Session 1 – Monday, 31 August 2015, 8:00 AM – 05:00 PM

1A – Keynote Address - 60 Years History of the AIChE Ammonia Safety Symposiums
Jim Richardson, Venkat Pattabathula

Note: No questions

1B - Safely Extending the Life of Two (2) 30-year-old Reformer Furnaces
Ken Lamb et.al

Q: Girish Patel, KBR UK
What is the schedule duration for reformer shutdown, reharping and retubing?
A:

Q: Ken Wohlgeschaffen, Chevron USA
Can you please describe the "Chemical Cleaning" process mentioned in your presentation? I am familiar with C02 Pellet blasting, air blasting, and mechanical (wire brush, etc.) cleaning methods but not chemical cleaning.
A:

Q: VK, Arora, KPI Inc. USA
You mentioned of 9% reduction in arch firing following ceramic coating. This perhaps reduced mixed feed preheat temp due to reduced BW temperature reduced flue gas flowrate. This would mean of a higher radiant duty unless you compromised with reduced radiant outlet temperature with resulting (absorption) higher methane slip and reduce process efficiency. If you could please comment about charges in mixed feed temp & methane s/b/
A:

Q: Muhammad Hashim, Fatima Fertilizer Company Pakistan
During chemical cleaning of furnace convection fins which technique was used for care and protection of refractory material?
A:

Note: No responses from Authors

1C - Surprising Internal Damages on a Horizontal Ammonia Converter Basket
Ashutosh Shukla, Arie De Bruijne, Michel Warzee

Q: Kalbande Abhay, RCF India
Catalyst must have gone to Synthesis loop & downstream exchanger. How you cleaned it?

A: There was some catalyst dust migrated in syn loop and exchangers which were captured in strainer in HP ammonia separator. The strainer was cleaned few times while the plant was online.
Majority of the catalyst was lodged between the screen and thermal barrier which was removed during the inspection in TA 2014.

Q: Shams Ali Al-Shammasi, SABIC KSA
Thank you for sharing this rich experience. The question is after you have this experience do you think it's better if you have replaced the basket and get away of the surprises and reduce the non-productive time.
A: Since the plant throughput was still high, the decision was to replace the catalyst as the differential pressure issue was more contributed by catalyst and internal bypassing through suspected cracked bellows, the surprising element was the finding on thermal barrier which got warped due to back flow and rapid depressurization caused by passing valves and lack of adequate back flow prevention.

The thermal barrier has not been fixed but additional monitoring is in place for heat leak coming out of failed barrier.

It was also discussed to have the new basket procured and installed but decision to inspect was more driven to actually determine the type of failures and incorporate the RCA outcome into the design of new basket and loop.

1D - From Potentially Unsafe to Unsafe by Inadequate Tube Plugging
Joost Roes

Q: S. K. Gupta, IFFCO India
Why the plug recommended is named "flexible"?
A: Tubesheets bend during operations some 2 to 3 mm maximum, a solid plug does not allow for any flexibility (see figure 5 of the paper). Stamicarbon's plug design shows flexibility as shown in figures 7 and 9 of the paper.

Q: S. K. Gupta, IFFCO India
In horizontal HP condensers having u-tubes, which procedure described for top or bottom shall be used for plugging the tubes?
A: The mentioned method we apply for Stamicarbon's high pressure synthesis equipment with protruding ends welded by a multilayer fillet weld.

Q: S. K. Gupta, IFFCO India
In case of Stamicarbon horizontal pool condenser, in case of tube leakage, which method to be adopted for plugging a leaking tube.
A: On a pool condenser / reactor in Stamicarbon design carbamate is present in the HP shell while water/steam is present in the tubes. In case of a leakage we recommend temporary plugs which have to be dimensioned to the specific vessel using PTFE as sealant. With these

plugs in place the plant can be operated till the next planned shutdown. During the shutdown we recommend to plug the leaking tubes by welding. We recommend doing this welding with the original equipment manufacturer since internal bore welding equipment is necessary.

Q: G. K. Gautam, IFFCO India
When almost all tube to tubesheet welds corroded and tube protrusions corroded, what should be the solution? Whether plugging will solve the problem or shortening of stripper by cutting off end portion of affected tubes in bottom tubesheet.
A: The method of plugging as described in the paper takes care of that; in the top tubesheet the protrusion as well as the tube is drilled away completely to enable a leak path in case of leaking plug. In the bottom we drill away the tube protrusion including the cross cut end corrosion when present. The plug weld is made on the existing tube to tubesheet weld as shown in figure 7 and 9 of the paper.

Q: Muhammad Hashim, Fatima Fertilizer Company Pakistan
What check method you identify about complete displacement of N2 with Ammonia vapours downflow? Can we go directly after N2 purging upward flow to cooldown step?
A: The question is not clear to me; The method is valid for vertical high pressure synthesis heat exchangers. On shell side only water is present and the high pressure side is open to the atmosphere to enable the repair.

1E - Commissioning of 2 x 50000 MT Ammonia Storage Tanks
Iftikhar H. Turi

Q: Nitin B. Kulkarni, RCF India
During purging of tank, Air-N2 exchange and N2-Ammonia vapour exchange is on continuous basis of pressurization and depressurization technique. Which will be more effective?
A: In our case it was done on a non continuous bases as advised by the tank manufacturer. In my opinion, it is more important to conduct Air-Nitrogen and Nitrogen- Ammonia exchange in a specific way mentioned in the paper.

Q: Nitin B. Kulkarni, RCF India
During external inspection of tank, if insulation needs to be removed, will expose the tank wall material to atmosphere. Will this harm the MOC of tank because of frosting due to moisture in air?
A: If it done for selected portions of the tank than no need to remove complete insulation.

Q: Juan Carlos Ruis-Rico, DNVGL Ireland
Why you considered as criteria for tank design selection an external inspection from the annular space?
A: To avoid internal inspection.

