TX</td>
<td>2000</td>
<td>Conoco</td>
<td>Immingham, England</td>
<td>1970</td>
</tr>
<tr>
<td>Petropower (ENAP)</td>
<td>Concepcion, Chile</td>
<td>1998</td>
<td>Conoco</td>
<td>Immingham, England</td>
<td>1970</td>
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<tr>
<td>Lyondell-Citgo</td>
<td>Houston, TX</td>
<td>1997</td>
<td>Sinclair Refining Co. Houston, TX</td>
<td>1970</td>
<td></td>
</tr>
<tr>
<td>Shell Oil Company</td>
<td>Martinez, CA</td>
<td>1996</td>
<td>Atlantic Richfield</td>
<td>Watson, CA</td>
<td>1969</td>
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<tr>
<td>Shell Oil Company</td>
<td>Deer Park, TX</td>
<td>1995</td>
<td>Humble Oil &amp; Refining Baton Rouge, LA</td>
<td>1968</td>
<td></td>
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<tr>
<td>Lagoven</td>
<td>Amuay, Venezuela</td>
<td>1994</td>
<td>Marathon</td>
<td>Burghausen, Germany</td>
<td>1968</td>
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<tr>
<td>Husky Oil</td>
<td>Saskatchewan, Canada</td>
<td>1992</td>
<td>Richfield</td>
<td>Wilmington, CA</td>
<td>1967</td>
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<tr>
<td>Repsol Petroleo</td>
<td>Puertollano, Spain</td>
<td>1990</td>
<td>Marathon Oil Co.</td>
<td>Robinson, IL</td>
<td>1966</td>
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<tr>
<td>YPF</td>
<td>Lujan De Cuyo, Argentina</td>
<td>1989</td>
<td>RAF. Sisak</td>
<td>Pancevo, Yugoslavia</td>
<td>1966</td>
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<tr>
<td>Kukdong Oil (Hyundai)</td>
<td>South Korea</td>
<td>1988</td>
<td>Shell Oil Company</td>
<td>Norco, LA</td>
<td>1966</td>
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<tr>
<td>YPF</td>
<td>La Plata, Argentina</td>
<td>1988</td>
<td>Humble Oil &amp; Refining Baton Rouge, LA</td>
<td>1965</td>
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<td>Esso A.G.</td>
<td>Karlsruhe, Germany</td>
<td>1985</td>
<td>Texaco</td>
<td>Lockport, IL</td>
<td>1963</td>
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<td>Champlin Petroleum</td>
<td>Corpus Christi, TX</td>
<td>1983</td>
<td>American Gilsonite</td>
<td>Grand Junction, CO</td>
<td>1957</td>
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<td>Chevron</td>
<td>Pascagoula, MS</td>
<td>1983</td>
<td>Texas Company</td>
<td>El Paso, TX</td>
<td>1955</td>
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<tr>
<td>Cities Service</td>
<td>Lake Charles, LA</td>
<td>1983</td>
<td>McColl Frontenac Ltd. Alberta, Canada</td>
<td>1952</td>
<td></td>
</tr>
</tbody>
</table>
Latest Advances on SYDEC\textsuperscript{SM} Delayed Coking

1. Terrace Wall\textsuperscript{©} Double-fired Furnace
2. On-line Spalling
4. Coke Drum Overhead Quench
5. Fractionator Bottoms Fines Removal
6. Recovery of Blowdown Vent Vapors
7. Large Coke Drums
8. Unheading System Improvements
9. Safety Features
10. Coke Handling Systems
11. Environmental Features
12. Operator Training
Operability Features – FW Furnace

Four Pass - Single Fired Heater
Operability Features – FW Furnace

• Single-Fired Heater
  – Firebox dimensions
  – In-tube velocity
  – Burner selection and spacing
  – Coil spacing
  – Separate flow pass control
  – Independent firing controls

Peak heat flux is 80% above average heat flux.
Latest Advances on SYDEC™ Delayed Coking

