



APPLICATION NOTE

Chemical

Differential pressure measurement for an ultra-high-pressure application in an oxo plant

- Upgraded high-pressure orifice measurement for aldehyde production
- Retrofitting the entire measurement setup enhanced plant safety and availability
- Hydrogen-ready PN700 (~10000 psi) measuring cell in weight- and space-saving design

1. Background

At one of its European sites, a global chemical company operates a plant for the large-scale production of aldehydes and alcohols via oxosynthesis as well as acetic acid esters (acetates). The production facilities are set up to operate almost continuously.

2. Measurement requirements

The oxo-products are derived through specific reaction types. In the production of aldehydes, special olefins are reacted with oxo gas which is a mixture of carbon monoxide and hydrogen gases. Depending on the desired outcome, at pressures ranging from 15...700 bar (218 to 10,153 psi) and at temperatures of +80...100°C (+176...212°F) those olefin catalysts are introduced to convert the gas mixture into aldehydes. A gas flow of approx. 7 kg/h (15.4 lb/h) is continuously discharged from the process in a controlled manner. This raw product is then purified by distillation at standard pressure or vacuum.



Previous DP transmitter before replacement

To achieve the best possible conditions for the various olefins, this plant features different types of processes. The chemical company can operate the plant at up to 700 bars (~10000 psi) for testing and research purposes. To monitor the gas extraction, the operator uses a flanged orifice plate with pressure rating PN700. The measurement takes place at a differential pressure of 0...500 mbar (~7.3 psi) and is monitored from a control room.

The previously used transmitter and orifice meter assembly with associated impulse lines and shut-off equipment had to be replaced due to measurement errors. Since the plant has a dedicated measurement and control department, the customer has a great deal of experience in manufacturing orifice plate meter assemblies for high-pressure applications, thus they opted to produce the retrofit assembly in-house. However, finding a suitable hydrogen-ready differential pressure replacement transmitter for high static pressures proved difficult.

KROHNE

3. KROHNE solution

KROHNE was able to supply the OPTIBAR DP 7060 differential pressure transmitter with the necessary PN700 pressure rating and gold-coated diaphragms for this hydrogen application. It was rigorously tested at the customer's test center.

Given its pressure rating, the design of the OPTIBAR DP 7060 is unusually slim for a DP transmitter. Considering its pressure rating, when compared to other dP transmitters, the design of the OPTIBAR DP 7060 is unusually slim so its low weight and reduced size initially led to an increased need for more information for the customer's technical evaluation. The full test reports and complete device documentation supplied by KROHNE were able to quickly address all open questions relating to the unit's very slim design.

Once successfully tested, the pressure transmitter was qualified and approved for continuous differential pressure flow measurement with a design pressure of 700 bar at the Oxo plant. The device was subsequently installed and commissioned in the plant and the customer's technical staff adapted the pressure tapping, including the impulse lines, all on their own.



Retrofitted flange pressure tapping



OPTIBAR DP 7060 DP transmitter with space-saving design and PN700 pressure rating

4. Customer benefits

The onsite technical department responsible for the oxo plant is very satisfied with the KROHNE DP transmitter. The new measuring device ensures and substantially improves plant safety and uptime.

To further increase long-term stability and process reliability, the OPTIBAR DP 7060 was also 3D-linearised over the entire static pressure and ambient temperature operating range. Since all specified operating ranges are covered, a stable and accurate measurement can be guaranteed under all process conditions. As a rule, high line pressures and increased ambient temperatures have thus practically no influence on the measurement uncertainty.

KROHNE is now a well-accepted supplier of DP transmitters for differential pressure flow measurement in the Oxo production facilities. Many flow, level and process pressure measurements in the chemical industry are still done with pressure and differential pressure transmitters and KROHNE provides the full scope of state-of-the-art process measurement instrumentation. The OPTIBAR process pressure transmitters are SIL 2/3 certified with explosion protection and feature many communication protocols such as HART[®], FOUNDATION[™] Fieldbus or Profibus-DP.

5. Product used

OPTIBAR DP 7060

- High performance DP transmitter with integrated line pressure measurement
- Unique 3D linearisation for excellent measurement stability over the entire static pressure and temperature range
- Ex ia, Ex d approvals; SIL 2/3 certified
- 2-wire, 4...20 mA/HART[®], FF, Profibus-PA, Bluetooth



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