"Tiny" for special tasks

Precise level control through smallest openings

In automated filling and dosing processes, reliable inquiry of filling levels is usually required. However, the medium to be monitored and the container itself often present applications with challenges that can be overcome with special solutions.

A chemical company fills products into small glass bottles at an automatic dosing station. The bottles with openings the size of a test tube are transported by a transport unit to a dosing unit, where they are filled with an exact quantity of a clear, transparent liquid. The amount of product filled into each bottle must be absolutely identical. Therefore, each container should be certified for the correct filling level before closing.

Obvious, but not a solution

For this task, the company initially tested a cover-proportional light barrier (transmitter/receiver system) with a linear light beam, which was intended to detect the filling level laterally through the glass wall of the bottles. However, the transparent liquid inside did not allow sufficient damping and therefore did not provide a clear signal. Light refractions also made reliable fill level monitoring difficult.

Inquiries independent of media properties

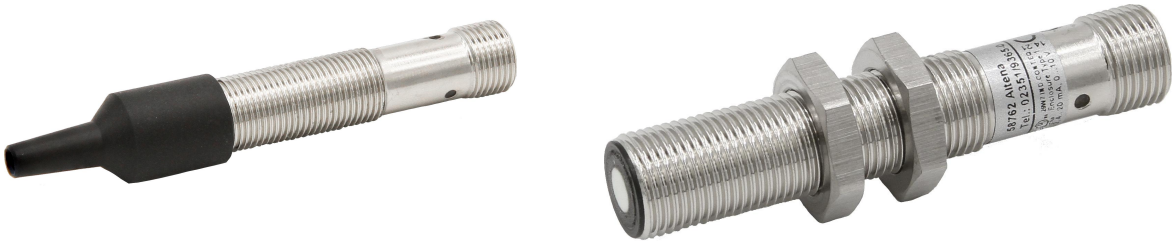
Due to the different challenges, the chemical company next opted for an ultrasonic sensor. The advantage of such devices is that ultrasonic can be used to detect filling levels in containers almost completely independently of the specific media properties. To check the fill level, it is necessary to position the sensor above the bottle opening, which in this case has a diameter of just 10 mm.

However, even this solution did not deliver the desired success. The reason: an ultrasonic sensor cyclically emits a short, high-frequency sound pulse. When this hits an object, it is reflected from its surface as an echo in the direction of the diffuse reflection sensor. The sound transducer integrated in the device simultaneously assumes the function of transmitter and receiver. After generating the sound pulse, the sound transducer therefore acts as a receiver for a short period of time. As the propagation velocity of sound in air is known, the distance from an object surface to the sensor can be determined by measuring the Time of Flight measurement of the pulse from transmitter to receiver. The first echo signal, i.e. the signal from the reflection surface closest to the sensor, is always evaluated, regardless of whether further reflection signals are received from more distant surfaces.

The decisive factor in the context of the practical example described is the surface of the sound transducer and the angle of beam spread of the emitted sound cone. As standard ultrasonic sensors have sound transducers with a comparatively large surface area depending on their size, the resulting sound cone of the sensor used also detected the edge of the narrow bottle openings due to its large angle of beam spread. The echo signal generated by the edge of the bottle was therefore the first received signal and was used to determine the distance. The result: the ultrasonic sensor only detected the distance from the sensor to the edge of the bottle.

Precise control through small openings

Although the attempts with the standard device failed, the choice of technology nevertheless pointed the right way. In the end, an ultrasonic sensor from the **UT12** series, which has a diameter of just 12 mm. The series offers solutions with switching output for position sensing **(UT129520)** and versions with analog output for distance-proportional measurements (e.g. for level detection) such as the **UT129021.**



The ultrasonic sensors in the **UT12** have a diameter of only 12mm. On the right the **UT129520** with digital switching output. Left the **UT129021which** is used by a chemical company for level control.

One series for many tasks

In the chemical company's filling plant, the filling level of the **UT129021** was installed directly behind the dosing unit to detect the fill level. The features of this device are the so-called beam columnator attached to the sensor head. The nozzle focuses the ultrasonic, creating an almost linear sound cone. This further reduces the angle of beam spread of the sound compared to a device without a beam columnator. This makes it possible to inquire filling levels in containers with very small openings. The resulting analog signal from the sensor, which is proportional to the fill level, is evaluated by the higher-level control (unit). The advantage: the reference value and the approval tolerances for the filling level can be set flexibly in the control (unit) so that different batches with different filling levels can be produced. Bottles with a fill level that is too high or too low are ejected from production by the system control.

The dosing unit itself is also equipped with a **UT129520** with digital switching output for presence monitoring is also installed on the dosing unit itself to ensure that a bottle is always in the desired position before the filling process.

Ultrasonic sensors of the series **UT12** in an automated dosing system: The device behind the dosing unit checks the filling levels from above through the small bottle openings. Another sensor with switching output is used for presence monitoring. (All images: ipf electronic)