Q: Juan Carlos Ruis-Rico, DNVGL Ireland
Which approach are you using for internal inspection?
A: We have not done any internal inspection for our storage tanks and we believe it is not necessary for a double wall tanks

Q: Juan Carlos Ruis-Rico, DNVGL Ireland
Any related experience to share, DNV GL, as requested by a tank designer to develop a 25-year inspection strategy to operate the tank without an intrusive inspection.
A: A RBI (risk base inspection methodology) can be used for tank evaluation. The template is available on EFMA website.

Q: Salem Hazmi, Petrochemical Industries Kuwait
Did you take into consideration the link between the different storage tanks instead of release ammonia to sea?
A: A: We have no plan to send ammonia to sea and we are looking into options to transfer ammonia between tanks at the time of emergency.

Q: Bob Romero, FM Global
Guidelines for internal and external inspections?
A: One of the good sources is EFMA.

Q: Ken Lamb, Linde Engineering
With a tank with a "low bund wall" and thus a larger area in case of a spill, would you recommend a polymer liner in the containment?
A: Not quite sure that it will have any benefit except reduce ammonia contamination if the soil contains chloride.

2A - Lower Cost Operation with Low Pressure Drop Support Grids in HTS and LTS Shift Reactors
Christopher Biegel, Dan Morton

Q: S. D. Panadare, RCF India
As pressure drop is related to energy consumption, my suggestion is the same concept should be extended to all fixed bed reactor such as HDS, ZnO, Methanator etc. Whether such supply can be used for all makes of catalysts?
A: Yes, but the pressures and temperatures need to be looked at in each case, to be sure we can make it from reasonable material that does not price it out of any savings. But it sure will fit in most cases of axial flow fixed bed reactors.

Q: VK Arora, KPI Inc.
Did you explore radial type internal to further reduce pressure drop in HTS/LTS, besides the improved grid design done at your site?
A: No we did not.

Q: S. K. Gupta, IFFCO India
Refer to figure 13, why there is sharp increase in pressure drop in HTS with new grid configuration after approximately 60 days of operation.
A: This step change in HTS pressure drop occurred after an unplanned Ammonia plant trip. DCS trending did not reveal a root cause for the increase but a theory is that the catalyst bed may have shifted during the trip causing the increase in pressure drop after start-up.

2B - Overpressure and Vacuum Protection Challenges for Low Pressure and Atmospheric Storage Tanks
David Pierce, John Mason

Q: Iftikhar Turi, QAFCO Qatar
Will redundancy of pressure/vacuum relief system mitigate the risk of over pressurization by not securing adequate capacity?
A: To some extent, additional, or redundant, relief valves will reduce the probability of an over pressure event leading to storage tank damage. Every device has a possibility of failing on demand, so an additional relief valve is available to open if one of the other relief valves fails to open. There are two cautions that one must consider if planning to claim spare relief valves as mitigation in a PHA or LOPA:

1. *Is the valve truly redundant (i.e., has the overpressure contingency analysis identified every possible initiating event for over pressure) and is not required for any of the over pressure scenarios? Agrium had to tackle this question because, through a series of acquisitions and mergers, the number of pressure relief valves on ammonia storage tanks ranged from one (and a weighted manway) to five.*
2. *Is the redundant relief capacity reliable? In other words, does the device have an inspection, testing and preventative maintenance program so that its probability of failure on demand is verifiable (note: weighted manways, thief hatches, etc. do not have any means to test or inspect their function).*

Q: Dorothy Shafer, BakerRisk US
Emergency venting through relief systems and HIPS is preferred. However in the case of a relief situation not anticipated by the HIPS scenarios, would a frangible tank roof opening be preferred over a failure in the liquid portion of the tank? The history of incidents would seem to support a frangible tank seam as an added layer of protection, due to the severe consequences of a liquid NH3 leak.
A: Through proper application of an overpressure relief study to determine the required relief area, and a LOPA to align the total protection system with the company's acceptable risk tolerance, I do not believe that a frangible roof to wall seam is necessary. I would prefer to have well-maintained systems in place to prevent the overpressure event than rely on a mechanical seam to fail. In the end, the tank has still failed and taking it out of service to repair is not an inconsequential event either.

My experience through participating and facilitating (too many) PHA's and LOPA's, is that we tend to defer to the frangible seam as a very reliable safeguard. It can lead us to downplay the importance of a HIPS and it's on going inspection and testing. The lifecycle cost associated with a HIPS is not insignificant. Safety Instrumented Systems are often the very first casualty of budget cuts because they are unseen and rarely (sometimes never) do anything. It's a slippery slope, and my preference for dealing with the human side of safe guards is to ensure that the personnel understand that the HIPS is truly their last line of defense.

Also, I've seen frangible seams that didn't work, fortunately on "rig tanks" (500 bbl oilfield API 650 tanks).

Q: Ken Lamb, Linde Engineering
While not taking credit for it as a relief mechanism, would you favor a tank design with a stronger seam at the floor than the roof, to avoid a spill result?
A: See answer above. To expand, if API 620 required such a weld design, and as long as industry does not accept it as a safeguard in their LOPA, then I agree with what you propose.

2C - Re-tubing Experience of Synthesis Loop WHB No 1 and Failure of Incoloy WHB No 2
Geoff Blewett, Tamvada Srinivas, Giridhara Raju

Q: A.K. Singh, IFFCO India
What type of boiler water treatment is used? Could it lead to corrosion product deposition?
A: pH is controlled above 9.5 using aqueous ammonia and hydrazine is added if the O2 level goes above 20ppb. BFW treatment should not lead to corrosion product deposition if intermittent blow down is done regularly and from the correct location (i.e. above the center of the tubesheet)

Q: Peter Tait, Methanex, New Zealand
Did the boiler have a chemical cleaning regime?
A: No chemical cleaning regime was in place for the boiler that failed due to under deposit corrosion.

