Switching between
Pyrolysis Furnaces
cracking and decoking

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AMERICAN INSTITUTE OF CHEMICAL ENGINEERS
Netherlands / Belgium Section
Switching between cracking and decoking

Introduction

Cracking furnace in CRACKING mode of operation
Switching between cracking and decoking
Possible Hazards

While in CRACKING mode:

- Cracked gas leaking through decoke valve(s) to atmosphere
- Decoke air routed to furnace, mixing with HC
- High temperature downstream QOF in case of quench oil failure
- Backflow of cracked gas from header to cracking furnace in case of multiple radiant coil failure
- Low temperature downstream QOF due to failure of the emergency water back-up
Switching between cracking and decoking

Introduction

Cracking furnace in **DECOKING** mode of operation
Switching between cracking and decoking
Possible Hazards

While in **DECOKING** mode (open connection to atmosphere):

- Cracked gas leaking through cracked gas valve(s) to atmosphere
- Hydrocarbon feed routed to furnace, mixing with decock air
- DMDS connected to atmosphere
- Quench oil connected to atmosphere
- Decoke effluent routed to cracked gas analyzer
Switching between cracking and decoking

Introduction

Cracking furnace in **HOT STANDBY** mode of operation
Switching between cracking and decoking
Pre-conditions for change-over

- Hydrocarbon feed lines isolated
- Decoke air line isolated
- DMDS line isolated
- Quench oil line isolated
- Decoke air and HC feed lines purged with steam
Switching between cracking and decoking

**History**

<table>
<thead>
<tr>
<th>Individual operated valves</th>
<th>Mechanically linked valves</th>
<th>Electrically linked valves</th>
</tr>
</thead>
<tbody>
<tr>
<td>Decoke Effluent Valve</td>
<td>Cracked Gas Valve</td>
<td></td>
</tr>
<tr>
<td>Cracked Gas Valve</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

With 1 electric motor
Switching between cracking and decoking
Possible Hazards

During **TRANSFER** from cracking mode to decoking mode

- **Overpressure due to simultaneously (partial) closed decoke and cracked gas valve(s)**
- **Backflow of cracked gas to atmosphere while both valves are open**

Overpressure is possible in all 3 configurations
Switching between cracking and decoking

Safety Instrumented System requirements

During TRANSFER from cracking mode to decoking mode

- Overpressure due to simultaneously (partial) closed decock and cracked gas valve(s)
- Backflow of cracked gas to atmosphere
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Safety valve for overpressure protection

SP = Steam Purge
LC = Locked Closed

To Atmosphere
Switching between cracking and decoking
Conceptual design

Note: Switch-over can be manually from local panel or DCS or fully automatic through the safeguarding system
Switching between cracking and decoking

Conceptual design

AIR

FEED

STEAM

DMDS

Oil

Decoke cyclone

Decoke Effluent Valve

Cracked Gas Valve

CRACKED GAS HEADER
Switching between cracking and decoking
Pressure profile

CRACKING TO DECOCKING: STEP 1
Decoke Effluent Valve

CRACKING TO DECOCKING: STEP 2
Decoke Effluent Valve

CRACKING TO DECOCKING: STEP 3
Decoke Effluent Valve

CRACKING TO DECOCKING: STEP 4
Decoke Effluent Valve

CRACKING TO DECOCKING: STEP 5
Decoke Effluent Valve
Switching between cracking and decoking
Conceptual design

- Differential pressure transmitter
- Pressure transmitter

Diagram showing the flow of fluids and components involved in the switching process between cracking and decoking.
Switching between cracking and decoking
Differential pressure transmitters replaced
Switching between cracking and decoking
Improved reliability Safety Integrity Level

Decoke cyclone

Pressure transmitter

Decoke Effluent Valve

Cracked Gas Valve

1002D

CRACKED GAS HEADER
Switching between cracking and decoking

Emergency isolation

Closing the cracked gas valve after a multiple coil rupture

- Initiate furnace total shutdown:
  - Close feed and DMDS valves
  - Close decoke air valve
  - Close fuel gas valves
- Close quench oil valve (if applicable)
- Overpressure protection remains active
- Steam purge of HC and decoke air lines bypassed
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Emergency isolation

Maintaining overpressure protection and preventing backflow of cracked gas to de coke drum only possible with electrically linked valves.
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Conclusions

Advantages of electrically linked valves compared to mechanically linked valves

- Easier to install
- Easier to maintain pressures within safe limits
- Less dependent of dilution steam flow fluctuations
- Possibility for **EMERGENCY ISOLATION** after coil rupture while maintain overpressure and back flow protection
Advantages of 4 gauge pressure transmitters compared to 2 dP-transmitters + 2 gauge transmitters

- Continuous comparison of transmitter availability
- Higher availability and reliability
- Less process connections = less steam purges
- No potential backflow over instrument equalization valve
Switching between cracking and decoking

Conclusions

Advantages of overpressure protection with pressure transmitters compared to safety valve

- Overprotection always available
- Higher reliability – no blocked PSV inlet
- No key-interlocks required
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QUESTIONS ?
Thank you