



Controlling Exposure to Cobalt - a practical approach

BOHS 2017, Harrogate

Karen Parry
Industrial Hygiene Advisor, Shell Health



Scope

- Setting the scene
- Management of Co handling
- High risk exposure scenarios
- Controls
- Sustainability?



Setting the scene - site

- Pearl Gas To Liquids (GTL) Plant
- Located in Qatar, JV between Qatar Shell and Qatar Petroleum
- World's largest GTL plant - two identical trains + utilities + support
- GTL Unit – Heavy Paraffin Synthesis (HPS)
 - Converts syngas ($H_2 + CO$) to liquids
 - 24 reactors, each of 30,000 tubules (12m long, 2.5 cm diameter, 6.5 kg catalyst)



Setting the scene - Cobalt (Co) Catalyst

- Black exudate - 20-30% Co_3O_4 + >1% CoO + TiO_2
- Respiratory and skin sensitiser
- OELeg 0.02mg/ m³ (US OSHA) – 8hr TWA, as Co (under review)
- Supplied in ‘big bags’ (approx 450kg)
- Catalyst life span of 24-36 months, exchange activity required every 1-2 months (24 reactors)
- Recovered for recycling via regeneration



Catalyst Exchange Activities – Risk Assessment

Identified all health hazards in individual activities:

- Many hazards (heat, ergonomics, noise, lighting, chemical etc)

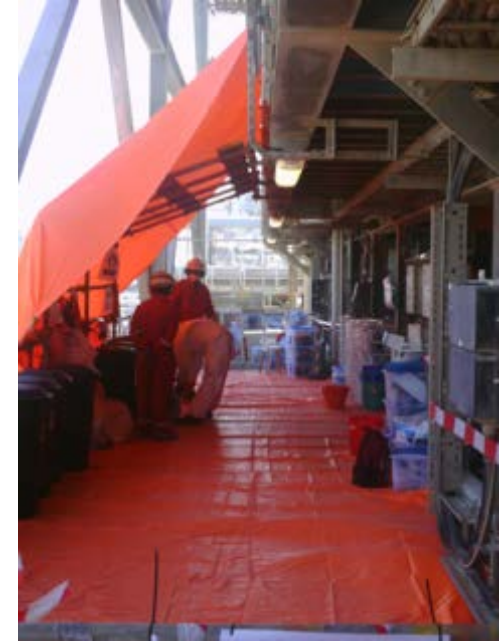
For today only discuss Co:

- Risk categorisation – H, M and L activities
- High Co risk: Unloading and loading of catalyst



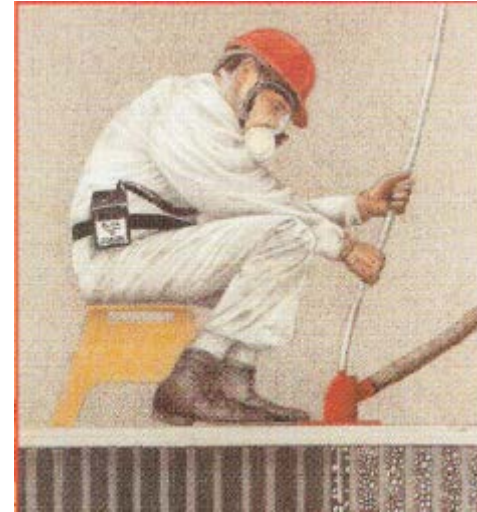
Management of Co Handling

- Priority is to control exposure:
 - Via limiting inhalation and skin contact
 - Other than by simply providing PPE
- Maximise worker efficiency
 - Avoid downtime
 - Limit requirement for restrictive PPE (movement, vision, thermal etc)
- Environmental considerations
 - Exhausts, fugitive loss, spillage, recovery, waste generation
- Demonstrate business assurance requirements



Air Lancing (Unloading)

- Compressed air forced into each tubule
- Catalyst is agitated
- Removal by vacuum and pressure from lance
- Transported to catalyst collector unit
- Dust separated out by cyclone
- Bagged for recovery



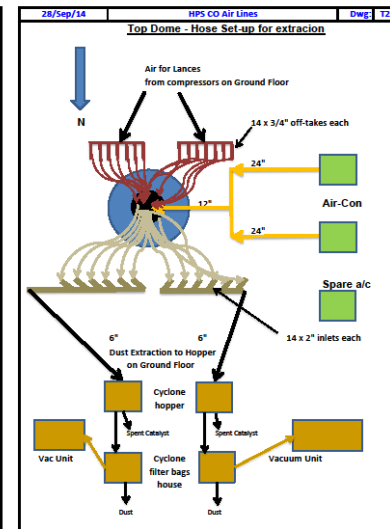
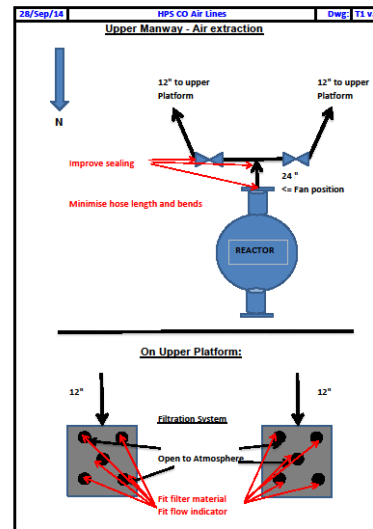
Refilling (Loading)

