„Flooding impossible“

- Hydrostatic Measuring of Filling, Independent of Climate Conditions -

No more Drift Problems!

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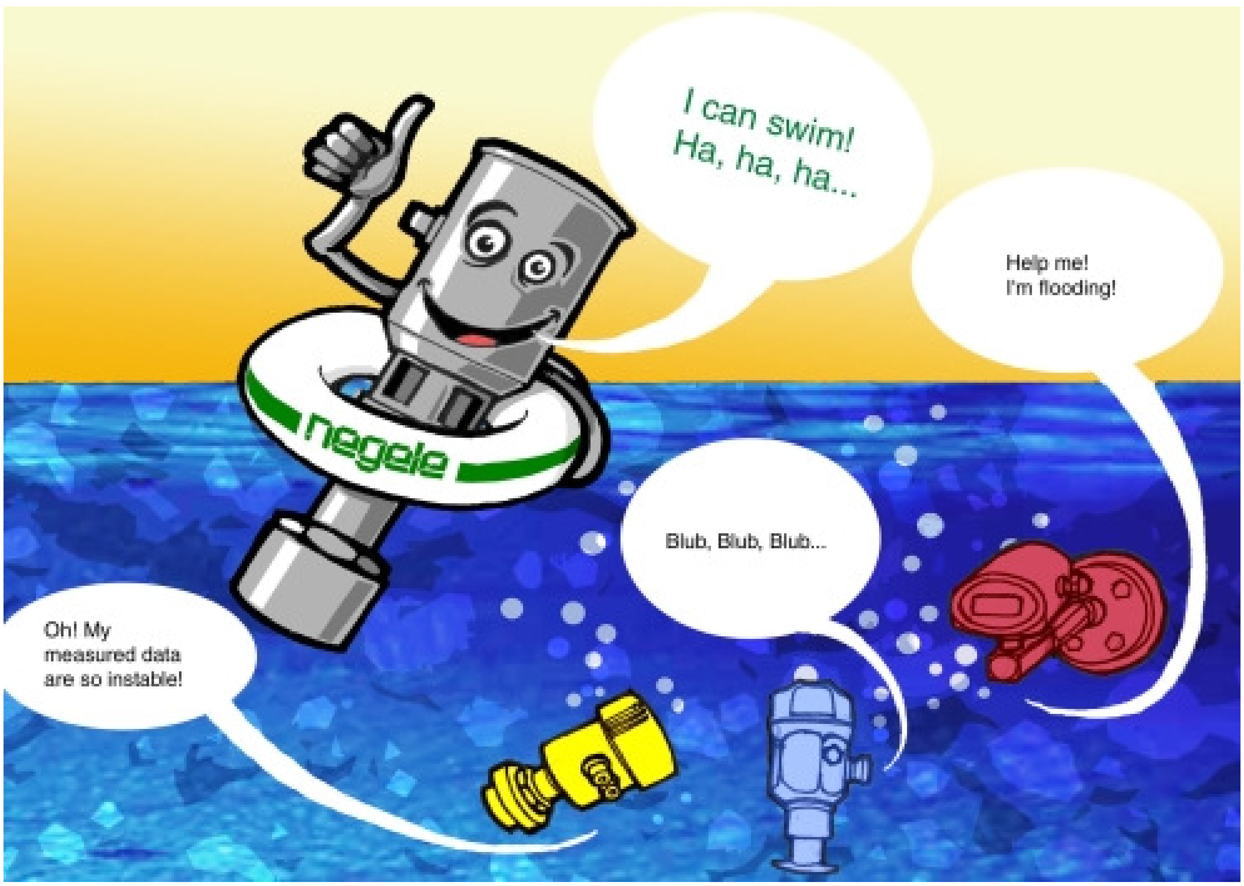

Future needs Quality

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„Flooding impossible“

Filling level measurements with hydrostatic pressure transmitters are widely used, similarly widespread with these sensors are, unfortunately, drift phenomena and unstable measurements. These problems become evident by the fact that after a certain period in operation the measured values are no longer credible. In principle the phenomenon occurs on all hydrostatic filling level sensors, independent of manufacturer. Here the reasons for this behaviour are investigated, and a solution is put forward.

