XIV Triennial Decoking Seminar

Topic: Automation Update + Case Study

Long Beach - September 11th 2018

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Product Specialist Decoking Systems
Agenda

- Equipment Required for Automation
- Automated Decoking Process
- Site Implementation
- Site Feedback
Automation Requirements

Hardware Required for Automation

- Autoshift Combination Cutting Tool
- Hydraulic or electric actuated Winch and Rotary Joint
- All field components controlled through the Decoking System PLC
  - DCV, Line Isolation Valves, Winch, RJ, etc.
- Drum Vibration Monitoring System
- HMI at Operator Panel and Central Control Room
Vibration Monitoring System

Vibration Sensors → DAQ → PLC → Communication (MODBUS) → HMI
The following operations remain to be done by the operator manually:

- Start and Stop of the Lubrication Oil system
- Start and Stop of the Jet Pump Train
- Start and Stop of the Hydraulic Power Unit / Variable Frequency Drives
- Unheading of coke drum (top and bottom)
- Selection of coke drum for Decoking from the Operator Panel
- Start of the Automatic process from the HMI

After Start of the Automatic process the cutting equipment (Winch, Crosshead, Rotary Joint, Drill Stem, Autoshift Tool) and the corresponding valves in the cutting water line (DCV, Bleed Valve, Line Isolation Valves) will be operated and controlled fully automated by the Flowserve Decoking Control System to perform the process steps as following:
Automated Decoking Process

Process Steps:

1. Unlatch the Cutting equipment
2. Measure the height of coke bed (Outage)
3. Boring of pilot channel
4. Cutting/Reaming the cone section of the drum
5. Perform final Cutting of the coke bed
6. Washing of the coke drum
7. Latch the Cutting equipment
The properties of the petroleum coke varies with the elevations inside the same coke drum (lower layers are harder compared to the softer top layer)

Solution:
- Drum is separated into 3 separate zones
  - Height of each section is adjustable
- For each zone individual cutting parameters can be set to optimize the Cutting sequence
  - Ex. Slower RJ RPM’s at lower zones to cut harder coke more efficiently
Parameter Screen
Automated Decoking Alarms

In case of a problem or unusual field signal, a corresponding alarm gets displayed on the HMI’s and the Automatic sequence gets paused to wait for Operator confirmation

• Examples:
  – Slack Rope Alarm when plugged Boring channel
  – High Drill-Stem Torque Alarm when coke bed collapse

In “pause” mode, the Joystick at the Operator Panel is re-activated for manual operation
Common Operational Issue:
Plugged Bore Channel due to coke collapse

Solution:
During the Cutting sequence, if either of the following alarms occur:
- Drill Stem Maximum Torque
- Low rope tension
Result in an automated sequence to change the Autoshift Tool back to Boring mode and free the channel, before proceeding with the Cutting sequence at the trouble causing elevation.
• Coke drum size:
  Height: 41 m (134 ft)
  Diameter: 8.6 m (28 ft)
• Coke type:
  bonded shot
• Coke cutting time frame:
  2:30 - 3:00 hours
2007/2008: Project - Decoking System for a new 4 drum Delayed Coker Unit

Key points at that time:

- Hydraulic actuation for winch and Rotary Joint (because of REPSOL electric drive skepticism)
- Instrumentation and hardware provisions for Automated Decoking option at a later date

2010/2011: Installation and commissioning of the Delayed Coker Unit

- Manual operated Decoking from the Cutting Deck
- Using Bently Nevada Monitoring system to display drum vibrations during coke cutting
- REPSOL to stabilize/optimize their own operation of the new Coker Unit including the coke cutting routine within the following 2 years
2013/2014: Automation Expansion Project

- Replacing the Bently Nevada drum monitoring with IPS-APEX data acquisition controller for monitoring the cutting progress
- Implementation of the automation sequences in the PLC and HMI extension screens (for parameter input + operation functions)

2016: Implementation of an Auto-calibration function for the Drum sensor signals

- Replacement of the IPS APEX controller with cRIO system
- Improvement of the sensibility of the vibration monitoring system + Auto-calibration function
DSQ: IPS APEX controller replaced by cRio Monitoring System
(1 Rack covers 2 Coke Drums)
Since its implementation in February 2014 the Automated Decoking is their standard mode of operation. Manual cutting is only done in a very few exceptional cases.

The field Operators simply start the automated sequence from the Cutting Deck and can then perform other duties. Typical monitoring of the Cutting process gets done by a panel Operator in the Central Control Room.

The field operator rarely intervenes with the automated sequences.
• Coke drum size:
  Height: 33 m (108 ft)
  Diameter: 8.4 m (28 ft)
• Coke type:
  shot coke
• Cycle time:
  16 hours
• Coke cutting time frame:
  2:00 - 3:00 hours
2013/2014: Project - Decoking System for a new 4 drum Delayed Coker Unit

Key points at that time:

- Hydraulic actuation for winch and Rotary Joint
- Manual operated Decoking from the Cutting Deck
- Drum Vibration Monitoring for indication on HMI only

2015: Installation and commissioning of the Delayed Coker Unit

- First Delayed Coker Unit in Turkey (lack of operation experiences)
- Issues with feedstock quality (different to original process specification)
- Severe cooling issues of the coke (permanent + heavy steam eruptions during Decoking)
- Steam eruptions with H2S forced Cutting Operator sometimes to wear Oxygen mask + bottles (even inside the shelter)
December 2014

October 2015
2016/2017: Remote Operation vs Automation Upgrade Project

- Skipped Remote Operation Panel expansion
- Replacement of the IPS APEX controller with cRIO system
- Upgrade PLC and HMI codes for Automated Decoking process
- Installation of a Video Monitoring System

Since its implementation in February 2017 the Automated Decoking is their standard mode of operation. Manual cutting is done only in a very few exceptional cases. Monitoring of the Cutting process gets done by a Panel Operator in the Central Control Room.
Main Reason To Go For An Automation Upgrade?

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<th>REPSOL Cartagena</th>
<th>TÜPRAS Kocaeli</th>
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<td>Workload: free operators for other duties</td>
<td>Safety: remove operator from risky Cutting Deck</td>
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Impact to production during implementation of the Control System expansion?

**REPSOL Cartagena**

- Upgrade was done during normal production/operation of the Coker Unit

- For a few weeks Operation had to align with Flowserve supervision; due to several tests the standard Decoking time was a bit longer than “normal” but well within an acceptable time range and without a negative impact to the production

- During all the time the conventional, manual operation was also available for back-up / “emergency” operation

**TÜPRAS Kocaeli**
Operator duty change + acceptance?

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<td>• have been trained to fully understand the functionality of the Automated process</td>
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<td>• During + after the upgrade they verified functionality and optimized the system parameter</td>
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<td>• Became soon convinced + satisfied and are happy to got released from a drab job portion</td>
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<td>• For training purpose they need to cut a drum manually once in a while</td>
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Coke Cutting performance (timing + cutting quality)?

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<td>• The automated operation result a satisfying, consistent, and smooth process, being &gt; 99% within the 2:30 hour expected time frame</td>
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<td>• Provided 100% clean coke drums, or in very few cases, requiring a repeating manual drum wash</td>
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Parameter optimizing to better fit the performance in line with the given coke condition?

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<td>• Password needed to Login but change of parameter value is a simple handling</td>
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<td>• During the first weeks of operation some parameter gets optimized (by practical tests), later on there are minor changes necessary</td>
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Impact of the Automated process to the equipment?

- Mechanical maintenance found less issues and damages at the Coke Cutting equipment since implementation of the automated Cutting process