Q: G.K. Gautam, IFFCO India
Why the tube failure occurred beyond the end of tube ferrule and not at the bottom in WHB-01?
A: Up to the ferrule , tube is protected. Just after the ferrule heat flux is the highest .Deposit formation and under deposit corrosion at this point also contributes to the failure.

Q: Muhammad Hashim, Fatima Fertilizer Company Pakistan
Reason of great variation in BFW Chemistry like chloride and Oxygen contents? What is the good reason of this change? What parameter range in which you are operating Cl & Fe (Chloride & Iron)?

A:On the second WHB there was no significant variation in Cl-and O2 content. The trend showing Cl- has regular peaks which are due to the scheduled calibration of the analyser. Chlorides were always in the range o 10 – 30 ppb with the alarm set at 100 ppb. Fe was measured as <0.02mg/kg.

2D - Catastrophic Explosion in the CO2 Removal Unit of an Ammonia Plant
Alireza Orooji , S.Sajjad Hosseininia, Ehsan Askari Mahvelati

Q: Ken Wohlgeschaffen, Chevron USA
How do you know it was a vapor cloud explosion and not a fire, was a loud "bang" heard, for example? If it was an explosion, what was the overpressure (PSI) and damage as a result?
A: It was a vapor cloud explosion based on existing video which is captured by closed circuit cameras of the site. Also the bang sound heard and the wave of explosion was affected some personnel. The damages due to explosion caused to start extended fire on spreading amine on the equipments.

Q: Ken Wohlgeschaffen, Chevron USA
What was the velocity (ft/s) in the semi-lean pipe, on average, and also the maximum velocity based on CFD modeling?
A: The maximum flow velocity on the cross section at reducer end is summarized as: Case A (normal flow,60 deg.): 24.7 (ft/s). Case B (110%flow,90 deg.): 15.7 (ft/s). Case C (120% flow, 90 deg.): 17 (ft/s). Therefore, the local velocity over 24.7 ft/s near pipe wall could be considered as a threshold to prevent the damage in C.S pipe. There is no concern of the damage even though the local velocity exceeds 24.7 ft/s because the replacement by S.S pipe has been done.

Q: Alfredo Medina Vilar, JACOBS Consultancy Venezuela
In addition to performing a total HAZOP of the facility as included in the recommendations – performing a HAZID study should be followed by order to ensure that no additional design issues are still present.
A: yes, that's correct. HAZID can help to determine the adverse effects of exposure to hazards and plan necessary actions to mitigate such risks.

Q: Venkat Pattabathula, INCITEC Pivot Australia
How long the passivation was done in amine system?
A: The main passivation layer was formed after commissioning ant start up in 2007, three years before incident. Also in each start up of the plant,CO2 removal unit start up procedure should be follow to maintain and consolidate the passivation layer.
Q: Muhammad Hashim, Fatima Fertilizer Company Pakistan
Do you have sample check of Fe contents in C02 removal MDEA system. How much it increased?
A: The Fe content in amine system was high, up to 30 PPM before incident because of high corrosion rate of carbon steel raschig rings packing in BED#1 of stripper tower. The remaining carbon steel packing was changed to S.S material one month before incident.

2E - Implementation of Best Practices for Improvements in Reformer Performance and Reliability

James Widrig , Giuseppe Franceschini

Q: Ken Wohlgeschaffen, Chevron USA
Why do you consider a tube leak a safety incident? What is the safety concern?
A: The tube failures as discussed in the paper are generally considered as reliability concerns when contained within the reformer. Safety concerns may be possible if the tube leak results in damage to equipment beyond the reformer or personnel are in some way exposed to hazards resulting from the tube leak.

Q: Ken Wohlgeschaffen, Chevron USA
Why did you choose 20,000 hr as the "alarm limit", what is the basic technical basis for choosing this number
A: The choice of 20,000 hours as the safe limit is somewhat arbitrary. The limit is set such that tubes could operate under this condition for 2 years before failure rather than a condition that would result in a more immediate failure. Additionally, the creep life curves as presented in API 530, have a lower limit of 20,000 hours, below which the creep rupture strength data may not be reliable.

Q: V. Ramaswamy, Proplant Inc. USA
What is recommended guideline for TWT monitoring during start up/emergency shutdown conditions?
A: TWT should be continuously monitored during start-up or transient operations. This monitoring should be performed by visual observation of the tubes by the field operators to ensure that flame impingement or excessive temperatures are avoided. This monitoring should be performed frequently until the operation is stabilized.

Q: V. Ramaswamy, Proplant Inc. USA
What is emissivity setting recommended/guideline for optical Pyrametery
A: Emissivity is dependent upon the surface condition of the material, wavelength of the instrument, the viewing angle, and the temperature of the surface. When using Quest Integrity's CorrectIRTM software, radiance temperatures are measured using an emissivity setting of 1.0 and the software application applies appropriate corrections. More information on emissivity can be found in Dr. Peter Saunders book titled "Radiation Thermometry, Fundamentals and Applications in the Petrochemical Industry" whose work is referenced in this paper.

Q: Tamvada Srinivas, QAFCO Qatar
Is nipping of Reformer Tubes Safe?
A: Reformer tube nipping has been successfully accomplished when the material is in good condition, proper equipment is used, personnel are properly trained, and safeguards are in place. In general, reformer tube nipping is viewed are a high risk activity. Several operators

now prohibit nipping due to the potential consequences of an uncontrolled release and personnel exposure and favor a reformer shutdown to isolate failed reformer tubes.

2F - Flange Dissassembly - An Under Rated Source of Safety Incidents
Sam Tait

Q: Muhammad Hashim, Fatima Fertilizer Company Pakistan
We are experiencing flange leak in secondary reformer O/L and converter O/L flanges. What is your recommendation to eliminate thermal cycling phenomenon.
A: Flanges in these services often require individual engineering to ensure the integrity of the joint and as such it is not possible to make a specific recommendation without full knowledge of the flange details and process conditions. I would recommend you have mechanical engineering review the bolt torque and gasket selection for these joints, it should be possible to eliminate any issues due to thermal cycling if these are correct.

