REFCOMM
ROTTERDAM
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Non-Operator Tower of the Coker

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Content

- Background
- Safety philosophy
- Overview Gelsenkirchen Coker
- Pre-Automization Steps
- HLI
- Sequences
- Full-Automization
- Goals
Due to an accident in 2001, Gelsenkirchen refinery decided to automize the coker operation.

New development, as the market didn’t provide any solution.

Development of an engineering concept to ensure permanent controls.

Development of a logic for implementation into the existing PLC/DCS.

Integration of a PLC/DCS interlock-system to avoid failure in operation.

Goal: Reduce residence time for operators in the structure to zero!
Overview Gelsenkirchen Coker

- Coker Furnace: 4800 t/d, 496-499°C, 24h cycle
- Recycle: 30 t/h, 3-3.2 bar

Downstream Technology
Development phases of automation

- 2008 DDC
- 2005-2006 SEQ Auto-Cutting
- 1999-2001 SEQ Switching and Heating Up
- 1998-1999 SEQ Quenching
- 1997-1998 SEQ Disconnecting
- 1996 HLI First SEQ „Pressuretest“
- 1995 MOV’s
SP Valve Description

- **Quenchwater**: SP-8.1, SP-8.2
- **Steam**: SP-13, SP-14
- **Drain line**: SP-9.1, SP-9.2
- **Blow-Down System (liquid hydrocarbons)**: SP-10.1A, SP-10.1B, SP-10.2A, SP-10.2B
- **Main Fractionator**: SP-6A, SP-6B
- **Coker furnace**: SP-7A, SP-7B

Flow directions:
- **Quenchwater overflow**: SP-8.1 to SP-8.2
- **Drain line**: SP-9.1 to SP-9.2
- **Blow-Down**: SP-10.1A to SP-10.1B, SP-10.2A to SP-10.2B
- **Main Fractionator**: SP-6A to SP-6B
- **Coker furnace**: SP-7A to SP-7B

**Downstream** feed lines:
- **Quenchwater**: SP-13
- **Steam**: SP-14
Implementation of MOV’s

[Diagram of a process flow with various components labeled, including Quenchwater, drain lines, and Blow-Down System (liquid hydrocarbons).]

- Quenchwater overflow
- Drain lines
- Coker furnace
- Blow-Down System (liquid hydrocarbons)
- Main Fractionator
- Downstream Te

Components include SP-12A, SP-9.1, SP-9.2, SP-1A, SP-10.1A, SP-2A, SP-2B, SP-10.1B, SP-7A, SP-7B, SP-6A, SP-6B, SP-13, SP-14, and SP-12B.
Implementation of Pressure Interlock

[Diagram showing the flow of Quenchwater and Steam through various pressure interlock points labeled with SP numbers and M for manual control.]
Pre-Automization Steps

- Implementation of MOV’s
- Remote Control from DCS
- Implementation of Pressure Interlock
High Level Interlock System
High Level Interlock System

- **Not Closed**
  - Bottom Flange Closed
  - Top Flange Closed
  - SP-8.1 B Closed
  - SP-8.2 B Closed
  - SP-9.1 B Closed
  - SP-9.2 B Closed

- **Closed**

- **Emergency Switch**

- **<= 1**

- **Interlocked**
High Level Interlock System

- Top Flange Closed
- Bottom Flange Closed
- SP-8.1 B Closed
- SP-8.2 B Closed
- SP-9.1 B Closed
- SP-9.2 B Closed

Emergency Switch

>= 1

Unblock
DDC Layout

Drum B
16h in operation

Drum C
8h in operation

Switch to Drum
Stripping
Quenching
Drilling
Cutting
Pressure test
Heating up

FA-101A

100.50%

FA-101B

47.11%

FA-101C

Switch to Drum
Stripping
Quenching
Drilling
Cutting
Pressure test
Heating up

FA-101D

Sequence Pressure test
Completely Finished

Sequence Pressure test
In Operation

Timestamp of last switching
Calculated Cycle-Time
Calculated Rest-Time
Calculated Space-Time

