Application of Foxboro Invensys Magnetic Resonance Analyzer at Refinería Isla (Curazao) S.A

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- Re-design of SSC & achieved results
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Refineria Isla is a subsidiary of

**Petróleos De Venezuela Sociedad Anónima**

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**Objectives**

- Safety
- Productivity
- Refinery profitability
- Increase client satisfaction
- Improve implementation & Completion of projects
- Productivity
- People
- Total quality
<table>
<thead>
<tr>
<th>REFINING CAPACITY</th>
<th>335 MBD</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>DISTILLATION UNITS:</strong></td>
<td></td>
</tr>
<tr>
<td>3 Atmospheric</td>
<td>335</td>
</tr>
<tr>
<td>5 High Vacuum</td>
<td>186</td>
</tr>
<tr>
<td><strong>CONVERSION UNITS:</strong></td>
<td></td>
</tr>
<tr>
<td>1 Cat Cracker</td>
<td>50</td>
</tr>
<tr>
<td>2 Thermal Crackers</td>
<td>80</td>
</tr>
<tr>
<td>1 Platformer</td>
<td>18</td>
</tr>
<tr>
<td>1 Alkylation</td>
<td>9</td>
</tr>
<tr>
<td>Polymerization</td>
<td>4</td>
</tr>
<tr>
<td><strong>SPECIALTIES UNITS:</strong></td>
<td></td>
</tr>
<tr>
<td>1 Naphthenic lubes</td>
<td>2</td>
</tr>
<tr>
<td>1 Paraffinic Lubes</td>
<td>5</td>
</tr>
<tr>
<td>Asphalts: Penetration / Roofers</td>
<td>15 - 20</td>
</tr>
</tbody>
</table>
KEY REFINERY OBJECTIVE

Refinery Profitability

Maximize opportunities in incremental crude processing.
COMPANY OBJECTIVES

IMPLEMENTATION OF CRUDE MANAGEMENT PROJECT

- Maximize yields of more valuable products
- Maximum utilization of crude potential and minimize loss during crude switch
- Platformer operating condition are based on the naphtha specs at the Crude Distiller
EQUIPMENT TO BE INSTALLED ON A TRIAL BASIS

**Foxboro Invensys to supply:**
- MRA Analyzer & required analyzer data
- Required sample conditioning system
- Initial models for prediction of all required parameters

**Isla to provide:**
- Sample transport lines for the crude, kerosene & naphtha samples
- Utilities
- Power requirements
- Lab analysis for validation
## CRUDE UNIT 3

<table>
<thead>
<tr>
<th>Specification</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rate capacity</td>
<td>30,000 tons/day</td>
</tr>
<tr>
<td>Crude handled</td>
<td>26 – 29 API</td>
</tr>
<tr>
<td>Modes of operation</td>
<td>Paraffinic crude</td>
</tr>
<tr>
<td></td>
<td>General Purpose crude</td>
</tr>
<tr>
<td>Mode switch frequency</td>
<td>Every 2-3 days</td>
</tr>
</tbody>
</table>
MRA
Multi Purpose Single Schedular
Software version 3.0
D- magnet
Analyzer shelter with all required utilities available
Sample take-off and return points for crude at a short distance (60 m) from the analyzer shelter.
Crude sample can be transported at ambient condition
Existing naphtha supply & return line available at analyzer shelter
Kerosene take-off & return point at a distance of 150 m.
SAMPLE CONDITIONING POINTS OF ATTENTION

- Thermal stress to ceramic part MRA sample probe:
  - Crude temperature @ 35
  - Naphtha temperature @ 130
  - Kerosene temperature @ 130

- Cross contamination of sample in MRA probe
- Stream sequence: Kerosene – Naphtha - Crude
- Sample return during flushing through the probe
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INSTALLATION & INIT. TARGETS

TARGETS

<table>
<thead>
<tr>
<th>Measurement</th>
<th>Achieved</th>
</tr>
</thead>
<tbody>
<tr>
<td>Crude analysis</td>
<td>No</td>
</tr>
<tr>
<td>Kero analysis</td>
<td>Yes</td>
</tr>
<tr>
<td>Naphtha analysis</td>
<td>Yes</td>
</tr>
</tbody>
</table>
### ISLA MRA PERFORMANCE vs LAB MEASUREMENT

