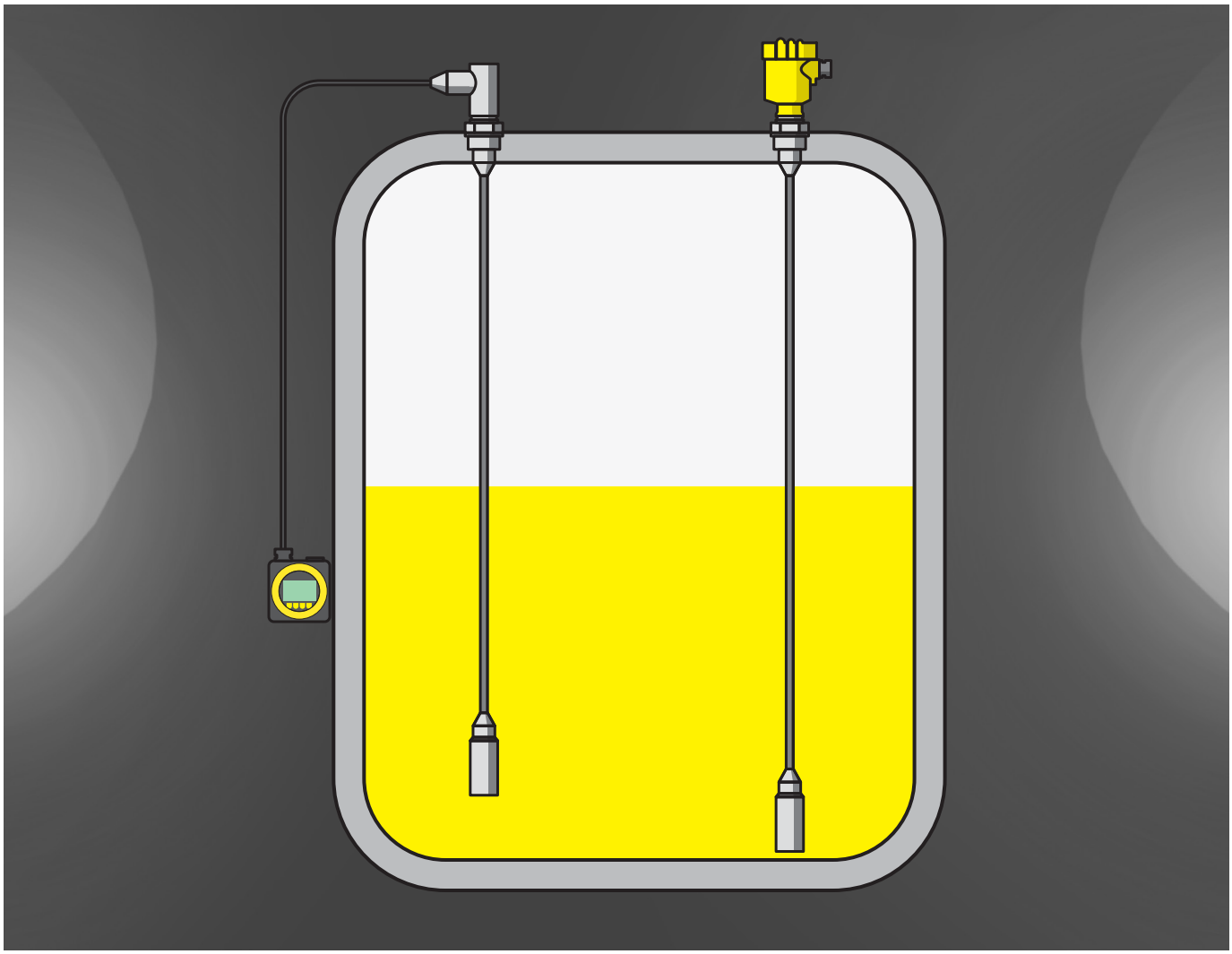

Level Measurement 101:

The Case for Hydrostatic Pressure

Pressure is one of the oldest, most trusted process measurements. Walk into any plant and you are bound to find a pressure transmitter somewhere. In my many years working with pressure instruments, I've seen them used in dairies, in oil refineries, in chemical facilities, and beyond. One reason for the ubiquity of pressure sensors is their versatility; they can do so much, including deliver a consistent level measurement.

This paper explains how hydrostatic pressure can be used for liquid level measurement, its advantages and limitations, and common industrial applications where it can be found.

How hydrostatic level measurement works

Hydrostatic pressure refers to the mass of a stationary liquid at a given point of measurement. As level increases inside a tank, the hydrostatic pressure increases proportionally. Thus, the higher the hydrostatic pressure measurement, the higher the liquid level measurement.

