Advantages of VEGA's 80 GHz through-air radar

Accurate, reliable and less burdensome than ever

Radar is one of the most common level measurement technologies in the instrumentation market. Whether measuring liquids or solids, from chemical plants to wastewater facilities and for ready-mix cement manufacturers, radar provides accurate, reliable level measurement without the need for ongoing maintenance and frequent recalibration. Radar sensors are not only a trusted means of pinpointing level control; they are easy to use as well.

When the process automation community discusses radar for level measurement, the conversation veers in one of two directions: through-air radar and guided wave radar (GWR.) This article explains how through-air radar operates and it's advantages and limitations in industrial applications.

How through-air radar works

Radio microwaves are transmitted by the antenna system of the sensor to the measured product, reflected by the product surface, and received again by the antenna system. The microwaves travel through the air, hence the label, through-air radar. The time of flight from emission to reception of the signals is precisely proportional to the distance to the product surface: The longer the time of flight, the greater the distance. This distance is inversely proportional to the level in the tank. The greater the distance, the lower the level.

Many parameters determine the strength of the signal returned to a radar sensor. An agitated, turbulent surface will affect the reflected signal strength, and distance to the product surface will, too. Even normal process conditions such as build-up on the antenna system may influence a return signal. Signal strength also depends partially on chemical composition, as not every product reflects microwaves equally.

Conductive products reflect almost all microwave energy and non-conductive products reflect only a portion of the energy. Non-conductive products with low dielectric constant, oil for instance, produce weaker signals than those with high dielectric constant, such as water. The range of signals a radar sensor can detect is called its dynamic range. Sensors with large dynamic range are sensitive enough to register weak signals as well as strong ones. Radar sensitivity varies from manufacturer to manufacturer and they even differ from sensor to sensor in a manufacturer's instrument line.

The focus of the microwave beam depends on a radar transmitter's antenna size and its transmission frequency. The smaller the antenna, the wider — and less focused — the beam. The larger the antenna, the more focused the beam. That's why the development of liquid level sensors operating at a transmission frequency of 80 GHz was such enormous news in the process automation industry.

The same directional performance and measurement certainty available from guided wave radar (GWR, left) is now available in a non-contact, 80 GHz through-air radar devices such as VEGAPULS 69 (right).

Radar level measurement with 80 GHz

At VEGA, we have seen the practical benefits of our 80 GHz level sensors, the VEGAPULS 64 and VEGAPULS 69, in over 70 000 installations worldwide, every year. In containers and silos with many internal installations, enhanced focusing helps reduce the influence of noise created by microwave energy reflecting back to the antenna from something other than the product surface. Noise is commonplace in vessels with agitators, baffles, or heating coils, and the walls of the vessel itself sometimes create it. Noise is a problem because it distorts level measurement, but it can be overcome.

Advantages of through-air radar sensors

The most obvious advantage to using a through-air radar sensor is that it is a non-contact level measurement that requires less maintenance due to a lack moving parts and a lack of contact with corrosive product. Users also do not have to worry about the level sensor being damaged or blocked by adhesive solids.

Through-air radar sensors are unaffected by fluctuating product properties or by changing process conditions such as temperature, pressure, or intense dust generation because they use radio waves to make a measurement. Few process variables can disturb the flight of a radio wave, making through-air radar sensors a reliable option for level measurement.

The VEGAPULS 64 is ideal for continuous level measurement in small tanks where the small process fittings offer special advantages. Excellent signal focusing enables its use in vessels with internal components such as stirrers and heating spirals.

Another benefit of using a through-air radar sensor is that initial set-up and adjustment can be done while the vessel is in use. Installing a level device without stopping the process saves time and avoids the costs of a shutdown.

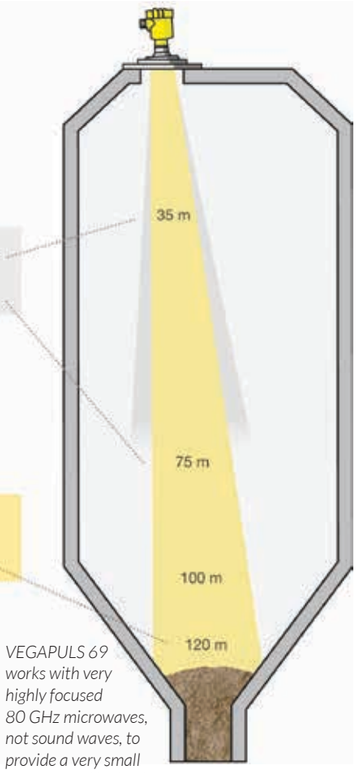
Common applications for through-air radar

Radar level transmitters are used for non-contact level measurement of liquids and bulk solids, even under high pressure and at extreme temperatures. They can be used in simple as well as aggressive liquids and are suitable for applications with stringent hygiene requirements. Radar level sensors measure light as well as heavy bulk solids with absolute reliability, even in the presence of dust and noise, without being affected by build-up or condensation.

Limitations

Through-air radar has tremendous capabilities and offers many benefits to users. However, through-air radar is not a level measurement panacea; it's not right for use with every product.

In applications with rampant, heavy foam, radar is sometimes not the right solution because microwaves can be absorbed right into the foam. Another limitation is that, in order to use radar for level sensing, a user must have a connection at the top of the tank. The connection can be small, but it has to be present. Through-air radar is a great fit for the vast majority of applications, even ones with foam, but not all of them. Users would be wise to discuss the specifics of their level application with their instrument providers before choosing a technology.



VEGAPULS 69 works with very highly focused 80 GHz microwaves, not sound waves, to provide a very small beam angle (3.5°), along with optimised sensor performance for solids handling.

Conclusion

There has never been a better time than right now to use through-air radar for level measurement. The instruments are more focused than ever before, making them a reliable option in vessels with obstructions or applications that require isolation valves.

VEGA and other instrumentation manufacturers are pairing this hyper-focus with incredible sensitivity and intelligent software so users can measure non-conductive products and suppress noise from false signals. High transmission frequency sensors have made antenna sizes smaller than ever, so retrofitting and mounting are less costly and less burdensome than ever before.

Any users who have shied away from radar in the past should rethink their position, while users relying on older radar sensor should consider an upgrade. The new instruments are now very good. ❑

After reports of success on valves in the field, VEGA tested the VEGAPULS 64 in its Learning Centre Lab and saw impressive results. The tests revealed that level measurement through a valve is easy with 80 GHz devices and impossible with GWR.