Operability Features – FW Furnace

Double-Fired Furnace
Operability Features – FW Furnace

• Double-Fired Furnace
  – For Difficult Feeds
  – Feedstock Flexibility
  – Longer Runlength

FW Design Features
  * High average heat flux to maintain film temperature
  * Reduced coil volume
  * High in-tube velocity
  * Independent pass control
  * Sloped heater wall for even flux

Peak heat flux is only 20% above average heat flux.
Latest Advances on SYDEC℠ Delayed Coking

Operability Features – FW Furnace
Latest Advances on SYDEC℠ Delayed Coking

Operability Features – FW Furnace

Note: Burners and Air Plenums Shop Installed
Latest Advances on SYDEC$^{SM}$ Delayed Coking

Operability Features – FW Furnace
Latest Advances on SYDEC℠ Delayed Coking

Operability Features

Heater On-line Spalling
Latest Advances on SYDEC\textsuperscript{SM} Delayed Coking

Operability Features – Maximum Liquid Yield

The Variables

- Temperature – Higher is better
- Pressure – Lower is better
- Recycle – Lower is better, but . . .

The Trade-off of Recycle with HCGO Quality

- Higher Endpoint
- Higher CCR
- Higher Metals
- Higher C\textsubscript{7} Insolubles
### Latest Advances on SYDEC$^{SM}$ Delayed Coking

**Operability Features – Recycle & HCGO**

<table>
<thead>
<tr>
<th>HCGO Properties</th>
<th>Ultra Low Recycle</th>
<th>True Zero Recycle</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gravity, °API</td>
<td>12.78</td>
<td>11.55</td>
</tr>
<tr>
<td>Sulfur, wt%</td>
<td>2.58</td>
<td>2.55</td>
</tr>
<tr>
<td>Nitrogen, wppm</td>
<td>5,303</td>
<td>5,087</td>
</tr>
<tr>
<td>CCR, wt%</td>
<td>0.53</td>
<td>2.43</td>
</tr>
<tr>
<td>$C_7$ Insol., wppm</td>
<td>432</td>
<td>2,000</td>
</tr>
<tr>
<td>Ni + V, wppm</td>
<td>1.0</td>
<td>3.8</td>
</tr>
<tr>
<td>Distillation</td>
<td></td>
<td></td>
</tr>
<tr>
<td>10%</td>
<td>729</td>
<td>734</td>
</tr>
<tr>
<td>50% LV</td>
<td>864</td>
<td>893</td>
</tr>
<tr>
<td>EP</td>
<td>1,072</td>
<td>1,141</td>
</tr>
<tr>
<td>Watson K</td>
<td>11.13</td>
<td>11.12</td>
</tr>
</tbody>
</table>
Operability Features – Low Recycle

Design Considerations for Ultra-Low Recycle

• Coke Drum Overhead Quench
• Fractionator
  – Spray Chamber Wash Zone
  – Eliminate Fresh Feed Splash
  – Coke Fines Removal
Operability Features – Low Recycle

- Wash Oil Spray Chamber
- Coke Drum OVHD Vapor
- Heat Shield
- Eliminate Fresh Feed Splashing
- Fresh Feed
- On-Line Fines Removal
- Heater Charge
Latest Advances on SYDEC\textsuperscript{SM} Delayed Coking

Operability Features – Zero Recycle

Quench

P/A

MCGO or HCGO

Wash

Coker Feed

HCGO or XHCGO
Latest Advances on SYDEC℠ Delayed Coking

Operability Features – Overhead Quench

- QUENCH OIL STRAINER
- HCGO QUENCH From Fractionator
- Blowdown Oil from Blowdown Tower
- MEDIUM PRESSURE STEAM
- FO
- PI
- PC
- TCV
- FC
- TI
- FULL CONE SPRAY NOZZLE
- COKE DRUM VAPOR OUTLET
- OVHD VAPORS
- COKE DRUM VAPOR OUTLET

