Foamy Liquids, Viscous Fluids, and Solids
3 Challenges for Level Sensing and the Technologies that Solve Them
Level sensors are an important part of the manufacturing processes in many industries—from food and beverage to pharmaceutical, agricultural to automotive. Measurements that previously required large, mechanical, and expensive devices can now be performed using advanced, highly-versatile technologies that are also durable, precise, and easy to implement. In a previous whitepaper, we shared eight common level sensing methods for reliable and cost-effective measurement.

In many cases, more than one technology can be used to solve the same level sensing application; however, for tougher applications, a single technology often stands out as the best choice. Traditionally challenging substances for level measurement include foamy liquids (beer, soap, caustic blends), highly viscous fluids (honey, sewage, industrial adhesive), and solids (grains, wood chips, injection molding pellets).

This white paper explains these challenges, the risks of choosing a poor solution, and the ideal technologies to solve them.

Challenge: Foamy Liquids
It can be especially challenging to accurately measure the level of liquids that produce foam (e.g., soap, beer, or caustic blends). For example, when using ultrasonic technology, the presence of foam absorbs the signal, preventing the sensor from accurately detecting level.

This leads to a risk of tank overflow, causing lost product, incorrect inventory, inaccuracy in mixing applications, or even safety concerns in the case of spilling caustic liquids like sodium hydroxide. Overfilling a tank or chamber can also damage other instrumentation if the level gets too high.

In other applications—for example, in the processing of milk—overfilling the tank may actually be desirable in order to eliminate unwanted foam. An accurate level sensing technology is therefore necessary to ensure that the amount of overflow is sufficient to eliminate the foam, but not so much as to waste product.

Solution: Guided Wave Radar (Guided Microwave)
Guided wave radar technology is a top-down, direct measurement technology based on the time domain reflectometry (TDR) principle that measures the distance to the product surface. This is accomplished by sending a microwave signal down a probe and measuring the amount of time it takes for the signal to be reflected by the target (surface of medium) and returned to the sender.
Traditionally, guided wave radar devices were unable to provide an accurate measurement in foamy applications for two reasons:

1. The dielectric constant (Dk) of the foam was not high enough to detect.

2. The radar signal travels faster through liquid than air. Because foam is a mix of liquid and air, the signal moves more slowly through the foam, tricking the sensor into detecting the level of the tank as lower than it actually is.

New advancements in guided wave, however, have enabled accurate level measurement in foamy applications. The key to success is sensor intelligence. Special algorithms in the sensor adjust for the dielectric constant (Dk) value of the foam and medium as well as calibrate the sensor to the change in the time of flight (TOF) signal. An algorithm that takes both of these properties (Dk and TOF principles) into account will allow for successful and accurate level measurement in foamy applications. Algorithms that take only one principle into account will not measure accurately.

Challenge: Highly Viscous Fluids

Highly viscous fluids like honey, industrial adhesives, and sewage pose an enormous challenge to any level sensing technology where the device comes in contact with the fluid. For example, when using a pressure measurement device in a heated process, there is the potential for the product to cool and solidify between the process and the pressure diaphragm of the device, causing an on-scale failure. Such an interference with measurement function could lead to loss of product due to unintended overflow or tank draining.

Similarly, industrial adhesives or sewage can leave buildup between the probes of a tuning fork. If product buildup continues to accumulate on the unit, the sensor could provide inaccurate measurements or remain permanently tripped. Heavy buildup can also be an issue for many guided wave radar products without an adjustable sensitivity threshold. Using a product that can withstand buildup is especially important in applications dealing with environmentally harmful materials, where it is crucial to ensure that tanks do not overflow.

Solution: Ultrasonic Technology

Ultrasonic devices gauge levels by measuring the duration and intensity of echoes from short bursts of energy. Because ultrasonic level sensors are non-contact, there is a reduced risk of measurement
disruption due to the accumulation of residue. Ultrasonic sensors are also ideal for measuring caustic and acidic mediums (for example, cleaning solutions that might erode metal).

When selecting an ultrasonic device, however, it is important to consider whether the sightline between the device and the liquid in the tank is obstructed by mesh, grates, chains, or other instrumentation. If there is an obstruction in the foreground, it is essential to choose an ultrasonic level sensor that features foreground suppression that can filter out interferences in order to maintain accurate measurement.

**Challenge: Solid Level Measurement**

Finally, solid level can be very difficult for many level sensing technologies to detect for a variety of reasons. For one, solid products are often extremely dusty (for example, bulk powders or wood chips). The presence of dust can degrade the signal strength of many level sensing technologies, including ultrasonic.

In addition, clear solids—like plastic pellets for injection molding—can essentially turn everything in the vessel into a lens, scattering the light source from a laser-based sensor causing false measurements to be read by the device. Furthermore, many bulk powder applications (for example, level detection of flour) require explosion-proof or intrinsically safe devices.

**Solution: Tuning Forks and Mono-Probe Tuning Forks**

Tuning forks are the top choice for sensing solid level because they rely on resonant frequency technology. The presence of material contacting the fork causes the frequency to change, indicating that the material has reached a certain level. A tuning fork offers point level detection only, which means that instead of detecting a range of levels, a single tuning fork simply detects whether or not the substance has reached a certain point.

For this reason, multiple forks are often used to detect level in a single tank. For example, one fork might detect when the level is too high in order to prevent overfill, and another fork is used to detect a low level. If necessary, additional forks could also be used to create warning levels (i.e., using extra forks to indicate that the tank is approaching the low or high level and may require action).

There are also two different types of tuning forks: traditional tuning forks and mono-probe tuning forks. Both types operate using the same resonant frequency technology. The difference is that the mono-probe produces the resonant frequency within a single probe.

At a lower price point, a traditional tuning fork may be the more economical choice, but in some instances, solid product can become lodged between the two probes, causing the fork to become
permanently tripped. For example, in bulk detection of small granular materials like corn, kernels can become wedged between the probes. In these types of applications, a mono-probe should be used to reduce the risk of false trips.

For more information about level sensing for challenging applications, please contact your local SICK sales representative, or email us at info@sick.com. You can also visit our website at www.sickusa.com

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