Reason for sensor failures - problems associated with hydrostatic filling level sensors

Further analysis discloses that as a rule the sensors affected are those that are required to measure a cold product in very moist ambient conditions. In other words in operations such as are often to be found in breweries or dairies. What is the reason for these failures?

To answer this question it is necessary to understand the principle of hydrostatic filling level measurement. In the first instance a sensor is installed in the floor of the tank. The membrane of the sensor is loaded by the height of fluid in the tank as well as the air pressure. As is generally known air pressure alters with the height of the measurement location above sea level, but very significant variations in air pressure also occur as a result of weather conditions. For this reason these variations or differentials must be continuously compensated for. The following example makes clear the necessity for this so-called relative compensation: A 3 metres high milk tank, vented to atmosphere, produces a pressure loading on the membrane of 300 mbar. Between meteorological conditions of high and low air pressure a pressure difference of as much as 50 mbar can occur, which here can lead to an error of more than 16 %.

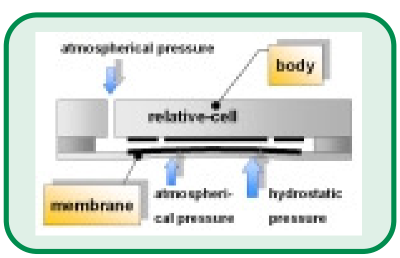

Fig. 1: Principle of Relative pressure cell

Basically there are two solutions available on the market

There are two types of sensors that are independent of climatic conditions:

Hydrostatic level sensor LAR-361 from Negele Messtechnik

1) a pressure measurement cell with a compensation capillary to compensate for atmospheric pressure, and
2) a double membrane, in this case fitted, however, with a Gore-Tex filter as a moisture barrier.

In the case of the so-called relative pressure measurement cells with a compensation capillary a thin tube directs the atmospheric pressure from the environment on to the rear face of the measurement membrane. Since the air pressure is now exerted on both faces of the membrane, only the hydrostatic pressure that is actually of interest, that of the medium in the tank, contributes to the resultant measurement signal (Fig. 1).

In the other method using a sealed relative pressure measurement cell and an in-built Gore-Tex filter one pressure membrane measures hydrostatic pressure and the other measures atmospheric pressure.

Both methods have however a crucial disadvantage: the diffusion of gaseous water vapour through the membrane cannot be prevented. In particular for the operating conditions already described where there is a cold medium in the tank and moisture outside the tank a problem now arises: vapour passes through the Gore-Tex filter element and condenses at the coldest location as soon as the temperature falls below the dew point. This coldest location is unfortunately the measurement cell itself. Since the condensation process develops a momentum that is, so to say, self-perpetuating, a not insignificant quantity of water collects in the measurement cell. The moisture inside the measurement cell leads to sensor drift, fluctuations in measured data, and eventually to the destruction of the cell. (Pic. 1)

The simplest solution, one that is not very helpful for the facility operator, however, is to limit the permissible ambient moisture in the technical specification to the typical value of 80 % relative humidity quoted by some manufacturers, including some leading names. Better advice, although still not very practical, is the suggestion that the capillary line should terminate in a dry room space.

How does the condensate form (saturated water vapour)

Dew point, dew point temperature: temperature at which, in a gas-vapour mixture, the gas is just saturated with the vapour. With cooling below the dew point condensation of the vapour occurs as a result of super-saturation, i.e. the gas-vapour mixture releases fluid. In the case of water vapour in the air water droplets form, e.g. in the form of dew. Where there is water vapour in the air the dew point is reached when the relative air humility is 100 %.

Negele sets a new standard - previous problems are now a thing of the past

With the LAR-361 hydrostatic filling level sensor, newly introduced into the market, the actual internal measurement

Pic. 1: Condensation at the level sensor LAR-361

system is hermetically welded up such that any penetration of gases is completely impossible.