Full Cone Spray Nozzle

Full Cone Spray Nozzle
Latest Advances on SYDEC$^\text{SM}$ Delayed Coking

Operability Features – Fractionator Bottoms Fines Removal

Coke Drum OVHD Vapor

Heat Shield

Fresh Feed

On-Line Fines Removal

Heater Charge
Latest Advances on SYDEC™ Delayed Coking

Recovery of Blowdown Vent Vapors

- Lt. Gas Oil Makeup
- Blowdown Condenser
- Blowdown Settling Drum
- Circulating Oil Cooler
- Blowdown Vent Vapors to Recovery Compressor
- Blowdown Oil
- Blowdown Sour Water
- Wax Tailing
Latest Advances on SYDEC<sup>SM</sup> Delayed Coking

Large Coke Drums

Coke Drum Design:

<table>
<thead>
<tr>
<th></th>
<th>6 years ago</th>
<th>today</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inside Diameter</td>
<td>29.0 Ft</td>
<td>32.0 Ft</td>
</tr>
<tr>
<td></td>
<td>(8.83 m)</td>
<td>(9.75 m)</td>
</tr>
<tr>
<td>Flange – Flange</td>
<td>120.0 Ft</td>
<td>140.0 Ft</td>
</tr>
<tr>
<td></td>
<td>(36.58 m)</td>
<td>(42.67 m)</td>
</tr>
</tbody>
</table>

Advanced Plate Chemistry
Minimum or No Plate Thickness Changes
Latest Advances on SYDEC℠ Delayed Coking

Safety Features – Unheading Systems

Foster Wheeler Systems

- Fifty-one Semi-Automatic Bottom Devices
- Ten Automatic Bottom Devices
- Thirty-six Top Semi-Automatic Devices

DeltaValve Systems

- Twenty Installations Done / In Progress
Latest Advances on SYDEC℠ Delayed Coking

Safety Features – FW Unheading

Semi-Automatic Bottom Device
Latest Advances on SYDEC$^{SM}$ Delayed Coking

Safety Features – FW Unheading

Semi-Automatic Bottom Device
Latest Advances on SYDEC\textsuperscript{SM} Delayed Coking

Safety Features – FW Unheading

Fully Automatic Bottom Device
Latest Advances on SYDEC$^\text{SM}$ Delayed Coking

Safety Features – FW Unheading

Fully Automatic Bottom Device
Latest Advances on SYDEC SM Delayed Coking

Safety Features – FW Unheading

Semi-Automatic Top Device
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Safety Features – DV Unheading
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Latest Advances on SYDEC$^\text{SM}$ Delayed Coking
FW – Safety Features

- Advance Drum Unheading
- Drum Switch Interlocks
- Heater Interlocks
- Coke Cutting Interlocks
- Relief Systems
- Ergonomic Layouts
- Hazop & Management of Change
- Structure Safety Egress
- Structure Fire Safety Systems
- Structure Shelters & Barriers
- Process & Operator Safety

Latest Advances on SYDEC$^\text{SM}$ Delayed Coking
Latest Advances on SYDEC\textsuperscript{SM} Delayed Coking

Safety Features – Switch Deck

- Single Level Switch / Unheading Deck
- Barrier Walls
- Positioning of Control Panels
- Layout of Piping / Valves
- Clear Lanes for Emergency Egress
- Firewalls at Elevator & Stairways
- Audiovisual Alert Devices
Latest Advances on SYDEC$^\text{SM}$ Delayed Coking
Latest Advances on SYDEC$^\text{SM}$ Delayed Coking

Safety Features – Switch Deck Layout
Latest Advances on SYDEC℠ Delayed Coking

Safety Features – Switch Deck Barrier
Latest Advances on SYDEC\textsuperscript{SM} Delayed Coking

Safety Features – Switch Deck Barrier
Safety Features – Cutting Deck

- Enclosed Cutting Shelters
- Clear View of Coke Pit
- Barrier Walls for Emergency Egress
- Firewalls at Elevator & Stairways
- Escape Towers and Chutes
- Escape Gondola
- Audiovisual Alert Devices

