APPLICATION

Guided Wave Radar Level Measurement Reduces Costs, Improves Accuracy in Wastewater Applications

Precise level measurement in the wastewater holding tanks is equally important when environmental regulatory compliance is on the line, and GWR level is often the most efficient and cost-effective technology for that application.

By Sumant Juvekar

GUIDED WAVE RADAR (GWR) level measurement is frequently associated with large tank farms and applications where precision level analysis is crucial to custody transfer or prevention of explosions or fires. But precise level measurement in wastewater holding tanks is equally important when environmental regulatory compliance is on the line, and GWR level is often the most efficient and cost-effective technology for that application.

Under stable storage conditions, some contents may enter the holding tank at higher temperatures and then cool. In the parts of the nozzles or stilling wells exposed to ambient conditions, heavy condensation or freezing of the material may occur on the instrumentation, potentially impacting level measurement. Because of accessibility reasons, only top-down level technologies can be used, such as mechanical level gauges or radars. Most plants with wastewater holding tanks will be faced with this choice.

In such applications, mechanical level gauges have the following limitations:

- Mechanical parts such as floats get stuck due to coating
- Ice forms in nozzles because of condensate freezing
- Accuracy is low due to changing product properties such as density
- An increased number of cables are used when transducers and transmitters have separate housings and terminals
- They require frequent maintenance

GWR technology provides a versatile, reliable solution:

- No mechanical parts
- Less sensitive to ice formation
- Accuracy independent of product properties
- Integral probe-transmitter solution
- Virtually maintenance-free

GWR is based on microwave technology. Microwaves are only affected by materials that reflect energy, which means that temperature variations, dust, pressure, and viscosity do not affect accuracy - an important factor in challenging wastewater holding tanks. In most wastewater processes, varying conditions are common, especially regarding temperature, density, and viscosity. Variations in level measurement can easily occur under these conditions, but the GWR technology is unaffected by these changes. The device does not need to compensate for changes in density, dielectric, or conductivity in the fluid, which makes this top-down measurement very robust.

When measuring tank levels, the GWR device sends a low-energy microwave pulse down a probe. When the pulse hits the media, a significant proportion of the energy is reflected back up the probe to the device. The level is directly proportional to the time-domain reflectometry.

GWR can also use a proportion of the emitted pulse that continues down the probe to detect an interface between two liquids. The ability to measure surface level and interface level between two liquids is particularly useful in wastewater applications that can potentially have more than one liquid (water mixed with other liquids).

One example is oil on water. When microwaves hit the oil surface, some are reflected and some continue through the oil. The reflected microwaves provide the level reading and the microwaves that continue through the oil will be reflected on the water surface, providing the interface reading.

One of the criteria for measuring levels of two liquids is that there should be a sufficient difference in dielectric constants (wave reflecting capability) between the liquids. Water has a high dielectric constant (80) and any other liquid floating on top of water can be expected to typically have a much lower dielectric constant. Therefore, this kind of application makes it a very good fit for level and interface detection by guided wave radar.

Note, however, the higher the dielectric constant, the stronger the reflection of the microwaves. Vacuum gives no reflection at all and has a dielectric constant of 1. Oil is approximately 2, and water around 80. A dielectric constant below 1.5 is often challenging to measure, so processing facilities should look for high-sensitivity guided wave radar level transmitters, which are able to handle such challenges.

The win/win, of course, is that with just one device, wastewater treatment facilities can measure both level...
for soundness and safety. Emptying the pits is extremely difficult, so this company, like many others, conducts regular “water logging” inspections. During these inspections, the pits are filled with water and left for a period of time, after which any decrease in the water level is measured using a level gauge and recorder. A significant problem, however, occurs because several steps of the wastewater treatment process need to be stopped completely during these inspections, delaying production. Therefore, the inspections must be performed as quickly as possible without raising costs or sacrificing accuracy. It was because of these demands that the chemical company decided on guided wave radar. Originally using level gauges, the inspection of the company’s four pits took two full days. After the installation of GWR, inspection time was reduced by 75 percent, and most significantly, inspections now only need to take place once a year - a dramatic cost saving.

When considering the use of GWR for interface level measurements, wastewater facilities need to consider these factors:
- The lower dielectric fluid detected, the upper fluid layer must be > 13 cm
- Target applications, upper layer dielectric (< 3) and lower layer dielectric (> 20)

For the Japanese chemical company, GWR proved to be a significant improvement over the previous test devices because of its accuracy and minimum maintenance. They compounded their advantages by choosing to use wireless technology for the installation. Because the transmitter is wireless, the original installation costs were low. In addition, transmitter locations can be easily changed, if necessary. The WirelessHART™ technology is unaffected by obstacles - which is especially important in an unpredictable environment like wastewater holding tanks. Their wireless technology is designed as a self-organizing network based on the IEC 62591 WirelessHART standard. The device is self-healing, secure, robust, and endlessly configurable. The mesh technology offers a data reliability of more than 99 percent that ensures an interoperable, adaptive, and flexible approach. For the Japanese company, using a digital signal - rather than 4-20 mA analog - to the DCS improved the repeatability from 5mm to 2mm. Because the inspection time is reduced by 75 percent, the cost totaled less than 30 percent of the original level gauges, resulting in savings of $9,000. The new system also reduced the number of inspection hours needed from 22 down to 5.5 and reduced the downtime of the wastewater treatment facility saving an estimated $27,000 per year.

Obviously, every wastewater treatment facility must evaluate their level measurement requirements based on individual parameters, but in many holding tank applications, the use of guided wave radar is a cost-saving, accuracy-enhancing choice.

About the Author
Sumant Juvekar is the Sr. Senior Business Development Manager, Rosemount Level at Emerson Automation Solutions. Emerson, headquartered in St. Louis, Missouri (USA), is a global technology and engineering company providing innovative solutions for customers in industrial, commercial, and residential markets. Its Emerson Automation Solutions business helps the process, hybrid, and discrete manufacturers maximize production, protect personnel and the environment while optimizing their energy and operating costs. The Emerson Commercial and Residential Solutions business helps ensure human comfort and health, protect food quality and safety, advance energy efficiency, and create sustainable infrastructure.