Calculated Cycle-Time
Calculated Rest-Time
Calculated Space-Time

Downstream Technology
# Sequence „pressure test“

## Neutralisation and pressure test Drum A

<table>
<thead>
<tr>
<th>Step</th>
<th>Description</th>
<th>Utilities</th>
<th>Valve</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>Step1</td>
<td>Connection to distribution station</td>
<td>utilities</td>
<td>SP7A</td>
<td>open</td>
</tr>
<tr>
<td>Step2</td>
<td>Remove oxygen in drum A</td>
<td>Overflow FB-603</td>
<td>SP8.1A</td>
<td>open</td>
</tr>
<tr>
<td>Step3</td>
<td>Remove oxygen in drum A</td>
<td>Overflow FB-603</td>
<td>SP8.2A</td>
<td>30%</td>
</tr>
<tr>
<td>Step4</td>
<td>Isolation valve at distributor</td>
<td>Steam to drum A</td>
<td>SP13A</td>
<td>open</td>
</tr>
<tr>
<td>Step5</td>
<td>Set required amount</td>
<td>Steam to drum A</td>
<td>F-1008</td>
<td>12 t/h</td>
</tr>
<tr>
<td>Step6</td>
<td>Neutralisation temp. &gt; 110°C</td>
<td>Overflow FB-603</td>
<td>SP8.2A</td>
<td>close</td>
</tr>
<tr>
<td>Step7</td>
<td>Drum pressure 0.6 bar &gt; op. pressure</td>
<td>Steam to drum A</td>
<td>F-1008</td>
<td>close</td>
</tr>
<tr>
<td>Step8</td>
<td>Isolation valve at distributor</td>
<td>Steam to drum A</td>
<td>SP13A</td>
<td>close</td>
</tr>
<tr>
<td>Step9</td>
<td>Dewatering at drum lowest point</td>
<td>dewatering</td>
<td>SP9.1A</td>
<td>open</td>
</tr>
<tr>
<td>Step10</td>
<td>Dewatering at drum lowest point</td>
<td>dewatering</td>
<td>SP9.2A</td>
<td>20%</td>
</tr>
<tr>
<td>Step11</td>
<td>Drum pressure = op. pressure</td>
<td>dewatering</td>
<td>SP9.1A</td>
<td>close</td>
</tr>
<tr>
<td>Step12</td>
<td>Dewatering deck 22m</td>
<td>Overflow FB-603</td>
<td>SP8.2A</td>
<td>20%</td>
</tr>
<tr>
<td>Step13</td>
<td>Drum pressure 0.6 bar &lt; op. pressure</td>
<td>Overflow FB-603</td>
<td>SP8.2A</td>
<td>close</td>
</tr>
<tr>
<td>Step14</td>
<td>System pressurised and dewatered</td>
<td>Overflow FB-603</td>
<td>SP8.1A</td>
<td>Close</td>
</tr>
</tbody>
</table>

**Failure**

**Sequence end**
## Sequence „disconnecting / stripping“

### Disconnecting and Stripping Drum A

<table>
<thead>
<tr>
<th>Step</th>
<th>Description</th>
<th>Control</th>
<th>SP</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>Step1</td>
<td>Product inlet is closed</td>
<td>control</td>
<td>SP6A</td>
<td>close</td>
</tr>
<tr>
<td>Step2</td>
<td>Set the required amount</td>
<td>Steam to drum A</td>
<td>F-1008</td>
<td>1 t/h</td>
</tr>
<tr>
<td>Step3</td>
<td>Blow-Down valve opens</td>
<td>Vapours to Blow Down</td>
<td>SP10.1A</td>
<td>open</td>
</tr>
<tr>
<td>Step4</td>
<td>Disconnecting / SP2A closes AND</td>
<td>Vapours to Blow Down</td>
<td>SP10.2A</td>
<td>10 %</td>
</tr>
<tr>
<td>Step5</td>
<td>Disconnecting / SP1A closes AND</td>
<td>Vapours to Blow Down</td>
<td>SP10.2A</td>
<td>open</td>
</tr>
<tr>
<td>Step6</td>
<td>Set the required amount</td>
<td>Steam to drum A</td>
<td>F-1008</td>
<td>7 t/h</td>
</tr>
<tr>
<td>Step7</td>
<td>Connection to distributor</td>
<td>Water to drum A</td>
<td>SP14A</td>
<td>10%</td>
</tr>
<tr>
<td>Step8</td>
<td>Set the required amount</td>
<td>Water to drum A</td>
<td>F-0161</td>
<td>4 t/h</td>
</tr>
<tr>
<td>Step9</td>
<td>Pressure-time monitoring</td>
<td>Stripping time</td>
<td>DCS</td>
<td>1 min</td>
</tr>
</tbody>
</table>

**Failure**

**Sequence end**
Eleven adjustable segments have been defined to provide maximum flexibility. In all segments, the speed of the drilling heads, direction of rotation and winch speed (down/up) can be adjusted as required.
Automatic Cutting & Drilling Control

- Automatic cutting via microphone under the chute
- Blocked pilot whole function
- Completely PLC/DCS controlled
- No operator in the top shelter
Dynamic Steam and Antifoam Management

Steam control

- Blow-Down System (Liquid hydrocarbons)
- Quenchwater overflow
- SP-8.2
- SP-8.1
- SP-10.1A
- SP-2A
- Main Fractionator
- SP-6A
- Coker furnace
- SP-13
- Quenchwater
- SP-14
- Steam
- SP-7A
- SP-9.1
- SP-9.2
- SP-12A

Antifoam control

- Drum in operation
- U-01110
- LAH
- LBH
- LCH
- LDH
- LAL
- LBL
- LCL
- LDL
- MI-Distillate
Full automation

Next steps:
∞ Elimination of manual heading/unheading
∞ Implementation of Top and Bottom Slide Valves
∞ Upgrade of the HLI
∞ Upgrade of the existing sequences: Quench (open drum) and Cutting (close drum)
∞ Reduce residence time of the operator in the structure
Goals

- Non-Operator drum operation – maximum safety
- Operator convenience
- Transparency and monitoring
- Harmonize Coker operation over all shifts
- Exclusion of false operation (High Level Interlock)
- Provision of rapid fault diagnosis and debugging
- Visualization of all program steps in the DCS
- Flexible sequence parameters to optimize cycle time
- Reliable operation