Latest Advances on SYDEC\textsuperscript{SM} Delayed Coking
Latest Advances on SYDEC$^{SM}$ Delayed Coking

Safety Features – Cutting Deck Layout
Latest Advances on SYDEC<sup>SM</sup> Delayed Coking

Safety Features – Cutting Deck Shelter
Safety Features – Fire Protection

Decks and Stairwells

Fire Walls

Hydrants and Monitors

Deluge Systems
Latest Advances on SYDEC\textsuperscript{SM} Delayed Coking

Safety Features – Interlocks

Basics

- During Cutting
  Physical Separation
  Permissives Based on Tool Position
- During Switching & Unheading
  Physical Separation
  Permissives Based on Process Variables
  Permissives Based on Valve Positions
Latest Advances on SYDEC<sup>SM</sup> Delayed Coking

Safety Features – Interlocks
Safety Features – Interlocks

Safety Interlocks

– Coke Drum Inlet Isolation Valves, Switch Valve, Utility Valve, and Top & Bottom Unheading
– Coke Drum Outlet Isolation Valves and Blowdown Valves
– Coke Drum Vent, PSV Isolation
– Heater Pass Flow, Fuel Pressure and Combustion Air
– Coke Cutting System
Deep Pit System

Operability Features – Coke Handling

- Clear Water Sump
- Finess Settling Maze
- Chute
- Pit

Latest Advances on SYDEC<sup>SM</sup> Delayed Coking
Latest Advances on SYDEC™ Delayed Coking

Operability Features – Coke Handling

Pad System

- COKE PAD
- FINES SETTLING BASIN
- CLEAR WATER SUMP
- FRONT-END LOADER ACCESS
- MAZE
Latest Advances on SYDEC\textsuperscript{SM} Delayed Coking

Operability Features – Coke Handling

Pit / Pad System
Operability Features – Coke Handling

Coke Dewatering and Handling
* High Volume Maze for Fines Recovery
* Full Drum Coke Volume Available Below Chute
* Drum Drain to Pit
* On-Site Coke Storage for Draining and Cooling
Latest Advances on SYDEC<sup>SM</sup> Delayed Coking

**FW – Environmental Features**

- Enclosed Blowdown System & Vapor Recovery
- Sludge Injection Technology
- Heater NOx Controls
  - SCR & Low NOx burners
- Minimal Water Use - cutting water recycle
- Coke Particulates
  - Wetting systems
  - Clean up spills
  - Wash stations
- Coke Handling Systems
  - Special conveyors
  - Covered storage “barns” and reclaimers
Latest Advances on SYDEC\textsuperscript{SM} Delayed Coking

FW – Training & Operations

- **Operations Support**
  - **Startup Planning**
    - System Definition
    - System Sequence
    - Unit Sequencing
    - Startup Procedures
    - Coordination of Vendors
  
  - **Training**
    - Home Office
    - Site
    - Host Site
    - On The Job
• **FW’s Training & Operations Group**
  - Experienced and Focused
  - Full-time
  - Dedicated
  - Expandable
  - Well Respected
FW – Constantly Improving

Faster, Less Expensive, Safer

Repeat project teams

Standardized coker island design

Standardization of specifications

Incorporating latest vendor developments

Plot plan optimization

Process design and tools

Proprietary equipment – furnace and unheading
* The Number of Successful Coker Projects
* Coking is One of Our Core Businesses
* Depth of Experienced and Expert Staff
* Leadership in Innovation and Improvement
* Understanding of Safety, Reliability & Environmental Issues

* We Will Work with You to Optimize the Solution
LATEST ADVANCES OF THE SYDEC
DELAYED COKING TECHNOLOGY

Miguel I. Londono
Principal Process Engineer

XII FORUM ON ADVANCES IN THE OIL REFINING INDUSTRY

Mexico City, September 2006
Career Summary

Miguel I. Londoño
Principal Process Engineer

Miguel has over twelve (12) years experience in the Oil and Gas, and Refinery Industry.

