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Plastic-coated sensors for aggressive media

Within the last few years the prices for high-resistance metals like Hastelloy or tantalum have risen considerably. Sensor manufacturers cannot absorb these drastic price increases in the long term and are forced to pass them on to their customers. Due to the development of new plastic-coated sensors, a cost-effective alternative to the expensive metallic special materials is now available. Modern synthetic materials provide high diffusion resistance and are implementable in wide temperature ranges. The following examples show the advantages of plastic-coated sensors and their practical application possibilities.

PTFE & Co – ideal for many applications

By virtue of their chemical and physical properties, fluorine plastics like PTFE or PFA are particularly suitable for coating all kinds of sensors. Their chemical resistance is greater than that of almost any other material, which makes their use possible in a very wide range of applications. The temperature resistance of these synthetic materials also spans a very wide range. Since they have practically no tendency to get brittle, they can be used in very low temperatures – even down to -200° Celsius. This encompasses almost all areas of application, including liquid nitrogen. Fluorine plastics also show their strengths at high temperatures, being implemented up to 150° C, sometimes even up to 200° C without problem.

Since fluorine polymers have an extraordinarily non-adhesive surface, considerably less buildup can form on them than on a metallic structure. This is a significant advantage for many types of sensors. The surfaces usually have a roughness depth of 0.3 nm or better, which allows the use of such sensors in pharmaceutical applications. The disadvantage of fluorine plastics in the past was their limited diffusion resistance, but this has been improved on considerably in the last few years. Modern PTFE materials, even in the form of a relatively thin layer, can now be used in chlorine applications.

Sealing concepts without elastomers

In many chemical applications, not only is the chemical resistance of the applied metals a concern, but the question of which sealing material to use for flange seals or for the sensor elements also arises. In many cases the materials have to be selected individually and often present serious problems to sensor manufacturers and users.

Since all the medium-wetted parts of plastic-coated sensors are protected, the user doesn't need to worry about the sealing materials. A standard solution for many different applications is thus possible – this reduces stockkeeping and service costs.

PTFE – plenty of experience in the chemical industry

The lining of pipes and the coating of primarily mechanical components and sensors has been a measure for corrosion protection in the chemical industry for a long time. Pressure-measuring transducers and displacer systems were

protected mainly with PTFE. With new measuring techniques like vibration limit switches, radar or guided microwave, it was often not possible to apply such coatings due to technical reasons. But this has changed in the last few years as a result of new material compositions and new technologies. Today, measuring principles that are particularly interesting for chemical and pharmaceutical production also come in versions with a rugged plastic coating, thus expanding their application spectrum considerably.

Vibration limit switch with PFA coating

Because of its fine contours, the vibration limit switch VEGASWING gets a powder coating that is baked on in a thermal process. This manufacturing method makes coatings of PFA, ECTFE as well as enamel possible. The enamel coating is very durable and provides the same corrosion resistance that an enamelled container does. However, the glass-hard surface is very susceptible to impacts and relatively expensive to produce.

The PFA coating has the advantage of a higher diffusion resistance compared with the ECTFE coatings often used until now. Through the application of special barrier layers, considerably better properties are achieved than those of PFA linings made from semi-finished products. Therefore a layer thickness of approx. 0.8 mm is generally sufficient to provide anti-corrosion protection. The additional coating of the sensors has hardly any influence on the intrinsic frequency of the fork, so special electronics for evaluation of the signals are not required.

The field of application of coated vibration limit switches extends from the monitoring of levels in storage vessels and reactors to dry run protection of pumps.



Fig. 1
Vibrating level switch VEGASWING 63 with PFA coating

Guided microwave with PFA coating

While it is fairly easy to realise a plastic-coated capacitive probe, guided microwave instruments are another matter – high frequency effects must be taken into account so as not to impair the performance of the sensor. By selecting a suitable material, material thickness and design, however, it is possible to coat the rods or cables of the sensor with a relatively thick layer of PFA. What is important here is that the process connection, usually a flange, gets a plastic coating that is durably welded together with the rod coating. Only in this way is a reliable anti-corrosion protection ensured.

The PFA coating is at least 2 mm thick and ensures good diffusion resistance, even in very aggressive media. The maximum working temperature of 150° Celsius covers a multitude of applications in the chemical industry. For small to mid-sized vessels, a rod version with a measuring length of up to 4 m is available; for larger measuring distances up to 32 m, a cable version with a completely insulated straining weight can be deployed. It is particularly suitable for storage tanks with aggressive liquids or for sterile areas.



Fig. 2

Sensors based on the guided microwave principle – VEGAFLEX 63 in rod and cable version with PFA coating

Radar sensors with PTFE process separation

In the case of free-radiating radar sensors, a plastic coating on a standard device with horn antenna makes little sense. Due to its construction, the antenna system cannot be coated permanently with synthetic material – a completely new design is required.

The ability of microwaves to radiate right through synthetic materials makes it possible to cover the entire process connection with a plastic disc. The conical

form of the antenna cover, besides acting somewhat like an optical lens and providing additional focusing of the microwaves, also allows condensate to drip off more easily. To achieve a higher pressure resistance, the antenna system is completely filled with synthetic material. This allows implementation in process pressures up to 16 bar.

In selecting the antenna filling, different requirements had to be taken into account. At a working temperature of 150° Celsius, the volume expansion coefficient of most synthetic materials is so large in comparison to high-grade steel that the cover disc would be deformed up to 2 mm – a load that would not be sustainable in the long run. Through an appropriate selection of plastic mixtures and fillers, the expansion coefficient can be adapted to that of the high-grade steel antenna.

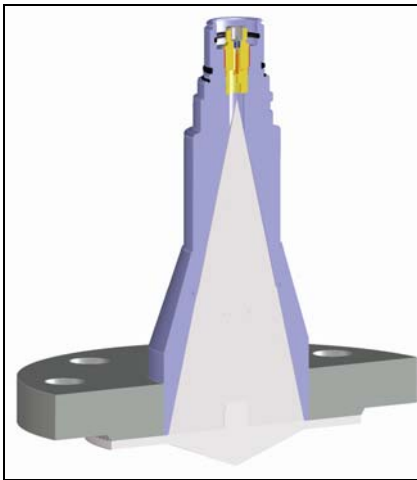


Fig. 3

Layout of the encapsulated horn antenna of the VEGAPULS 63 radar sensor

A very durable PTFE cover disc screwed to the antenna filling provides a totally reliable process separation. The 4 mm, or optionally 8 mm, thick material ensures an extremely high diffusion resistance and allows the sensors to be used in media like chlorine, bromine or hydrofluoric acid, even under high temperatures and pressures.

Because the sealing of the sensor is carried out directly by the PTFE disc, no additional seals which might limit the chemical resistance are required. The VEGAPULS 63 from VEGA Grieshaber KG is an ideal solution for continuous, contactless level measurement of aggressive liquids. The range of application extends from simple storage vessels to complex level measurement in reactors with multistage agitators and aggressive media.



Fig. 4
Radar sensor VEGAPULS 63 with PTFE process separation

Plastic coating as alternative to high-resistance metals

Sensor coatings of synthetic materials are in many cases today a real alternative to high-resistance metallic materials like Hastelloy, tantalum or even titanium. The price of a PFA or PTFE coated sensor, depending on the sensor type and required material, is often far below that of a metallic sensor. By incorporating the extremely high chemical resistance of fluorine plastics, which is surpassed only by platinum, these instruments offer a very wide application range for the demanding measurement tasks of the chemical industry.

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