Reliable Pressure Measurements
in the Urea High Pressure Synthesis Section

Introduction

SKW Pieteritz in Germany has developed a reliable pressure transmitter for the high pressure synthesis section in any urea plant. This pressure transmitter has been developed as part of the Innovative Overpressure Protection System for high pressure urea synthesis sections, which is presented during the AIChE Ammonia Safety Conference 2012 in Chicago and offered by the Safety Valve producer LESER in Germany. It has been agreed between the parties involved that UreaKnowHow.com will offer the pressure transmitter itself to urea producers.

To measure in a reliable way the pressure in a high pressure gaseous carbamate line, several challenges are to be encountered: crystallization, erosion and corrosion risks. Also in liquid carbamate lines these risks are present. Solutions have been found to avoid these risks and these pressure transmitters are successfully in operation since September 2011.

Challenges to measure pressure in the high pressure urea synthesis section

LESER Support Loaded System Safety Valves are part of the Innovative Overpressure Protection System for high pressure (HP) urea synthesis sections. Refer to the figure on the right side showing the principle components of such a system.

It is important to assure that the pressure measurement system measures the same pressure, which is present at the safety valve. The available length of the capillaries is limited and it is critical that the distance between the control unit and actuator on the safety valve is limited to assure a quick enough reaction of the safety valve.
This means one should measure the pressure in the high pressure carbamate gas line on which the safety valves are installed. Gas phase high pressure carbamate lines are prone to several risks like crystallization of carbamate and condensation corrosion caused by condensed carbamate. Crystallization and corrosion risks at the diaphragm are avoided by special design and construction details of the manifold and pressure measurement itself.

The pressure transmitter consists of a thin diaphragm, which is sensitive for erosion, corrosion and mechanical stresses. Using Hastelloy C 276 is not a good option as within less than one year the complete diaphragm was dissolved (refer to the picture right).

Using an AISI 316 diaphragm give a slightly better performance but still after some years on stream time the thin diaphragm is severely damaged (refer to the picture left).

Tantalum is a completely corrosion resistant in carbamate streams, so a perfect material to apply. Welding such a thin diaphragm is not a good idea as it will cause mechanical stresses, so another reliable way to fix the tantalum diaphragm has been developed.

The special design manifold assures that no dead volume is present at the diaphragm, so any risk for crystallization risks is avoided.

Pressure measurements:
- Three (1 of 3) measurements for SLS Safety Valve
- One measurement (PC1111) for process control
The figure above shows the principle of the pressure transmitter (left) and a picture of the tantalum membrane (right). This pressure measurement has proven to work very reliable and has an accuracy of 3%.

**Applications**

The pressure transmitter can be applied for several applications:

1. Measure the pressure of the urea synthesis section close to the safety valves
2. Measure the pressure of the urea synthesis section at any other location
3. Use the pressure transmitter for a Support Loaded System Safety Valve
4. Use the pressure transmitter for an instrumentation safeguard (high pressure switch which closes for example the heat input to the HP stripper)
5. Use two pressure transmitters to measure the level in the urea reactor

SKW Piesteritz operates three Stamicarbon CO₂ stripping plants. In all three lines these pressure transmitters are installed since September 2011. In two lines the pressure transmitters monitor the synthesis pressure and in the third line one pressure transmitters monitors the synthesis pressure and 1 out of 3 pressure transmitters are used to serve the Support Loaded System Safety Valves.

All pressure transmitters have been working successfully. The picture on the right shows the tantalum membrane after one year of operation.

In the turnaround of September 2012, also in the other two urea lines the Support Loaded System for the HP Synthesis Safety Valves are installed.

Reference document:
Contact

UreaKnowHow.com can supply to you the design and the supply of the complete pressure measurement system (manifold, pressure measurement, certificates etc).

In case you are interested to receive an offer, please contact:

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