He has participated in the conceptual design, basic design, and detail design to install new or expand existing Delayed Coker Units, Solvent Deasphalting units, ASCOT units, Hydrotreaters, and FCCU units.

He has participated in in the conceptual design, basic design, and detail design to install new Central Processing Facilities for Upstream Refinery Oil Treatment.

He has also been involved in pre-commissioning, commissioning, and unit start-up activities of Delayed Coker Units.

He has participated in HAZOP studies.

Professional Experience

2005 - Present  
Foster Wheeler USA Corporation – Houston

Principal Process Engineer

- Delayed Coker and Solvent Deasphalting yields development for several new and existing Units.
- TOTAL, Port Arthur, Texas, Delayed Coker Unit
  Lead engineer for the development of a Basic Design study for a new 50,000 BPSD / 4 Drum Delayed Coker unit.
- ROSNEFT, Tuapse, Russia, ASCOT Unit
  Participated in the development of a proposal study for a new 31,000 BPSD ASCOT Unit. (ASCOT is the FW Service Mark for an Integrated Solvent Deasphalting and Delayed Coking Technology).
- BP Cherry Point, Blaine, Washington, Delayed Coker Unit
  Lead engineer for the development of a Basic Design study for the expansion of an existing 60,000 BPSD / 4 Drum Delayed Coker unit.
- Sincor, Jose, Venezuela - Delayed Coker Unit
  Lead engineer for the development of a Basic Design study for the expansion of an existing 89,000 BPSD / 6 Drum Delayed Coker unit.
- COSMO Oil Co. – Sakai, Japan – Delayed Coker Unit
  Participation in proposal for the installation of a new 25,000 BPSD Coker Unit.
- Sincor, Jose, Venezuela - Delayed Coker Unit
  Lead engineer for the development of a Test Run and a Feasibility study for the expansion of an existing 89,000 BPSD / 6 Drum Delayed Coker unit.
- CHS Inc., Laurel, Montana - Delayed Coker Unit
Miguel I. Londoño
Principal Engineer

Lead engineer for the Process design of a new 15,000 BPSD / 2 Drum Delayed-coker unit to process Western Canadian Vacuum Residue.

2002 - 2004  Foster Wheeler USA Corporation – Houston

Senior Process Engineer

- *Delayed Coker and Solvent Deasphalting yields development for several new and existing Units.*
  
  *Petrolera Ameriven CA., Jose, Venezuela - Delayed Coker Unit*
  
  Process advisor for the start-up of a new 63,500 BPSD / 4 Drum Delayed-coker unit.

- *Premcor Refining Group, Inc., Port Arthur, TX - Delayed Coker Unit*
  
  Lead engineer for the development of the detail design for the expansion of an 80,000 BPSD/6 Drum Delayed-coker unit to 99,700 BPSD.

- *Delayed Coker and Solvent Deasphalting yields development for several new and existing Units.*
  
  *Premcor Refining Group, Inc., Port Arthur, TX - Delayed Coker Unit*
  
  Front-end design for the expansion of an 80,000 BPSD/6 Drum Delayed-coker unit to 99,700 BPSD and 109,000 BPSD. Responsibilities included: Supervision of the process engineering team for the development of PRO-II simulations of the Main Coker Fractionator, Vapor recovery unit and naphtha splitter units; preparation of heat and material balances, engineering flow diagrams, evaluation of equipment, instrumentation, safety systems and piping.

- *Participation in a Conceptual Study to install a new Solvent Deasphalting Unit and Delayed Coker Unit in Lloydminster, Saskatchewan, Canada.*
  
  Responsibilities include: Development, review, and issue of heat and material balances and process flow diagrams.

- *Participation in a Conceptual Study to expand a Delayed Coker Unit in Seo-San, South Korea.*
  
  Responsibilities included: Determination of unit capacity, development, review, and issue of heat and material balances and process flow diagrams. Debottlenecking studies and evaluation of adequacy of existing equipment for the expansion.

