

Plant Manager+

This is already the 15th in a series of discussions from a selection of round table topics discussed on the UreaKnowHow.com website. UreaKnowHow.com promotes the exchange of technical information to improve the performance and safety of urea plants. A wide range of round table discussions takes place in the field of process design, operations, mechanical issues, maintenance, inspection, safety, environmental concerns, and product quality for urea, ammonia, nitric acid and other fertilizers.

The 15th subject under discussion is the experiences with pressure safety valves, critical equipment in any urea plant.

Problem No. 15: Pressure Safety Valve experiences



Pressure safety valves are critical equipment items in any chemical process plant. In a urea plant additional challenges are to be met such as carbamate corrosion and crystallization risks. These challenges threaten a reliable operation of the pressure safety valves: too early popping up and /or crystallization of process media in the inlet or outlet lines. Furthermore these challenges make it very difficult to install spare pressure safety valves, as is common practice in other chemical processes.

Sufficient reasons to initiate a discussion about experiences with Pressure Safety Valves (PSV) in urea plants.



Mr. Mark Brouwer of UreaKnowHow.com starts up the discussion with a simple question: What are your experiences with pressure safety valves ?

Mr. Mohammad Rastegariyan of PIDEMCO in Iran replies and shares his valuable experiences:

The first critical ones are safety valves in the high pressure synthesis loop. In the past we faced passing problems due to seat & plug corrosion, which was the consequence of poor insulation. Then we improved the insulation condition.

The second critical one is the safety valve on discharge line of the high pressure ammonia pump. Problems were caused due to vibration. We had to replace it with a change over valve (twin safety valve).

Also the safety valve of the CO₂ compressor interstage popped several times and remained at open state. We need to mention that the pressure at this stage is higher than normal. Then we increased the safety valve set point.

Mr. Waqqar Ahmed of Fauji Fertilizer Company in Pakistan also shares his valuable experiences:

We faced following problems.

- 1- Passing problem in urea High Pressure stripper vapor outlet line Pressure Safety Valve. Its frequent passing resulted in severe corrosion of the blow down header. Once it was also gaged. The problem was resolved by proper seat & disc lapping and by proper seat flushing arrangements.
- 2- Pressure Safety Valve Bellow failure at the High Pressure carbamate recycle pump discharge line. The leakage resulted in forced shut down of plant. Main culprit was high line vibration.

Mark comes back with some background information and puts some more questions on the table:

Please find enclosed an interesting comprehensive presentation about safety valves in general.

Who has experience with Rupture discs upstream a Pressure Safety Valve ?

With which vendors you have experience ?

Any experience with a too early popping open of a safety valve ? Any remedies ?

There is a very nice innovation on the Safety Valve market: Leser GmbH in Germany developed a Pressure Safety Valve especially fit for the carbamate services in urea plants like for example:

- Reactor off gas in a Stamicarbon plant
 - Stripper off gas in a Saipem plant
 - Recirculation pressure safety valves
 - Desorber pressure safety valves
 - HP carbamate pumps
- etc

This LESER pressure safety valve has a continuous flush around its seat, which:

1. assures that the downstream side is completely flushed
2. flushes the seat and stem when the safety valve is in open position, which leads to the big advantage that the stem and seat will not get damaged due to erosion / corrosion of carbamate when the pressure safety valves pops up. This leads to the advantage that the valve will be able to close again properly after opening.

These valves are successfully in operation at several urea plants already and in one plant these pressure safety valves opened during an upset condition in the process. When they routinely send the valve to workshop for revision, not any damage could be observed.

Please contact LESER for more information: Leser gmbH, I:www.leser.com, Mr. Andreas Caldonazzi, E:caldonazzi.a@leser.com

Mr. Mahmood Rauf Zafar of Fauji Fertilizer Company in Pakistan introduces an important practical problem and also provides a solution:

Urea Plant Pressure Safety Valves are prone to passing problems. This is more severe because to get confirmation if a Pressure Safety Valve is either passing or not, is a difficult job.