Session 2 – Tuesday, 01 September 2015, 8:00 – 11:30 AM

3A - State of the Art Leak Detection for Ammonia Piping and a Barge Loading Facility
Andy Vluggen, Dwight Eldredge

Q: V. Ramaswamy, Proplant Inc.
Are DTS sensors ATEX certified for hazardous area installations?
A: The DTS sensor is a fiber optic cable. Through this fiber optic cable only laser light is being sent through. Because the fiber itself is no ignition source, it could be used in a ATEX zone. The DTSX unit should be place in a DCS/PLC inter connection room and not in the plant itself, because it is not Atex certified.

Q: S. K. Gupta, IFFCO India
Up to what concentration level of the ammonia thermal imaging camera can serve. Also, up to what distance?
A:

Distance from leak	Minimum detectable ammonia concentration on 0.5 m above the leak
m	ppm
12,5	125
25	300
50	1600

3B – Pulsations and Vibrations Control in Urea Plants
Constantino Bruni & Leonardo Galimberti

Q: Ken Lamb, Linde Engineering
Has Casale looked into the subject of vibration or pulsation in the piping below pressure relieving devices e.g. relief valves?
A: All piping branches where relief valves are installed shall be considered in the study. In fact one scope of the study is to avoid pulsations induced relief valves opening. Piping vibrations that may be present in these branches shall be controlled using a proper supporting system.

3C – Evaluation of Ammonia Converter Shell with Cracked Weld Defects for Continued Operation
Ara Nalbandian, Steve Wilmes, Wajid Bhatti & Azzam Azmi

Q: Maneesh Sankhyadhar, TATA Chemicals Ltd.
Whether equipment is shop welded / site welded, hot/cold wall and reason for crack. Type of converter?
A: Except for the girth weld 1a-1b, the converter was shop welded and it is cold wall. Cracking of the weld was attributed to hydrogen induced cracking (HIC) due to local PWHT of girth weld 1a-1b.

Q: Maneesh Sankhyadhar, TATA Chemicals Ltd.
Was NDT done in hot shell or after cooling catalyst / shell?
A: Ultrasonic inspection was performed on the external surface of the shell at the existing cracked location utilizing high temperature probe at an approximate temperature of 250°C (482°F).

Q: Charles Ormsbee, Agrium Canada
How was the vessel PWHT at original manufacturer i.e. entire vessel in furnace or local PWHT at weld seams?
A: Except for the girth weld, 1a-1b, the vessel was originally subjected to PWHT in the furnace at the OEM.

Q: Charles Ormsbee, Agrium Canada
Were weld hardness readings taken during the OEM QA/QC program? If so what did these readings reveal in terms of hardness?
A: Yes, these values were below 225HB. Additional hardness determinations were also made by the plant during the investigation of the crack incident; they were also acceptable.

Q: S.D. Panadare, RCF India
The crack repair method described in the paper is for single wall pressure shell. Whether similar method can be adopted for multiwall or multilayer pressure shell?
A: A similar method of crack repair may not be feasible for multilayered pressure vessels due to the complex nature of detecting cracking feature.

3D – Cleaner for Longer - Meeting the Reliability and Purification Demands of the Ammonia Process
M.J. Cousins & P.J. Carnell

Q: S.D. Panadare, RCF India
With increased resistance to position increase reliability, do you recommend short loading & catalyst to reduce pressure drop?
A: Where it is viable to reduce the loaded volume to fit with a maintenance schedule then this should advantage should be sought. The advantage is highest when the materials being used in the design for each duty have the; highest activity, slowest die off and are most resistance to poisoning. For LTS duty the Johnson Matthey's self-guarding catalysts such as KATALCOJM 83 Series provide a good example, where the volume of catalyst can be reduced for equivalent or better performance from the LTS unit operation, as was discussed in the paper.

Q: VK Arora, KPI Inc.
In existing plant configurations with separate como & ZnO beds, how is 3-in-1 catalyst (33-1) provides economic benefit besides AP advantage while penalizing the catalyst life of COMO catalyst-dictated by the sacrificial life of ZnO bed
A: The advantages of a combined purification material such as KATALCOJM 33-1 can be taken in several ways
1. Lower pressure drop, for the same life

2. More life from the same volume (so approximately the same pressure drop)

If the design optimisation allows then a layer of ZnO (i.e. KATALCOJM 32-4 or 32-5) or promoted ZnO (such KATALCOJM 32-6) can be used as a bottom layer. This will increase H2S absorption capacity. The role of the KATALCOJM 33-1 in this case is to provide the HDS functionality for the ZnO that is within the combined material and the ZnO below it. So in a well-designed system there need be no loss of life from the HDS section.

Q: Alfredo Medina Vilar, Jacobs Consultancy, Venezuela
Has JM collected data from modern (1990+) plants showing the average actual life of catalysts?
A: Yes, Johnson Matthey has decades of data on catalyst life, including information from the ICI archives. This allows trends to be assembled going back to the 1960's – 1970's.
This data shows that there has been trend for increasing catalyst life. The most pronounced improvements have been observed where operators have worked closely with us to develop solutions for their needs, as the example I showed detailing the case of primary reforming

catalyst where the life was increased whilst pressure drop was decreased as a result of using Johnson Matthey catalysts

3E– The Process Safety Engineer's Role in Ammonia Plant Design and HAZOP Facilitation
Glenn W. Parizot

Q: Jorge Camps, Jacobs Consultancy USA
Ammonia plants regularly operate at higher than design capacity during winter time, when the equipment is clean, etc. Shouldn't the PHA analysis also consider those events?
A: The engineering company is contracted to design the plant to meet a certain capacity. Anything above that capacity is the choice of the owner to run the plant outside of the safe, agreed upon design intent. The PHA only evaluates the design in regards to the design intent (contracted capacity).

