Baumer

Sensor Solutions
Motion Control
Vision Technologies
Process Instrumentation

Application report:

Greater Sensing Distances for Capacitive Sensors:
Level Monitoring With an Expanded Application Spectrum

It is hardly surprising that capacitive sensors are seen as the true allrounders when it comes to level monitoring: They are rugged and can be employed for a variety of applications because they are capable of detecting both metallic as well as non-metallic objects, are not afraid of direct contact with the media, and can peer through (non-conducting) container walls. However, since their measurement field is occasionally too small, conventional shielded mount sensors do not allow every task to be satisfactorily resolved. Baumer, the sensor specialist has reacted accordingly and brought its new CFAK line of capacitive sensors to the market; sensors which, thanks to their "external ground electrode" can operate over sensing distances of up to 30 mm. These rugged sensors designed for non-shielded mounting are available in a variety of sizes with either a fixed or adjustable sensing distance. They are encased in a rugged PBT plastic housing which also allows them to come into direct contact with inks, mineral-based oils, alcohol and (weak) acids or bases. Of course, the new sensors are also "in the know" when it comes to (non-conducting) containers. Aside from packaging, plastics and graphics equipment, other typical areas of application also include the broad fields of process or laboratory automation as well as wood processing.

Figure 1: The new, non-shielded mount sensors from the CFAK line.

The choice of the correct level sensor is always determined by the type of medium being monitored and the specific application conditions. Nonetheless, capacitive sensors which operate contact-free and can be employed in a number of applications are the true allrounders in the area of process technology. They are attractive thanks to their excellent price/benefit ratio, their high level of process security and their low maintenance expenditures. Since development in this area has not ceased, their already broad spectrum of potential applications should only continue to enlarge. The latest generation of capacitive level monitoring sensors already operate with greater sensing distances and are therefore suitable for what had, until recently, been considered to be more difficult applications.

Capacitive sensors bring a variety of benefits to the field of level measurement. They are extremely rugged and can be employed for a variety of applications, particularly as they are suitable for detecting the levels of both metallic and non-metallic objects. Normally, their active surface contains two electrodes arrayed concentrically, thus acting as a single, flipped open capacitor. Since the measuring zone's capacity changes depending on the sensing gap and the measured object's material, this allows the sensors to determine the dielectric characteristics in their environment. The capacitive sensor's capacitor creates a dispersion field. This field is part of an oscillating circuit which begins to oscillate as soon as an object or a medium enters it. The resulting current change is analyzed by the unit's electronics and, once it reaches a predetermined level, allows the output to switch.

"Peering" Through Walls

Since the measuring field can penetrate non-conducting materials such as glass, plastic or cardboard, capacitive sensors are also able to detect through these types of walls. This makes them particularly suitable for level measurements of liquids, pastes or bulk materials where the material in question must be detected through the container wall. In turn, this provides the following practical advantages:

The sensor does not need to come into direct contact with the medium – particularly practical when it comes to aggressive media. There is no risk of adhesion or dirt. Combined with their reduced maintenance expenditures, this results in a significantly higher level of process security. At the same time, this type of mounting also prevents the medium from becoming contaminated by the sensor.

Greater Sensing Distances Thanks to an External Ground Electrode

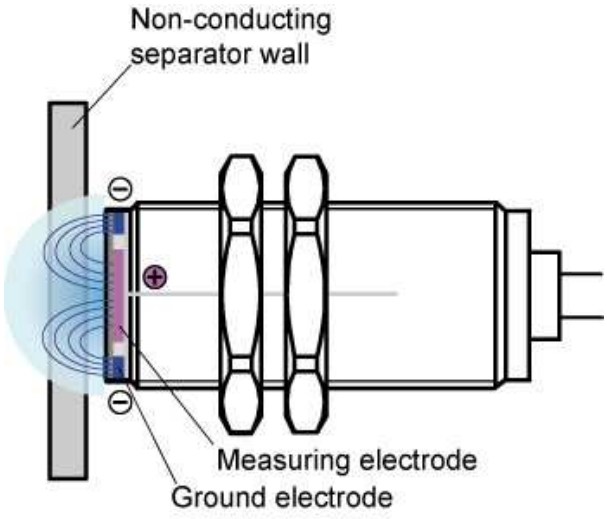

Figure 2: Previously employed shielded mount capacitive sensors possess only a limited sensing distance.