<table>
<thead>
<tr>
<th>Stream Parameter</th>
<th>Kero Flash</th>
<th>Kero Freezing</th>
<th>Naphtha End Point</th>
</tr>
</thead>
<tbody>
<tr>
<td>Avg diff.</td>
<td>-2</td>
<td>-1</td>
<td>4</td>
</tr>
<tr>
<td>Avg diff. Std Dev</td>
<td>2</td>
<td>2</td>
<td>3</td>
</tr>
</tbody>
</table>

- Avg diff. refers to the average difference between the installation and initial targets.
- Std Dev refers to the standard deviation.
INSTALLATION & INIT. TARGETS

INITIAL MRA CRUDE ANALYSIS
UNSUCCESSFUL

- Stability of the Crude sample temperature dependent
- Crude sample phase separate along the sample line
- Initial chosen stream sequence Kerosene – Naphtha – Crude
- Wax deposition within the MRA sample loop & probe while processing paraffinic crude
RE-DESIGN MRA SAMPLE SYSTEM

- Bring crude sample temperature to minimum 60 C & maximum of 70 C at take-off through MRA probe
- While flushing through MRA probe kerosene & naphtha
- Sample must be brought to the same temperature of 60 C
- Flushing through SSC & MRA probe must be routed to sample return
- Prevent sample cross contamination in SSC & MRA probe
**MRA SAMPLE TEMPERATURE CONTROL**

- Crude Fast Loop heater at sample take-off
- Sample Heater with PID control at MRA for temperature control sample through MRA probe
RE-DESIGN & ACH. RESULTS

Crude Fast Loop Heater
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we are the Energy

RE-DESIGN & ACH. RESULTS

SSC dwg
REFINERIA ISLA (CURAZAO) S.A.

we are the Energy

RE-DESIGN & ACH. RESULTS

SSC inside
ISLA MRA MEASURING RESULTS
POST RE-DESIGN OF SSC

MRA Parameters with Corresponding Lab Data

Kero Freeze & Flash

Naphtha T10, T50, T90, FBP
Kero Freeze Validation

-58.0
-56.0
-54.0
-52.0
-50.0
-48.0
-46.0
-44.0
-42.0
-40.0


Lab  NMR

Kero Frz. val.
Kero Flash Validation

Kero Frz. val.
Naphtha T10 Validation

Naphtha T10 val.
Naphtha T50 Validation

- Lab
- NMR
Naphtha T90 Validation

Naphtha Endpoint
Naphtha T90 Validation

![Graph showing Naphtha T90 validation with data points for Lab and NMR from 9/27/01 to 10/17/01. The graph illustrates the comparison of Naphtha T90 values over time with error bars for each data point.]
## MRA Parameters without Corresponding Lab Data

<table>
<thead>
<tr>
<th>Product</th>
<th>Parameter(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Naphtha</td>
<td>PIONA</td>
</tr>
<tr>
<td>Kero</td>
<td>FBP</td>
</tr>
<tr>
<td>Crude</td>
<td>API, sulfur, n-parafins, cumulative cutpoints &amp; yields</td>
</tr>
</tbody>
</table>
## AVAILABILITY & UTILIZATION

<table>
<thead>
<tr>
<th>Month</th>
<th>Availability</th>
<th>Utilization</th>
</tr>
</thead>
<tbody>
<tr>
<td>January 02</td>
<td>98%</td>
<td>98%</td>
</tr>
<tr>
<td>February 02</td>
<td>64%</td>
<td>64%</td>
</tr>
<tr>
<td>March 02</td>
<td>98%</td>
<td>98%</td>
</tr>
</tbody>
</table>
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RE-DESIGN & ACH. RESULTS

MRA

Optimizer
ROMEO

DCS

PI

APC

PLANT
PREVENTIVE MAINTENANCE MRA

- Cleaning sample loop filters
- Cleaning air conditioning filters
- Checking gas detector magnet compartment
- Replace switching valves
CORRECTIVE MAINTENANCE

August ’01 – March ’02

Still waiting for the first one