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Where the urea industry meets

How to manage Leaks in Urea Plants

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Content

AmmoniaKnowHow.com & UreaKnowHow.com

Internet platforms to exchange technical information
within the nitrogen fertilizer industry
with the target to improve the Safety and Performance of all nitrogen fertilizer plants

Urea in China
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nitrogen+syngas
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AmmoniaKnowHow
NH_3 HNO_3 CH_3OH NPK $[NH_4][NO_3]$

Partnerships

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**>12.500 Members representing
all nitrogen fertilizer plants worldwide**

Catalyzing Safety & Performance

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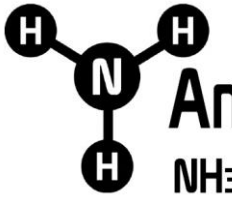
**Biweekly a
Technical paper**

Introduction



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NH_3 HNO_3 CH_3OH NPK $(NH_4)(NO_3)$

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Risk Registers

Incident Databases & HAZOPs

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Where the urea industry meets

Introduction

Why HP section Leaks are critical ?

Corrosion challenges

- A urea plant continuously fights against corrosion (due to presence of ammonium carbamate)
- Passive corrosion reduces wall thicknesses continuously
- Several reasons can cause active corrosion with high corrosion rates

Sealing challenges

- Due to the corrosion challenges, only a limited number of special urea grade materials can be applied
- Hardness figures do not always differ a lot
- More attention required to properly seal two parts

Why many leaks in piping systems

- A relative large number of safety incidents occur with high pressure 316L UG carbamate lines and NH_3 and CO_2 carbon steel feed lines
- Many failure modes exist when using standard materials like 316L UG and carbon steel
- Many welds of piping systems are made in the field instead of shop
- Welds in low pressure parts of feed lines are typically considered a lower risk level
- Piping systems are typically difficult to inspect and to reach

What happens when it leaks?

- Toxic ammonia gas is released directly and via dissociation of ammonium carbamate.
- Carbamate flashes from high pressure to low pressure, below 60 ^{o}C solids occur. When urea is present solids occur more easily
- These solids increase the risk of erosion damages along the leak path and/or cause clogging
- Ammonium carbamate is very corrosive for carbon steel and also for stainless steel when oxygen gets depleted (active corrosion)
- In case leak stops, pressures and temperatures increase leading to higher corrosion rates

What are Critical Leaks ?

Case 1: A leaking HP flange connection

What are Critical Leaks ?

Case 2: A solidified HP flange leak

What are Critical Leaks ?

Case 3: A solidified leak along stuffing box of a HP butterfly valve

What are Critical Leaks ?

Case 4: Cracks in HP gas line

What are Critical Leaks ?

Case 5: A leaking threaded connection of a HP drain valve

What are Critical Leaks ?

- Leaks touching carbon steel (bolts & nuts, tubesheets, loose liners)
- Along threaded connections
- Leaking HP piping accessories
- Cracks
- Be aware of end of lifetime conditions

Prevention Measures

- Minimise number of flange connections
- Choose a better (crevice free) design
- Apply more corrosion resistant materials (super duplex)
- Make use of high quality and experienced fabricators
- Perform risk based corrosion inspections including HP piping systems
- Pay more attention to flange connections (flange passport, perform soap test)
- Perform regular plant tours looking for leaks
- **Apply Zero Tolerance for leaks**

Mitigation Measures

- Install ammonia leak detection systems
- Shut down the plant
- Perform a risk assessment
- Flush away solids / dilute and monitor
- No clamping on ammonium carbamate and ammonia lines
- Avoid dripping on carbon steel wall of HP vessels

Conclusions

- Detect leaks at an early stage
- Shut down the plant
- Perform a proper Risk Assessment and assure you know all the possible failure modes. Perform all possible NDT inspections. Search for similar cases in the industry
- Never clamp ammonium carbamate and ammonia lines
- In case of a crack or leak along a threaded connection, shut down the plant
- Take all possible preventive measures to avoid leaks
- **Apply Zero Tolerance for leaks**

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Thank You
Any Questions ?