Q: Muhammad Hashim, Fatima Fertilizer Company Pakistan
While doing PHA with team during Risk Rating Step it is relatively easy to rank severity but very difficult to rank likelihood. Do you have similar issues and how to mitigate it? Based on judgment or past experience?
A: Yes, event/consequence likelihood can be difficult to obtain. Setting some base rules for some likelihood (such as control loops will fail at least once in a 10 year time period, as an example that the PHA team would then need to agree upon) can make the review process easier. Most importantly, having an experienced operations team (both contractor and client) to provide past experience for likelihood decisions in a PHA is essential.

3F – Management of Remaining Life Based on the Outer Surface Conditions of Catalyst Tubes
Toshikazu Shibasaki, Takashi Hokamura, Brian Shannon

Q: Ken Lamb, Linde Engineering
Is the surface roughness a function of scale formation (external influence of furnace atmosphere) or internal (reaction with chrome or other at temp) ?
A: Yes, the surface roughness is the result of scale formation with exposed temperature. The higher temperature is the easier to remove the scale from the surface.

Q: Charles Ormsbee, Agrium Canada
A furnace low flow incident can result in tube overheating and high tube well temperature. Will this type of incident affect your conclusions on tube operating temperature? (This type of incident can leave permanent surface texture on the tube from the high temperature.)
A: Yes, the type of incident affects the condition of outer surface.

Session 3 – Wednesday, 02 September 2015, 8:00 AM – 4:30 PM

4A – Managing Cold Temperature and Brittle Fracture Hazards in Ammonia-Related Industries
Daniel Benac, Dorothy Shaffer & David Wood

Q: Mark Schroeder, Koch Fertilizer
Do special precautions need to be taken when re-starting an ammonia plant in cold weather prior to packing the loop?
A: Yes, special precautions may be necessary, particularly for converters located in cold climates. Depending on the temperature of the pressure shell, the material properties and thickness of the converter components may limit the allowed pressure to avoid operating in a brittle region.

4B – Reformer Balancing For Optimization of the PCS Nitrogen Trinidad Unit 2 Primary Reformer
Hugo S. Roberts, Lawrence Sandy

Q: Ken Lamb, Linde Engineering
In an 8-row reformer, you have 9 rows of burners. When you adjusted the heat input to Tube rows 1 & 8. What was the relative heat input i.e. Burner Rows 1&2 and 8&9?
A:

Note: No responses from Authors

4C – New Sealing System for the Main Flange-Connections of Reactor 105-D
Norbert Brett, Jurgen Deininger, Franz Raymann

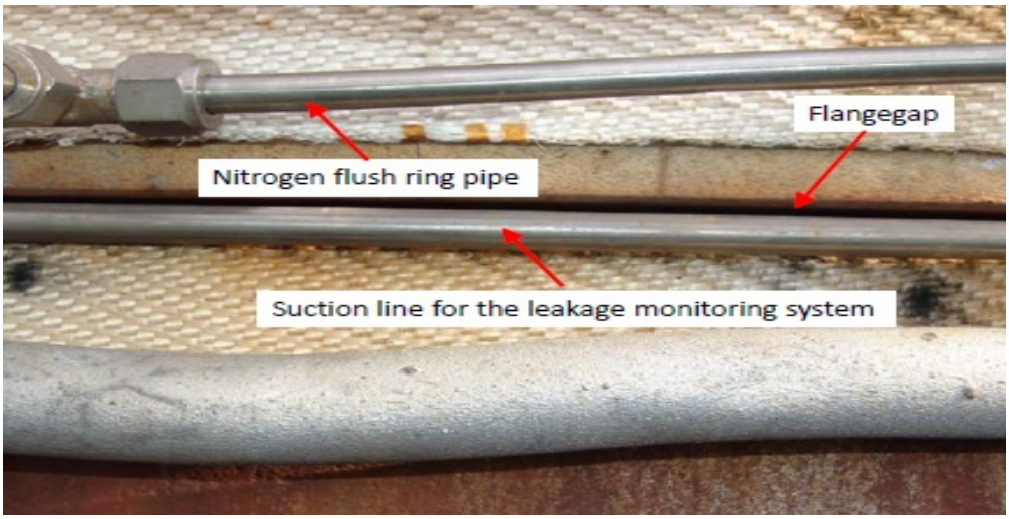
Q: Muhammad Hashim, Fatima Fertilizer Company Pakistan
How operator detects LEL all out of approach flanges for continuous Monitoring using son tector leak detection system? Hot tightening of flanges you do after re-start up of plant?
A: Up to a Revamp in 89/90, 15 years after commissioning leaks on the main flange connection of reactor 105-D never occurred. The working pressure was in this time 300 bar (4.351 psi).

In 1989/1990 a revamp in both ammonia plants performed. The capacity became increased from 1.350MPT to 1.650MPT. With the revamp it was possible, to reduce the working pressure up to 240 bar.

After reducing the working pressure several leaks occurred, especially after shutting down and restart.

For this case we have measures and procedures for safe handling the leaking flange, as eg.

- *A leak detection system with signal to the control room (With a pipe ring –with holes– we suck gas and analyze ammonia continuing)*
- *A nitrogen flush by an existing piping-ring with holes around the flange-gap*
- *A special procedure for increasing the bolt-force for safe retightening of the bolts onstream*
- *Qualified craftsmen´s do the job under the control of a skilled engineer*



Our experiences with the octagonal R gaskets, agrees with the most experts. They are excellent high-pressure gaskets. The contact force reinforced by wedging effect. With moderate bolt force the necessary shear yield strength is achieved.

Very important is in case of a leak, that through the 2-edge-seal effect the gas throttled 2 times on the leakage path from inside to outside. The leaks will be only very small.

For tightening and retightening the bolts we use an innovative bolting solution called SUPERBOLT® of Nord Lock.

