Strategic Energy Management For Resilience

Installation of HydroCOM for capacity control in 4303-JB make-up gas compressor

Shawn Chew
Process Engineer

7 October 2015
Company Info

PetroChina

Chevron

SPC

A Member of PetroChina

Caltex

Singapore Refining Company
Flow Chart on SRC's Refining Process

<table>
<thead>
<tr>
<th>Straight Run Refinery</th>
<th>Conversion Refinery</th>
<th>Process Services</th>
<th>Finished Products</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Original Refinery “CDU” (1979)</strong></td>
<td><strong>Catalytic Reforming Complex (1982)</strong></td>
<td></td>
<td><strong>Liquid Carbon Dioxide</strong></td>
</tr>
<tr>
<td>Crude Oil</td>
<td>Diesel Hydrotreater Unit 1</td>
<td><strong>Hydrogen System</strong></td>
<td><strong>Liquified Petroleum Gas</strong></td>
</tr>
<tr>
<td></td>
<td>Vacuum Distillation Unit 1</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Asphalt Blower</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Crude Oil</td>
<td>Kerosene Max Unit 1</td>
<td></td>
<td><strong>Diesel</strong></td>
</tr>
<tr>
<td></td>
<td>Diesel Hydrotreater Unit 2</td>
<td></td>
<td><strong>Low Sulphur Fuel Oil</strong></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td><strong>Bunker Fuel Oil</strong></td>
</tr>
<tr>
<td>Crude Oil</td>
<td>Kerosene Max Unit 2</td>
<td></td>
<td><strong>Sulphur</strong></td>
</tr>
<tr>
<td></td>
<td>Diesel Hydrotreater Unit 3</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Hydrocracker unit in the refinery cracks Vacuum Gasoil into high value fuel products like Jet and Diesel in the presence of hydrogen.

High Pressure / Temperature

Energy Intensive unit: ~210MMBTU/h
Previous Setup

Spillback for capacity control
4303-J Make up gas compressors

Pressure in the unit is controlled by make-up gas compressors

3 sets of 3 stage compressors
   - Typical loading 2 x 100%, 1 x 75%

Fast-acting and reliable operation

Sensitivity
Capacity Control

[Diagram showing energy consumed vs compressor capacity with different control methods: Stepped Control, Stepless Control (using spillback), HydroCOM]
HydroCOM

Hydraulically actuated Computerized suction unloading

**Working Principle:** Part Load: Reverse Gas Flow

3. **Reverse flow at part load**

The suction valve is held open after the piston has passed the bottom dead center. While the suction valve is held open, gas flows from the cylinder into the suction plenum.

The oil in the high pressure cylinder acts against the reverse flow drag force.

*Source: Hoerbiger*
Current Setup

Fine control of required capacity

[Diagram of reactor system with labeled components: Separator condenser, Separator, Recycle gas scrubber, Reactor, Charge heater, Recycle gas compressor, Flare Relief Valve, Make up H2 section, HydroCOM, etc.]
The 3 Stages Actuator of HydroCom for 4303-JB

1st Stage Actuator

2nd Stage Actuator

3rd Stage Actuator
Hydraulic Unit for the HydroCom for 4303-JB

Hydraulic Unit to power and drive all 3 stage actuators.
Challenges

Safety
  - Relief system study
  - Pulsation study

3 stage compressor

Control Scheme Integration
  - Split range control
HydroCOM has been successfully retrofitted onto HCU 2 make up gas compressor 4303-JB

The project has managed to decrease the electricity consumption of the compressor by ~14.4% and achieved savings of up to S$225M.

Simple payback of approximately 3 years.