- Bags hoisted to top gantry
- Emptied into hoppers
- Sieved to remove fines
- Delivered into reactor dome into loaders
- Channeled into delivery hoses
- Tubules filled (8 per cycle)
- Catalyst level and fill density tested
- Manual adjustment of catalyst level
- Capping



Control - Engineering

- Maintain dome under -ve pressure (visual confirmation)
- Clean the air prior to release to workplace (dust recovery)
- Boot design – extraction pressure and seals
- Pressure of lances, rate of removal optimised
- Extracted sieve for fresh catalyst (loading)



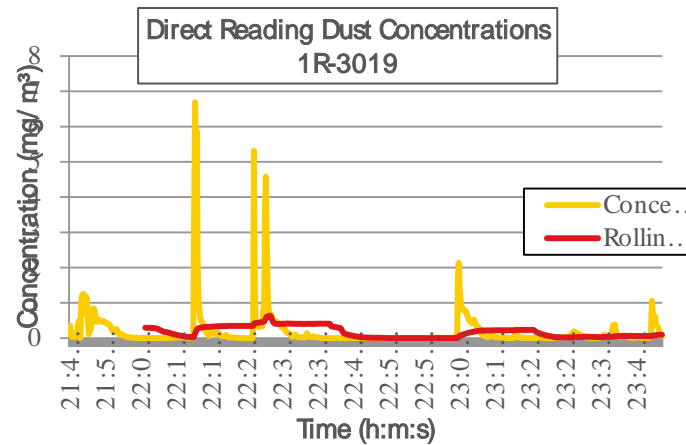
Control - Administrative

- Awareness & Training – induction, specific, refresher, TBT, posters
- Monitoring programs
- Permit to Work
- Medical surveillance – interview, lung function, skin, urine
- Personal hygiene development program



Monitoring Methods

- Direct reading - PM10 Thoracic Fraction dust (real-time)
- Personal and static total inhalable dust
 - Analysis of dust filters for cobalt content
 - Included in activity risk categorisation process
 - Monitor (check) exposure and control levels
- Progressed to development of 'early warning system'







Early Warning System

- Detect a potential over-exposure scenario
- Two filters exposed per shift (statics)
- Compared to developed matrix
- Easy, visual, immediate result
- Defined outcome actions
- Confirmed via chemical analysis
- Simple instructions

ACTION KEY	
	Adequate control
	Action needed to avoid over-exposure – Inform supervisor immediately
	<ol style="list-style-type: none"> 1. Determine cause of warning dust level and solve 2. Monitor filters closely to observe if dust level becomes green or maintains amber 3. If filter remains amber stop airlancing and investigate further
	URGENT action needed to avoid over-exposure – Inform Supervisor immediately
	<ol style="list-style-type: none"> 1. Stop air-lancing and remove personnel from dome 2. Determine cause of high dust level and solve <p>If filter colour Row 2 or 3 – Allow air-lancers to re-enter dome and continue lancing</p> <p>If filter colour Row 4 – air-lancers cannot re-enter dome. Replace with fresh personnel</p> <ol style="list-style-type: none"> 3. Start new filter sample and monitor at 30 mins, 1hour etc 4. If new filter reaches Red then remove all personnel and no further air-lancing permitted for the shift

HPS CATALYST UNLOADING – FILTER COLOUR CHART

Filter colour to be read at 30 mins, then 1 hour from start of sampling, then every 1 hour until 6 hours since starting sampling.

Filter Colour	Exposure Time – time from start of sampling						
	30 mins	1 Hour	2 Hours	3 Hours	4 Hours	5 Hours	6 Hours
1		Green	Green	Green	Green	Green	Green
2		Red	Yellow	Green	Green	Green	Green
3		Red	Red	Red	Yellow	Green	Green
4		Red	Red	Red	Red	Red	Yellow

For filter colour:
• any shade between row 1 and 2 = Row 2
• any shade between row 2 and 3 = Row 3
• any shade between row 3 and 4 = Row 4
• any shade darker than row 4 = Action as per Row 4

Personal Protective Equipment – ‘last resort’

- PPE and RPE
- Selected for
 - Risk
 - Fit and comfort
 - Cultural aspects (facial hair)
- Assurance of effectiveness
 - Training/ demonstrations
 - Supervision
 - Maintenance and checking
 - Face fit testing



Sustainability of Early Warning System?



■ Justification:

- Why? Not done elsewhere
- Demonstrated benefits – avoided over-exposure (risks and consequences), decreased stoppages

■ Reduce Program Cost:

- Over 1300 samples collected to date – good historical data (from 48 exchanges)
- Plan to reduce to 1 filter per shift
- Cover unloading only (highest potential), with ad hoc (assurance) cover of other activities



■ Continued upgrading of:

- Catalyst – reduced dustiness, decreased clumping/ sticking
- Unloading process – boot design, lancing pressure, tubule seal, remote or automated method
- Control mechanisms – ventilation, catalyst recovery

Questions and Answers

Controlling Exposure to Cobalt -
a practical approach