Making this measurement requires installing a pressure transmitter on a tank so the instrument's measuring cell is submersed in liquid. The transmitter measures hydrostatic pressure and converts it to a level measurement of the fluid above the sensor based on the fluid's density.

What are the advantages of hydrostatic level transmitters?

Hydrostatics have been in use in the process control industry for a long, long time. Thanks to this history of success, they are field-proven and familiar to users in many industries. Hydrostatic level instruments provide a reliable, accurate liquid level measurement even through adverse conditions in a tank such as foam, agitation, and obstructions. Users do not have to consider the dielectric constant of a product, and the instruments are easy to calibrate.

While hydrostatic level measurement is a process automation mainstay, the sophistication of the sensors is constantly increasing. Users are now empowered to choose the best measurement cell material for their process. For example, VEGA offers metallic measuring cells users have experience with and dry ceramic measuring cells for abrasion resistance and durability. Process conditions and the composition of the measured liquid will influence which cell material users should choose.

Comparing metallic and ceramic measuring cells

Traditionally, pressure sensors include an oil filled metallic diaphragm that separates the measuring cell from the process fluid. Metallic cells are a popular choice for liquid level because they are available in a variety of materials and it is easy for users to find one compatible with the product they need to measure. There's practically a metallic cell for every process. Despite their popularity, such sensors do have their weaknesses.

These instruments use filling oil to act as a transfer medium to move pressure on the diaphragm to the measuring cell. To allow the oil to transfer, the metal used for diaphragms is thin and fragile, which leads to quick wear and tear. When metal diaphragms fail, oil contaminates process material and users may lose an entire batch of product. A manufacturer cannot sustain such waste for very long. Making the situation worse is the fact that users often don't know failure has happened until it's too late—by the time anyone is aware there is a problem, the process is contaminated, and the metal diaphragm is ruined. To avoid these costly catastrophes, users are turning to pressure sensors with ceramic measuring cells.

Ceramic, by its very nature, is abrasion-resistant. The material's tight, dense matrix makes a ceramic diaphragm 10 times harder than stainless steel. This extra strength is advantageous because it makes ceramic better-suited to withstand harsh environments, including slurries, mines, and paper production—any application where liquid moves solids.

The ceramic cells we provide at VEGA are "dry" cells, meaning they do not use filling oil to measure pressure. Instead, ceramic cells use a capacitive measurement at the point of pressure. This means there is no need for thin material that wears easily, and it also means the process will never be contaminated with filling oil.

There are other reasons users may choose a pressure sensor with a ceramic cell, including minimal drift, the ability to output a temperature reading, and compatibility with nearly any liquid product. Metallic measuring cells are installed successfully in thousands of applications and users who are happy with their performance should continue using them. However, any users who have experienced any difficulties with measuring hydrostatic pressure should consider ceramic as a solution.

Common applications for liquid level measurement using hydrostatic pressure transmitters

Calculating hydrostatic level accurately means having a known specific gravity or density measurement for the product inside the tank or vessel. Because of the importance of this value, hydrostatic transmitters are used in applications where specific gravity and temperature (because it changes liquid density) are consistent and predictable.

Hydrostatic transmitters are found in all industries around the world. This "simple" device is used as the basic level measurement for everything from open pits and ponds to batch processing tanks to high capacity storage vessels.

Limitations of hydrostatic sensors

Limitations of hydrostatic sensors are as straightforward as the measurement itself. Installing a sensor may mean stopping the process and draining the vessel of product. Further, installing something at the bottom of a vessel could result in a leak path. Users may also incur the expense of a valve in case the sensor needs to be replaced during normal operation.

All of these limitations can be overcome by using a "top down mounted sensor." VEGA offers such a sensor with a ceramic diaphragm. These sensors utilize process connections at the top of the vessel and allow for full submersion into the fluid to make the measurement. This also allows the user to get the "zero" point further down, closer to vessel bottom making virtually 100% of the process fluid usable.

Hydrostatic transmitters work best when specific gravity and product temperature are consistent, so if either one of those conditions is in frequent flux, getting a consistent level output is possible but time-consuming with one hydrostatic sensor. But there is another way.

When density is changing and affecting the level measurement accuracy, differential pressure can monitor the changing density and compensate the level output. VEGA offers electronic differential pressure for this type of measurement, which means no capillaries are needed for remote seal installation and the level remains accurate independent of the density changes.

Conclusion

There's a reason a pressure sensor can be found in almost every plant: Pressure is a trusted technology. It's easy to see why. Understanding the relationship between hydrostatic pressure and liquid level is easy and the sensors themselves are relatively hands-off if the product's temperature and density remain consistent. For a consistent, economic, low-maintenance level output, there is a strong case to be made for hydrostatic pressure.

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