However even in this relative pressure measurement cell compensation for air pressure still takes place. This is made possible by means of a simple trick: the air pressure is exerted upon a second measurement cell. The latter directs the air pressure via a small tube filled with oil on to the rear face of the process pressure measurement cell. As already described above, the measurement signal is provided solely by the hydrostatic pressure that is of interest. The special feature here is that the air pressure cell and the process pressure cell are hermetically sealed and hydraulically connected. This comprehensively excludes the entry of moisture into this sensitive region. The problem is therefore attacked not in its effect, but at its cause. FDA-listed mineral oil serves as the hydraulic coupling medium (Fig. 2).

To carry out the temperature compensation that is also required, appropriate sensors are fitted to the measurement cells. The sensor can therefore be operated under all moist and wet installation conditions, both internally and externally, for which conventional sensors have only a very limited service life.

Typical areas of application and operation

In general the filling level sensors in the LAR-361 build series are suitable for all hydrostatic filling level measurements for which high levels of stability and long service life are more important than the lowest possible price.

A further, very common area of application is in dairies and breweries, since the operating conditions with a cold product and a warm and moist environment provide the ideal prerequisites for condensation on the sensor.

Alongside the storage of media in buffer tanks, storage tanks and reservoirs, the same conditions for condensate formation apply also for tanks in external areas, such as are to be found, for example, in breweries, dairies and mineral spring plants.

Not least, in areas with a hot moist climate the stability of the LAR is outstanding, thus enabling the task of sensor replacement in distant countries, unwelcome on account of the high costs involved, to be avoided.

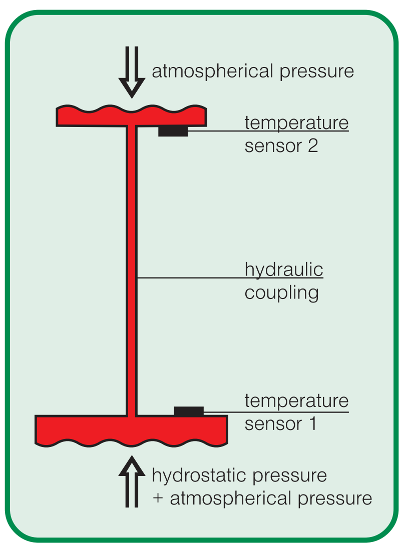

Fig. 2: Hermetically closed double membrane of the LAR-361

Needless to say the content in pressurised tanks can also be measured. With downstream evaluation units such as the pem-dd tank contents can in this manner be determined without a PLC, and non-linear tank geometries can also be linearised.

Further areas of application

Quite different applications, for which the filling level sensor LAR-361 is just as well suited, are the measurements of tank content for very hot products, such as for example during the manufacture of preserves, which must be boiled, as is generally known, or also in the wort pan during the brewing process. Conventional sensors are temperature-compensated up to a material temperature of approximately 80 °C; at higher temperatures the accuracy is dramatically reduced. The sensor presented here is compensated up to 120 °C; it can withstand a medium temperature of 130 °C without incurring damage. A sterilisation temperature of 140 °C for 30 minutes is of course also not a problem.

Further advantages offered by Negele's LAR-361

- metal membrane with Ra < 0,4 µm in contact with the product fulfils the highest aseptic demands
- IP 69K protection, and thus protected against water during high-pressure and steam jet cleaning
- can be variably adapted to each process by means of an extensive range of process connection designs

Summary

This filling level sensor, fabricated completely from stainless steel, covers all relevant fields of tank content management from 0.1 to 3.3 bars and can also be calibrated in the field.

The design fulfils the most stringent hygiene requirements, as does every sensor from Negele, and is fully CIP/SIP-capable. This is confirmed by expert reports and certificates from EHEDG and 3A.

Further information

Further informations are available at the internet at www.negele.net or with the feedback form on page 4.