Rising to the Occasion:

How through-air radar is changing the liquid level measurement paradigm

Using a through-air radar sensor to measure liquid level is easy sometimes. Media is stable and behaves accordingly. Temperatures and pressures stay at a nice, predictable constant. Vessels offer plenty of space and a clear path for microwaves to travel without noise-inducing obstructions. Sometimes using a radar sensor for liquid level measurement is child's play. Sometimes. But not always.

Other times, repeatedly and accurately measuring liquid level with a through-air radar sensor demands critical thinking and creative problem solving. Media is difficult and unreflective. Temperatures and pressures rocket up and down. Vessels are crowded with agitators, baffles, or other obstructions. Sometimes using a radar sensor for liquid level measurement is challenging. Not always. But sometimes.

Fortunately for engineers, technicians, and other users inside chemical plants, those challenging times are becoming more and more seldom as radar level measurement technology has advanced. Improvements in sensor materials, dynamic range, and transmission frequency have made daunting level measurement tasks far more manageable. This paper reviews three classically challenging chemical applications and explains why they are not as difficult as they used to be.

Chlorine level measurement

We'll start with a challenge to a radar sensor's material integrity. Chlorine production and storage places high demands on a level detector's chemical resistance. One must be careful about selecting an instrument's sealing materials to ensure its long-term use, and this decision can affect the plant's entire operation. An interruption to production comes at a great expense to the chlorine plant; thus, the reliability of instrumentation is a top priority.

Through-air radar sensors have the advantage of operating without contacting the media, freeing them from regular exposure to corrosion and harm. Still, things happen; for example, liquid chlorine can splash against an antenna. Instrumentation manufacturers protect their sensors from such mishaps by offering chemically-resistant seals. At VEGA, for instance, we offer an eight millimeters-thick PTFE disc to protect our radar antennas and extend their lives.

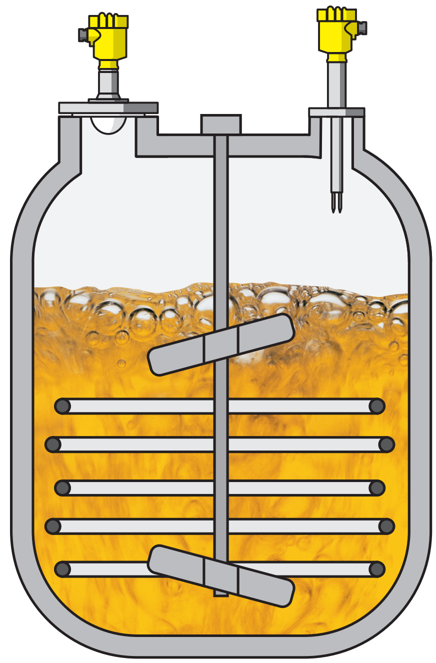
Chlorine measurement gives us the opportunity to discuss another way through-air radar sensors are rising to the challenges of modern chemical production. Chlorine is one of many liquids that is chemically difficult to measure, often due to a low dielectric constant. Liquids with a low dielectric constant—chlorine's dielectric value is 2—do not reflect radar signals well, making them resistant to radar technology. This resistance, however, can be overcome with large dynamic range.

A sensor's dynamic range is incredibly important, as large dynamic range ensures measurement certainty and makes a device suitable for a broader range of chemical applications. The greater a sensor's dynamic range, the more reliably it can measure media with poor reflective properties, including those with a low dielectric constant. Market-leading through-air radar sensors can measure anything, even chlorine.

Reaction vessels

Conditions are volatile inside reaction vessels. Media is changing, process pressures and temperatures are in flux, and the agitator spins relentlessly. This is a big engineering challenge, because any radar sensors used to control the process need to deliver reliable measurements under these adverse conditions. This is not as big of an ask as it used to be.

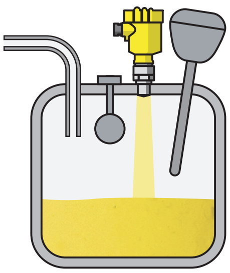
Modern radar level detectors are built to withstand extreme temperatures and pressures. Instrumentation suppliers understand the stress their sensors will undergo in application and design them to handle the strain. An agitator is another matter; not all radar sensors can cope with that.



Rotating agitator blades take up a lot of real estate and do not leave much room for a microwave beam to emit from a radar antenna, hit the product surface, and reflect back to the antenna without interference. The beam angle was just too wide. That is, until 80 GHz radar sensors hit the scene. These higher frequency devices produce a beam angle as narrow as 3°. This unrivaled focus makes it possible to use a through-air radar level sensor on a reactor, even as the agitator spins.

Small batch vessels

Many chemical manufacturers are turning to batching as a means of increasing the efficiency and lowering the costs of making seasonal or low-demand products. Typically, these processes occur in smaller vessels. Space is at a premium for small production setups and limited quarters often prevent operators from even considering radar for level measurement. Radar pulses need to be focused with an antenna to ensure they direct at the media and don't go scattering all over a vessel. Larger antennas, however, can be too long, and consume too much valuable space for practical use in a small vessel.



It behooves small-batch producers to choose a radar sensor with the smallest possible antenna. This is another case where higher transmission frequency is a benefit, as frequency and antenna size have an inversely proportional relationship. The VEGAPULS 64, for example, features a high frequency and the world's smallest antenna; it is situated inside the sensor's process fittings, allowing operators to capitalize on as much vessel space as possible.

Conclusion

Chemical composition, vessel internals, and vessel size no longer prevent chemical manufacturers from using through-air radar technology for liquid level measurement. Thanks to advancements in sensor construction, dynamic range, transmission frequency, and antenna size, radar is almost always a viable option. Not always. But almost.

Authors:

Matt Stewart
Chemical Industry Manager
VEGA Americas

Greg Tischler
Radar Product Manager
VEGA Americas