1. *Tendency for fretting on bolt thread.*
2. *As you have seen in Figure 7, the tightening of large bolts M130 is difficult and time consuming. For the installation of the device to another bolt, you need a crane.*
3. *Easy handling during assembly step*
4. *With the special tool, it should be possible to measure the bolt force.*

4D – Root Cause Analysis of Incidents during LTS Catalyst Reduction and Primary Reformer Coking Event

Eugene Britton, Kateryna Gliebova, Timothy Rembold

Q: Kalbande Abhay, RCF India

During preliminary reformer incidence, the isolation valve at control valve F-1A1B, was opened for 30 mins which allows gas to enter reformer. Why it was not included in the standard operating procedure.

A: In hindsight, closing the manual isolation valve more quickly should have been a part of the standard operating procedure. In a typical shutdown (planned or not) process steam flow does not stop completely, as it did in this incident. The temporary installation of motor operators on these isolation valves (activated by the process gas shut-off interlock) should mitigate this issue until the positive shutoff system is installed.

Q: Peter Herena, Baker Risk, Chicago

In the PHA was the discussion of possible causes and hazards of LTS catalyst reduction?

A: The LTS catalyst reduction was not included in a PHA. This will be corrected prior to the next catalyst reduction.

4E – Challenges in the Integration of the QAFCO 5 & 6 Mega Fertilizer Complex

Andrea Zambianco, Mohamed Noueiri

Q: Kalbande Abhay, RCF India

Construction of QAFCO 5 started two years before QAFCO 6 Project, then why QAFCO 5 Commissioning took place after 5 years. Why? What were the problems?

A: Q5 Project commissioning took place in October 2010, 2 years and 10 months after the Q5 Project start and not after 5 years, and first Ammonia Production was in August 2011. For the problem encountered during the commissioning please refer to the excellent paper of Mr Ali Jama presented at AICHE 2014.

Q6 Project first Urea Production was in July 2012 ahead of schedule.

It was possible to anticipate the schedule of completion of Q6 Project since the Project site constraints were well known.

Q: S.K. Gupta, IFFCO

Urea pipe conveyor 3 km long between Q1-4 to Q5-6. Is it a single conveyor or having intermittent transfer chutes to reduce the length? Who is the supplier of their pipe conveyor?

A: Pipe conveyor is a single conveyor without transition running from Q5-6 site to Q1-Q4 site, Phoenix is supplier of the belts and Thyssenkrupp the supplier of the handling package.

Q: Alfredo Medina Vilar, Jacobs Consultancy, Venezuela
Can you please describe the design features that were implemented to minimize Ammonia emissions from the process plants? Was there any concerns regarding ammonia emissions with the vent from the granulation units.
A: Granulation plant is standard UFT technology without acid scrubbing. The ammonia present in the urea melt coming from the urea solution plant is stripped out in the granulator and ends up in the granulator exhaust air stream. If the ammonia content of the exhaust air has to be lowered, up to half of the total UF85 can be injected by UF85/Water spray nozzles into the granulator exhaust air before it enters the granulator scrubber.
When the plant is operated as defined in the design basis the abatement system is not in operation. Plants are currently running at 110 – 120 mg/Nm3 NH3 from the granulator stacks.
There were no concerns related to ammonia emissions at any time.

Q: Bode Agagu, Notore Chemical Industries, Lagos
What were the key reasons for the crossing up of the delivery dates of Q5 & Q6?
A: Delivery dates of Q5 Project and Q6 Project were not crossing up.
Q5 Project Take Over was in August 2012 and Q6 Project Take Over was in September 2012.
Q6 Project is almost 1/5 of the Q5 Project in term of main quantities, this is the main reason for the shorter overall Project duration.
Moreover it was possible to anticipate the schedule of completion of Q6 Project since the Project site constraints were well known.

Q: Bode Agagu, Notore Chemical Industries, Lagos
What were the major challenges (most demanding top 4) on the project and what steps taken to overcome them?
A: Among all major challenges of Q5&6 Project, one of the largest and most challenging execution in the fertilizer field worldwide, the following are to be considered the most demanding top 4:

- *The size of the Project and the location*
- *The interconnecting in between Q5-6 and Q1-4 area*
- *Development of the overall electrical network including the integration with existing Q1-4.*
- *The Pipe Conveyor system*

The following are the key factors implemented to overcome them:

- *Proper assignment of resources to manage the whole tie-ins from the early phase of execution involving all disciplines*
- *Proper coordination between Contractor and Company to plan activities of integration during the allowable shut down of running plants*
- *Early identification of challenges in design stage*

4F – The Value of Primary Reformer Temperature Balancing and Monitoring
Michael Dean, Kendra Briggs, Jamie Chisamore

Q: G.K. Gautam, IFFCO India
Whether reformers balancing have taken into consideration the gas distribution pattern in furnace box?
A: The furnace balancing effort discussed in the paper was undertaken by identifying hot and cold areas of the furnace through Reformer Imager temperature measurement. Operations then made slight burner and fuel gas adjustments to decrease or increase temperatures in certain regions or rows. No additional modeling was done to determine gas distribution within the furnace box and how it might be affecting the temperatures in these regions.

Q: Peter Tait, Methanex, New Zealand
Do you compensate for the cooling effect of the air entering the sightport?
A: When utilizing the Reformer Imager to take tube measurements, the temperature measurements can be captured within a 10 second or less time frame. This time includes opening the peep door, taking the measurements, and closing the peep door; therefore minimizing the amount of air entering the sightport and the need to account for any cooling effects.

Q: Nabil Al-Naimi, SAFCO, Saudi Arabia
Was there compression done between this new measuring device and cup measurement?
A: The Reformer Imager temperature measurements require correction to determine true tube wall temperature, therefore a comparison of temperatures with Gold Cup Thermocouple measurements cannot be done until after temperature corrections are made to the temperatures measured with the Reformer Imager. With that being said, field comparisons have been done between the two devices and it has been found that after temperature correction, the tube temperatures measured with the Reformer Imager do compare well against those measured with the Gold Cup Thermocouple.

