CHALLENGES OF BLACK POWDER IN GAS LINES – A CASE STUDY

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Black Powder

- Black powder is an industry name for the rough, reactive impurity present in gas and hydrocarbon fluid transmission lines.

- Black powder ranges from light brown to black, and the minerals vary per production field and consists mainly of Iron oxides, Iron sulfides & Iron carbonates.

- In addition, the black powder contains varying dirt such as silica and calcium as well as chloride, sodium, and other materials.
Black powder forms throughout the process; through well bores, into gathering lines, in separation facilities, and along transmission pipelines.

The black powder continues to build in the gas plants and refineries and end user storages.
Black Powder Formation

It is understood that the Black Powder is formed as a result of chemical / microbial actions.
Black Powder Impact on Facilities

- Attaches to the internal surface of the Pipelines & Equipments
- Financial loss due to Production-cuts, Facility Shutdown, HSE issues - Flaring

More Maintenance
Parts Replacement
Damages Pump Seals

Affect Compressor Components
Glycol Foaming

Seriously Affects Rotating Equipments
Black powder damages pump seals, meters, compressors, trays, orifices, and valves. These affect components and instrumentation and lead to flow restrictions as well as faulty readings.
Black Powder Impact on Pipelines

- Product Contamination
- Customer Upset
- Flow Reduction
- Corrosion & Erosion
- Blockage
- Integrity
- Leakage Chances

Iron Oxide in the Black Powder is very hard and erode the Pipelines & Valves

The composition of Black Powder depends upon the composition of transported Gas
HSE Impacts

- Accelerates Corrosion / Erosion
- Process upsets, impacts downstream operations
- Damages to rotating equipments
- Contaminate (Catalysts, etc) in the downstream
- Lead to Feed reduction / production cuts
- Choking the Impulse Lines of Instruments
- Pyrophoric - may lead to Fire / Explosion
- Integrity Issue: Affect Inline Inspection (such as Pigging)
- Flaring
HSE Impacts

Affect Control Elements, Isolation Valves, PSVs leading to serious impact on Process Control / Safety

- Middle East Regions’ O&G fields are facing a critical issue of the isolation Valve of the Safety Relief Valve.
- Safety relief valves are the critical equipments to any plant.
- Safety relief valves are usually installed with an upstream block valve to facilitate O&M of the safety relief valve.
- The impact of Black Powder on the isolation valve, is impacting the very maintenance of the Safety Relief Valve.
Towards the solution...

Complex phenomenon – Occurrence during Production, Flow Pathway, Destination

Get rid-off – Not yet known

Similar Plants / trains with similar feed had complete different behaviour

• Comprehensive solutions / strategies needed
The Approach

One of our field experience ‘Black Powder Issue’ recently

Task Force Team formed. Adopted – Short Term Measures

• The Task Force Team includes personnel from Operations, Maintenance, Inspection Corrosion Teams
• The TFT objective was to analyze the Root Cause & Formation as well as to propose / implement Short Term Solutions
• Rigorous Pigging and Corrosion monitoring were undertaken
The Approach

• Fields’ entire Gas Network – taken into consideration for Black Powder investigation
• Pigging of the lines undertaken and the quantities of Black Powder were recorded
• After one month Pigging carried out and the quantities were again recorded, this exercise was done for few months
• Special attention paid to stagnant lines and Pigging were scheduled for these lines
• Mothballing of the idle lines have been done
• Rigorous / strict frequent corrosion monitoring undertaken
• Affected lines identified
Black Powder Concentrations

Black Powder Contamination

- **High**
- **Medium**
- **Low**

- Network Lines were monitored for High, Medium and Low Quantities of Black Powder every month
- Special attention given to high Black Powder producing Lines
## Short Term Results

<table>
<thead>
<tr>
<th>Line SIZE</th>
<th>FROM</th>
<th>TO</th>
<th>Observations</th>
</tr>
</thead>
<tbody>
<tr>
<td>12”</td>
<td>GC-XX</td>
<td>TR1</td>
<td>Clean</td>
</tr>
<tr>
<td>14”</td>
<td>GC-XY</td>
<td>MF</td>
<td>Small Quantity of Black Sludge</td>
</tr>
<tr>
<td>16”</td>
<td>GC-XX</td>
<td>BS</td>
<td>Clean</td>
</tr>
<tr>
<td>30”</td>
<td>BS</td>
<td>XTZ</td>
<td>Small Quantity - Black - Powder Observed</td>
</tr>
<tr>
<td>30”</td>
<td>BS</td>
<td>GC</td>
<td>Small Quantity - Black - Powder Observed</td>
</tr>
<tr>
<td>16”</td>
<td>EP</td>
<td>PA</td>
<td>Clean</td>
</tr>
<tr>
<td>30”</td>
<td>BS</td>
<td>PA</td>
<td>Clean</td>
</tr>
<tr>
<td>40”</td>
<td>SC</td>
<td>SC-1</td>
<td>Medium Quantity - Black Powder Observed</td>
</tr>
<tr>
<td>10”</td>
<td>GCX</td>
<td>BS</td>
<td>Clean</td>
</tr>
</tbody>
</table>

The ‘Short Term Measures’ shows significant improvements at two levels;

1. Black Powder Formation - Reduced
2. Faster Black Powder Removal from the Network Lines
Recommendations

Following measures to be considered

- **Dehydration Units**
  Efficient Operations along with controlling the Dew Point to avoid moisture in the stream

- **Reduce H2S, CO2**
  Reduction and strict monitoring of H2S & CO2 shall be undertaken

- **Pipeline Safeguarding**
  Stagnant Lines to be pigged and Mothballing of unused lines to be done
I thank our Team Leader Operations Technical Services (Gas) Team Dr. Fahad Al-Ghanem for motivating us to undertake the subject work.
Thanks and Questions