Following are the main reasons:

- PSV seat continuous steaming keeps downstream line in hot condition. Most of the time isolation of individual PSV steam is not fruitful due to other PSV's steam back flow from blow down header.
- Opening of PSV downstream line drain is also not fruitful due to vacuum in blow down vents.
- Sound checks are also not such helpful most of the time as steam flow or process flow misguides.

In my experience the only option is Lab sampling from individual PSV's downstream open drain. Any one who have best experience in this regard, please share.

In our plant we have changed Urea stripper vapor outlet PSV angle from ~75 degree to 90 degree of the line and now comfortable.

Mr. S K GUPTA of Iffco in India provides important information about his experiences with rupture discs:

We have used rupture discs upstream of the following safety valves, which earlier used to pass frequently (our plant is Saipem technology): CO₂ compressor 4th stage suction PSV and final discharge PSV and the high pressure ammonia pump discharge PSV.

We are facing problem of frequent passing of Hydrolyser PSV. We used a rupture disc in the upstream line of this PSV also but premature bursting of rupture disc due to corrosion is frequent. Problem remains as such. Any feedback for this PSV ?

Mark replies and asks some more information:

The hydrolyser PSV is in the gas phase, right ? Here condensation of carbamate gasses can cause condensation corrosion problems.

Which material you applied ?

Possible solutions are: use more corrosion resistant materials, proper tracing / insulation, is a flush upstream the rupture disc possible ?

How is your experience with the synthesis PSV ?

Any problems there ?

You have experienced ever premature opening of these PSV's ?

Mr. Girish Prakash of Tata Chemicals Ltd. in India shares his experiences:

With this arrangement, what is the average life you have achieved for the rupture disc installed? We have experienced premature lifting of Stripper PSV in one of our units (Saipem technology).

Mark asks some more clarifications:

Thanks Girish: How many safety valves you have at the stripper ?

Was the premature lifting during a start up situation ?

Did you have to refurbish the safety valve or did it close again ?

Which materials you use for stem and seat ?

Girish replies:

Most of the time it happened during the start-ups and/or immediately after start-ups. We have two pressure safety valves in the HP loop (one on the HP separator and the other on Stripper). This PSV was gaged and was inspected and recalibrated.

S K Gupta replies also:

Hydrolyser PSV is in the gas phase. Material for disc and seat is HVD-1 and for rupture disc it is 316L. Initially PSV for hydrolyser was installed at the pipe rack with about 6 meters of upstream piping. Frequent chocking in up stream piping was observed. Now we have put the PSV and rupture disc at hydrolyser body flange. Upstream part of rupture disc is too short for flushing requirement. Insulation is already there. We are getting maximum 5 to 6 months life of the rupture disc.

We also have some time faced passing problem of HP Stripper Off Gas PSV. We have low pressure steam jacketing for the PSV disc and seat. Steam temperature is 148 °C while Stripper off gas temperature is 190 °C. We think this steam in body jacket is helping in condensation of gasses on disc and seat and hence promoting condensation corrosion. What is your opinion in this regard ?

Mark comes back with his opinion:

I suggest to use MP steam for steam tracing in the HP synthesis section. Next question is what is the quality of the tracing installation and insulation. I suggest to contact the company Controls SouthEast who design and supply heating solutions especially for these cases (I: www.csi.com, Mr. Jim Hartman, E: hartman@csiheat.com).

Are the synthesis PSV's installed directly on the main pipelines ?

Which materials are applied ?

Mr. Amrit Ramnanan of IPSL in Trinidad and Tobago asks some questions:

What is your experience as to the cause of passing Synthesis Pressure Safety Valves? Is it because the seat often gets damaged due to crystallization due to periodic moments when/if the relief lifts and reseats?

At site our PSV's are steam jacketed and there is also a steam purge on the outlet piping to prevent crystallization. But this does not prevent the PSV from passing. On multiple occasions these were found to be passing. What are your experiences as to the cause? What is your experience and opinion of using the PSV with integral steam flush? Do you know any success stories?

Mark replies:

Yes, the LESER Safety Valves are a very successful innovation and have proven their success in several Stamicarbon urea plants already. During the AIChE Ammonia Safety Conference in Chicago in September 2012 the details were presented and the Technical Paper with all the detailed information is now available.