Q: Omar M. Takrouri, SABIC, Saudi Arabia
What is the time span required to do reformer thermal imaging?
A: The time span required to take a full set of temperature measurements for a furnace will be dependent on furnace size, but overall can be accomplished very quickly. For example a full temperature survey can be completed in an hour or less for a 400 tube furnace with measurements taken at all top and bottom level peep doors.

5A – Ureaknowhow.com Urea Incident Database: Learning from each other
Jo Eijkenboom, Mark Brouwer

Q: S. K. Gupta, IFFCO India
We have faced problem of thermowell failure (Reactor overflow line to stripper) due to corrosion – erosion of the thermowell tip. Is there any method to check the condition of thermowell tip without removing it from pipe?
A: To inspect these thermowells is not an easy job. Radiographic methods are limited by the pipeline diameter.

Our advice to apply a more corrosion resistant material like 25-22-2 or duplex.

5B – Steam Reformers Overheating: Absolute Protection Now Available
Oscar Olatte

Q: Venkat Pattabathula, INCITEC Pivot Australia
Have you applied this to an ammonia plant reformers?
A: TGM technology has not been applied at this time to Ammonia plants, though BD Energy Systems, LLC expects to do so in the near future. There is no reasons to believe that it won't work in ammonia technology as the reforming process and technologies available are in most if not all cases similar. The basis of TGM is to measure the thermal expansion of tubes, so as long as your are able to measure it, TGM is applicable with no problems.

Q: Ken Wohlgeschaffen, Chevron Products Co. USA
What is the approximate installed cost (USD) for this system on a furnace that is side fired (Forster Wheeler Design) having 336 tubes? What is the annual maintenance cost (USD/year)
A: The unit approximate cost of installation for TGM is USD 5200 for a Foster Wheeler furnace. Maintenance costs are minimal as long as there is an appropriated maintenance plan in place. BDE is available to discuss details with the interested person.

Q: Ken Wohlgeschaffen, Chevron Products Co. USA
Other than a methanol plant, has this system been installed in any hydrogen or ammonia plants?
A: TGM technology has not been applied at this time to Ammonia or hydrogen plants, though BD Energy Systems, LLC expects to do so in the near future. There is no reason to believe that it won't work in ammonia or hydrogen technology as the reforming process and technologies available are in most if not all cases similar. The basis of TGM is to measure the thermal expansion of tubes, so as long as your are able to measure it, TGM is applicable with no problems.

5C – Automated Sensor Placement for Industrial Plants: A Case Study on Ammonia Plant
Shahryar Khajehnajafi, Azar Shahraz

Q: Ken Wohlgeschaffen, Chevron Products Co. USA
I see that my company's logo (Chevron) is shown on your last slide in the presentation. I was not aware of your company working with us on sensors in our plants. Can you please tell me where you have used this technology in our company and who you worked with in Chevron?
A: The list of logos on the last slide represented companies using our SAFER software. The list does not necessarily means we have done sensor siting for them. A Chevron site was using our analytical software tool "SAFER TRACE", however, they are not active anymore. So we apologize for any confusion the display of Chevron logo has caused. We will rectify the list by removing Chevron's logo.
Q: Peter G. Herena, BakerRisk, USA
How does the model take into account probability of failure?
A: We do not take into account the probability of failure. However, we design the sensors network based on the worst weather condition and assume that the plant sites keep the sensors in good working condition at all times.

Q: Peter G. Herena, BakerRisk, USA
Does the model take into account release momentum- that can be a larger factor than wind?
A: No. However, keep in mind that release momentum (dilution) creates the best case. We design the sensors network based on the worst case which is no momentum or dilution at the source.

Q: Robert McAdams, BASF Corporation, USA
As actual wind conditions deviate from conditions assumed in mode, what is the effect on the sensor location output? Can the results be invalidated? Is there a way to apply "waste case" wind conditions?
A: We use the worst case weather condition which is a wind speed of 1.5 m/s and F stability. This will result in a narrowest possible plume. Other weather conditions produces wider plume which will definitely be caught by the designed sensors network.

Q: Venkat Pattabathula, INCITEC Pivot Australia
Can we apply this to hydrocarbons also?
A: Yes, you can.

5D – GPIC Experiences in PG Cooler (E-301) Fouling
Eyad Rafei

Q: Nitin B Kulkarni, RCF Ltd., India
What is the effect on refractory if PG cooler tubes cleaned by hydrojetting? If cleaned by hydrojetting what precautions to be taken during cleaning and start up?

A: Hydrojet cleaning of PG cooler tubes invariably wets the refractory surfaces even after taking good precautions. Thermal insulation paper provided behind ferrule also gets wet when hydrojet being done as gap is sufficient for water to enter. So, hydrojet cleaning, if necessary, to be done with extra care . In GPIC case it was done few times , care was taken to do cleaning in the flow direction of ferrule, In to Out not reverse, to avoid water wetting of insulation paper & Refractory. During startup, dry out procedure adopted to avoid damage to refractory.

Q: S. NAND, The Fertilizer Association of India
You mentioned that cooling water jacket on Secondary Reformer may also be contributing to fouling of PG Cooler. Can you please explain?
A: Condensation of gas behind the refractory wall possible for Ammonia plants. A close observation on Refractory walls during last few turnarounds , some material and flow marks observed in the gaps of refractory. This was considered as one of the main contributor to the fouling.

Q: Kalbande Abhay, RCF India
As explained in Presentation, external shell cooling of secondary reformer is contributor to fouling, but in our plants, we don't have water shell cooling. Still we are facing the same problem. What may be the reason? Who is supplier of corundum balls?
A: Water jacket is one of the reasons for fouling . Other reasons were discussed in presentation , Potash carryover from Primary Reformer catalyst and this potash act as catalyst for hydrolysis of Alumina and carried away with the gas and gets deposited in colder zone of PG cooler. Short loading of Secondary Reformer helped to avoid milling and thus dust going to PG cooler. CHRISTI is the supplier for Corundum balls.