- *Participation in the Conceptual and Basic Design of a Hydrotreater Unit in Concon Chile.*
  
  Responsibilities included: Development, review, and issue of heat and material balances, process flow diagrams, and equipment data sheets.

2000 – 2001  Foster Wheeler USA Corporation – Venezuela

Senior Process Engineer

*Dacion Field Venezuela*

- Participation in the Management Team that designed, developed, and built major new heavy oil production facilities. Facilities to process up to 70,000 BPD oil, 260,000 BPD produced water with re-injection, and up to 228 MMscfd lift gas injection.

- Section Leader of the Dacion Oil System Team. Responsible for the design of the oil treatment system for the new facilities. Development, review, and issue of heat and material balances, process flow diagrams, and piping and instrument diagrams. Finalize instrumentation and control schemes, equipment and instrument specifications and operating philosophies. Perform detail engineering assistance and follow-up. Perform pre-commissioning and commissioning assistance. Participation in the HAZOP studies for the oil treatment system.
The new field facilities included Remote Manifolds, three Flow Stations, two Main Process Stations, and pipelines between stations.


2000
Foster Wheeler USA Corporation – Venezuela

Senior Process Engineer

Upstream New Processing Facilities for LASMO - Dacion Field, Venezuela

- Participation in the conceptual design and optimization study for the development of major new heavy oil production facilities in Dacion Field, Venezuela.
- Responsible for the design of utility systems for the new facilities. Development, review, and issue of heat and material balances, process flow diagrams and engineering flow diagrams, equipment and instrument specifications.
- The new field facilities included Remote Manifolds, three Flow Stations, two Main Process Stations and pipelines between stations.

1999 - 2000
Foster Wheeler USA Corporation - Houston

Process Advisor

Reliance Petroleum Limited Jamnagar Refinery, India - Delayed Coker Unit

Participation as a process advisor in the commissioning, start-up, and operation of a 122,400 BPSD/8 Drum Delayed coker Unit in India, (four months continuous experience).

1998 - 1999
Foster Wheeler USA Corporation - Houston

Process Advisor

Clark Refining and Marketing, Inc., Port Arthur, TX - Delayed Coker Unit

- Engaged in the supervision of process engineers and in the preparation of process design calculations, economic studies, and evaluations with computer applications, process and engineering flow diagrams, instrumentation, and equipment specifications.
- Basic and detailed design of a 80,000 BPSD/6 Drum Delayed-coker unit. Responsibilities included: PRO-II simulation of the Main Coker Fractionator and Absorber-Stripper Gas Plant, preparation of heat and material balances, engineering flow diagrams, sizing and specification of equipment, instrumentation, safety systems and piping. Participated in the HAZOP study for the coker section - (14 Months continuous Experience)

1997 - 1998
Foster Wheeler USA Corporation - Houston

Process Engineer

Phillips Petroleum Company, Sweeny, TX

Proposal for a 54,000 BPSD Delayed Coker Lump Sum - Responsibilities included sizing and specification of equipment and line sizing.

Phillips Petroleum Company, Delayed Coker Unit, Sweeny, TX

Responsible for the PRO-II simulation for an existing FCCU Absorber-Stripper Gas Plant, TSWEET simulation of existing FCCU Acid Gas and LPG Treatment Systems, checking of existing equipment for new operating conditions, preliminary sizing and specification of new equipment required.

Clark Refining & Marketing Inc., Port Arthur, TX
FCCU Absorber Stripper Gas Plant FCCU Acid Gas and LPG Treatment Systems for Clark Refining & Marketing, Inc., Port Arthur, TX. Responsible for checking existing pressure safety valves (PSVs), sizing, and specification of new PSVs required for an Isomerization unit.

1996 - 1997

*Foster Wheeler USA Corporation - Houston*

Process Engineer

*Bahrain Petroleum Company, BAPCO - Platforming Separation Unit*

Development of the Conceptual and Basic Engineering for a Platforming Product Separation System. Responsibilities included: PRO-II simulation of the new unit, preparation of engineering flow diagrams; heat and material balances, sizing and specification of equipment and lines.

