HAZOP Analysis of P-Xylene Production

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Overview

What is para-Xylene?

What does it come from?

What is it used for?

Who produces it?

How is it produced?
p-Xylene Production Process
Scope
HAZOP-Melt Tank
Flow from Pipe 16

<table>
<thead>
<tr>
<th>Guide Word</th>
<th>Cause</th>
</tr>
</thead>
<tbody>
<tr>
<td>High</td>
<td>1) Blockage in V-10 to pipe 15</td>
</tr>
<tr>
<td>Low</td>
<td>1) Blockage in V-10</td>
</tr>
<tr>
<td></td>
<td>2) Fouling in the pipes</td>
</tr>
<tr>
<td></td>
<td>3) Leakage</td>
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# HAZOP-Melt Tank

## Flow from Pipe 16

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| High       | Flow from pipe 16 to melt tank is too high | 1) Blockage in V-10 to pipe 15  
2) Flow indicator is malfunctioning | 1) Decreased production  
2) Possible damage to pipe 16 | Add a redundant valve with a flow control |
| Low        | Flow from pipe 16 is too low | 1) Blockage in V-10  
2) Fouling in the pipes  
3) Leakage | 1)2) Crystals not fully melted-damage to pump and fouling  
3) Loss of profit | 1) Add a redundant valve with a flow controller  
2) Increase the temperature of p-xylene |
HAZOP-Melt Tank
Temperature of P-xylene from Pipe 16

<table>
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| High       | 1) TC-2 is not functioning properly, temperature sensor fails  
             2) V-11 is malfunctioning                     |
| Low        | 1) TC-2 is malfunctioning                       
             2) Blockage in V-11                         |
# HAZOP-Melt Tank

Temperature of P-xylene from Pipe 16

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| High       | Temperature of stream 16 is too high | 1) TC-2 is not functioning properly  
2) V-11 is malfunctioning | 1)2) Energy costs are higher  
1)2) Continuous input of hot material into tank cause rapid and unstable temperature increase | 1) Add a temperature indicator on melt tank  
2) Redundant temperature control via bypass of V-11 |
| Low        | Temperature of stream 16 in too low | 1) TC-2 is malfunctioning  
2) Blockage in V-11 | 1)2) Crystals not fully melted-damage to pump and fouling | 1) Redundant temperature control via bypass of V-11  
2) Add an alarm on the Melt tank |
p-Xylene Fun

Across
3. P-xylene is mainly used for the production of
7. Used after the crystallizer for separation
8. What the “p” stands for in p-xylene

Down
1. Main separator step
2. Acronym for a type of safety analysis
4. Type of drum used in process
5. Tanks used to hold feed or product
6. We mainly investigated this stage, comes after recovery and scavenger stages
Plant Overview

Safco 4 - Urea Production Plant

-Jubail, K.S.A. Kingdom of Saudi Arabia

-Saudi Arabian Fertilizer Company

-One of the largest producers of urea in the world.

-Single train urea plant with a capacity of 1.1 mtpa
Process Overview
Operability
Operability
Questions???

Game time
<table>
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<tr>
<th>Process Intro/Overview</th>
<th>Operability</th>
<th>HAZOP</th>
</tr>
</thead>
<tbody>
<tr>
<td>CANDY</td>
<td>CANDY</td>
<td>CANDY</td>
</tr>
<tr>
<td>Chocolate</td>
<td>Chocolate</td>
<td>Chocolate</td>
</tr>
<tr>
<td>Gum</td>
<td>Gum</td>
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</tr>
</tbody>
</table>
Disinfection in Drinking Water Treatment

Elaf Kasim, Shraddha Panchal, Sarah Najib
Agenda

1. Process Overview
2. Operating Window
3. Flexibility & Reliability
4. Start-up & Transition
5. Interactive Activity
Process Overview

Liquid Oxygen → Convert to Oxygen Gas → Ozone Generator → Ozone Contactor → Destruction of Excess Ozone

Upstream Water

Activated Carbon Contactor → Disinfected Water
Ozonation: Operating Window

- Generated on-site due to rapid decay of ozone
- Contact time: Min.- 10 minutes, Max.- 30 minutes
- The maximum allowable ozone concentration in the discharged off-gas is 0.1 ppm (by volume)
Reliability

- Back up units:
  - Vaporizers,
  - Ozone generators
  - filters

- Additional activated carbon storage - Change used carbon when carbon efficiency reduced

- Back up electricity generators in case of power outage
Flexibility

- Design ozone generator in excess capacity or add extra generators to accommodate changes

  - Disturbance: Season changes has effect on organisms, warmer months require more ozone for disinfection
Start up and Transition phases

- Dry air or oxygen should be allowed to flow through the generator to ensure that any moisture has been purged prior to energizing the electrodes- **approx. 12 hours**
- Use for start up process

- As an alternative, a small flow of dry air can be passed through the generator continuously when it is in standby mode to maintain the dry condition
- Use for spare generator units
Comparing Alternative Treatments
Class Activity