Q: Yasser Abdelmonem, EBIC, Egypt
De-scaling operation, you mentioned you can make de-scaling operation during plant online, through venting gas U/S HT reactor. High velocity can affect the reformers cat. and also how you can control steam drum level?
A: De-scaling operation were carried out keeping in mind maximum limit for gas velocity in PG cooler as given by licensor, having said that I agree that de-scaling operation should be used only when you have no other operation to keep your plant running without loosing production. Normally, steam production comes down by about 20 Te/hr , so maintaining level in steam drum was never a concern.

Q: Ken Wohlgeschaffen, Chevron Products Co. USA
What was the source of the potassium (K) contamination?
A: Primary Reformer catalyst is having about 0.3 to 0.6 % potash .

Q: Ken Wohlgeschaffen, Chevron Products Co. USA
How did boiler feed water quality affect fouling of the process gas order?

A: If BFW quality is not good , then fouling possible on tubes external surface (shell) which can limit heat transfer and thus higher tube temperatures can lead to failure. Our boiler feed water quality was good and this problem not observed.

Q: Ken Wohlgeschaffen, Chevron Products Co. USA
Whose catalyst do you use in your primary and secondary reformers?
A: Topsoe catalysts . (RK-211 , RK-201 & R-67-7H for Primary Reformer ; RKS-2-7H for Secondary reformer)

Q: Leonhard Werner, Borealis Austria
Did you also consider the potassium quotation of the primary reformer catalyst and boiler feed water quality as contributing factors to the fouling phenomenon.
A: Yes . Potash carryover from Primary reformer catalyst happens , it catalyses hydrolysis of Alumina as explained in the paper. This gets deposited once process gas gets cooled in PG cooler. BFW can also contribute , but in our case not considered due to BFW good quality and good condition of tubes during turnaround inspections. One of the observation to add , PG cooler temperature gone up by about 20 Deg C once potash promoted catalyst was used in our Methanol plant (no Secondary Reformer) but didn't pose a major limitation. So Potash can contribute to the fouling problem in the Process Gas Coolers, but not a major contributor.

Q: Venkat Pattabathula, INCITEC Pivot Australia
Please describe the on-line de-scaling method?
A: De-scaling operation carried out by increasing the velocity in PG cooler by decreasing the back pressure with synthesis loop running. Pressure will be reduced by taking vent upstream of HTS & Absorber and suction of pressure of Syngas compressor dropped to a value suggested by licensor.

5E – Tube-to-Tube Sheet Weld Scanning System
Jen Peter Bertelsen

Q: Wajid Bhatti, Fauji Fertilizer Pakistan
Can the technique of P. Scan be applied on In-service HP Urea Equipment i.e. Urea stripper, carbamate condensers having welds with surface pinholes and depth in unknown can cause failure of equipment.
A: Yes, the system can be applied on in-service equipment. For the type of inspections you refer to, the system will be calibrated, typically ø0.8-1.0mm holes in the mock-up. Orientation and depth of the calibration holes will depend on the actual requirements/situation.

It shall be noted, that single pores can be difficult to detect by any ultrasonic technique, however clusters of pores are easy to detect.

Questions & Answers

Q: Suresh Matthew, Tata Chemicals Ltd.

What is the use of water in the operation?

A: The water is the coupling media between the ultrasonic transducer and the tube inner wall. To be able to transmit the ultrasonic sound from the transducer into the tube wall and weld, a coupling media is required. The transducer is spring loaded to maintain a pressure against the tube wall, but even if the transducer is close-fitting to the inner tube wall, there will be a

border or very small gab between the transducer and inner tube wall. Here is water, oil or another liquid substance required the make the sound pass this border.

Q: Barry Nancoo, IPSL Trinidad & Tobago

Can this approach be used to detect defects in fillet welds for tube plugs.

A: Yes, the system can be used for detecting defects in fillet welds. I can add, that when we make inspections on in-service objects, indication we detect, are often repaired and we then follow up with a new scan of the repair.

Q: Bode Agagu, Notore Chemical Industries, Lagos

Can this application be extending for use on other fillet welds like on weld-o-lets?

A: We have never scanned weld-o-lets with the system. I think the only possible way to make a weld-o-let would be to insert the probe into the weld-o-let.

If you have drawings or sketches of the type of weld-o-let, which you have in mind, I would be interested to make an evaluation of the possibilities for a scanning.

You are welcome to contact me on email: jsb@force.dk

Q: Joost Roes, Stamicarbon

What is the detection sensitivity for pores?

A: Calibration is typically made on ø0.8 – ø1.0mm holes. It shall be noted, that single pores can be difficult to detect by any ultrasonic technique, however clusters of pores are easy to detect.

Q: Joost Roes, Stamicarbon

What is the status regarding the phased array probes*?*

A: We are in the initial process of making computerized simulations of PAUT of the tube-to-tube sheet welds. Nothing has been determined concerning the best approach, I do however trust, the a immersion technique will be the most likely technique. This is mainly due to the ovality we often see in the tubes, cause by heat input from the welding process and by rolling of the tube inside the tube sheet.

Q: Joost Roes, Stamicarbon

Can elongated pores or worm hook defects be detected?

A: Elongated pores can be detected. Calibration for this type of defects is typically made on ø0.8 – ø1.0mm holes.

It will properly not be possible to separate pores from worm hooked defects. Single pores can be difficult to detect by any ultrasonic technique, however clusters of pores are easy to detect.

Q: G.K. Gautam, IFFCO India
Whether this system can be used for vertical tubes overhead position and have many welds in a day.
A: It makes no difference during the scanning whether the tubes/welds are in vertical or horizontal position. Number of welds scanned per day is still typically 650-750.