*Fina Oil and Chemical Company, Port Arthur, TX*

Responsible for checking all existing Pressure Safety Valves (PSVs), sizing and specification of new PSVs required for a DEMEX Unit.

1994 - 1996

*Foster Wheeler (FW Andina, S.A. Bogotá, Colombia)*

Process Engineer

*Chevron Petroleum Co., Colombia - Asphalt Plant*

Developing of the Preliminary Engineering of an Asphalt Plant. Responsibilities included: preliminary simulation in DESIGN-II of the unit, preliminary heat and material balances, sizing, and specification of equipment.

*British Petroleum BP Exploration Colombia - CO2 Removal Unit Pie de Monte Llanero, Colombia*

Development of the Basic Engineering of a Natural Gas CO2 Removal Unit - Responsibilities included: sizing and specification of equipment and lines, preparation of engineering flow diagrams and heat and material balances.

*Empresa Colombiana de Petroleos Ecopetrol, Colombia*

Development of the Preliminary Engineering of a Plant for the treatment and injection to the water flood of river, well and produced water - Responsibilities included: selection of the water treatment process, preliminary sizing and specification of the equipment.

- Water Treatment and Injection Plant (Phase II) for British Petroleum BP Exploration Colombia. Cusiana, Colombia
- Development of the Detailed Engineering of a Plant for treatment and injection to the water flood of well and produced water. Responsibilities included: preparation of Piping and Instrument Diagrams (issued for construction) and equipment data sheets.
- Water Treatment and Injection Plant (Phase I) for British Petroleum BP Exploration Colombia. Cusiana, Colombia

*Barrancabermeja Refinery and Petrochemical Complex, Colombia*

- Environmental audits to the Barrancabermeja Refinery and Petrochemical Complex regarding to Pollutant and Waste emissions to the Water, Air and land. Audit developed along with Foster Wheeler Environmental Corp. Responsibilities included the process technical support for the FW Environmental team for the following units: Sulphur Plants, UOP FCC Unit, Exxon Model IV FCC Unit, Kellogg Orthoflow FCC Unit, BTX Aromatics Unit, Waste Water Treatment Plant, and API Separators.
Miguel I. Londoño  
Principal Engineer

- Environmental Audit to the Barrancabermeja Refinery and Petrochemical Complex for ECOPETROL, Colombia
- Development of the Basic and Detailed Engineering for the expansion of a Brewery. Responsibilities included: design of the water supply, treatment and distribution systems.

*Cervecería Leona S.A., Tocancipá, Colombia*

- Brewery Plant Expansion Project

*Empresa Colombiana de Petroleos Ecopetrol, Colombia*

- Environmental Studies on Clean Air technologies. Emphasis in Flue Gas Desulfurization Systems and NOx treatment.
- Seminar at the Colombian Institute of Petroleum, ICP, Bucaramanga, Colombia.
- Development of the Basic Engineering for a Produced Water Gathering, Treatment and Injection system. Project included 18 oil treatment stations, 3 water injection plants, and flow lines for interconnection between stations.
- Produced Water gathering, treatment and injection system for the Colombian Petroleum Company, ECOPETROL El Centro, Colombia.
- Proposal for the expansion of an Offshore Petroleum Distribution Terminal. Responsibilities included checking of the existing pumping and storing oil systems and the waste-water treatment plant.
- Responsible for the Conceptual Engineering of a Produced Water Gathering, Treatment and Injection System. Project included 18 oil treatment stations, 3 water injection plants and flow lines for interconnection between stations.
- Produced Water gathering, treatment and injection system for the Colombian Petroleum Company, ECOPETROL. El Centro, Colombia
- Responsible for the Development of a Theoretical Model for the study of thermal regression in pipes that relieve gas at high pressure to the atmosphere.

*British Petroleum BP, Colombia*

- Mathematical Model to evaluate venting high-pressure gas lines to atmosphere. Model developed for the "Flow Lines and Well Pads Project" for British Petroleum BP Exploration Colombia. Cusiana, Colombia.