Unfortunately, conventional, shielded mount sensors are unable to satisfactorily resolve every application encountered in level measuring. This is already apparent from the size of the measuring field (Figure 2). The advantage of the clearly defined ground electrode can prove to be disadvantageous as it limits the sensing range. Baumer, the sensor specialist, has reacted accordingly and introduced its new line of CFAK capacitive sensors to the market. Thanks to their significantly greater switching distances, these sensors are now also suitable for applications with media such as alcohol or ink, previously considered too difficult. Compared to their predecessors, these non-shielded mount sensors work with a significantly larger measuring field (Figure 3). They are suitable for direct media contact but can also be “in the know” outside containers. If the sensors are to be mounted outside a given container, the container walls can even be somewhat thicker since sensing distances between 4 and 30 mm give their users an adequate amount of play.

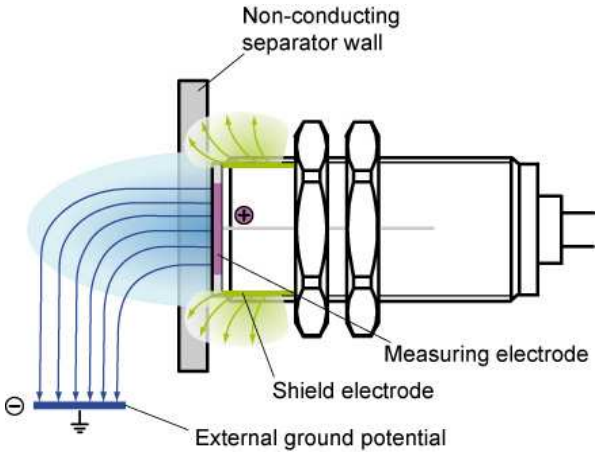

Figure 3: With the new sensors, the ground electrode in the form of the medium or a grounded object is located outside the sensor itself, thus offering a significant increase in the sensing distance.

The technical background behind the new generation of sensors is easily understood: Only the measuring electrode is actually housed on the active sensor surface area of the new generation (Figure 3). The ground electrode required for the measurement lies outside, significantly increasing the sensing range. The additional shielding field also helps shield the measuring field from the electronics and compensates for dirt and media residue on the sensor surface. Typical applications for the latest capacitive sensor generation are therefore greatly multiplied since an opposite number which can function as the second capacitor plate can be found in most applications. Because the sensors are also offered in M12, M18 as well as M20 designs, the end user also has a greater choice of active surface areas. The sensors are available with either a fixed or a selectable sensing distance. They are encased in a rugged PBT plastic housing capable of handling direct contact with inks, mineral-based oils, alcohol and (weak) acids or bases.

Practical Application Examples

In order to ensure a proper ink supply, the fill level in a printing machine’s containers must be monitored. The employed inks come in a variety of colors and are either water or solvent based. Fill level monitoring is performed by capacitive sensors. These can be easily mounted under conditions of limited space, their color independent measurement principle ensures a high level of process security while even direct

contact with the medium will not result in any sensor damage as the plastic material is impervious to solvents. These same properties are also useful when it comes, for example, to roller offset presses (Figure 4). Here, the capacitive sensor servers to continuously monitor the color tanks.

Figure 4: The fill level in even large color tanks can also be monitored by capacitive sensor.

Other application areas are as widespread as sand on the beach: The spectrum ranges from packaging technology through to laboratory automation, i.e., wherever liquids must be transported, drained or filled. In these cases, measurements made through the tank wall prevent any contamination of the raw materials. And since capacitive sensors are also available for high-temperature operations, even applications such as those shown in Figure 5 present no problem. Here, adhesive granulate is melted at temperatures of up to 180℃ before being processed by the application system. The container fill level is detected by an M30 sensor. The sensor head's Teflon coating prevents any glue residue from adhering to the unit. Additionally, the sensor's small temperature drift provides the greatest possible degree of process security even where temperature differences exist. This new line of sensors will undoubtedly open a whole new range of possible applications for capacitive level measurement including, for example, in plastics processing or in other areas of process automation.

Figure 5: Even when things get hot such as in this hot melt adhesive processing unit, capacitive sensors are suitable for fill level monitoring.