The heated sensor tip reduces the risk of diaphragm damage

Precise Pressure Measurement without Mercury

Extrusion. Pressure sensors that contain mercury can, in the event of improper handling, pollute the environment and be harmful to health. Newly developed mercury-free pressure sensors raise no health concerns and are highly accurate. In addition, they are extremely robust and have a very long service life.

ACHIM KRAUSE

Pressure sensors play a central role in the control of the extrusion processes. Without exact pressure measurement, it is almost impossible to control the production process in most cases. The melt pressure values measured are used not only to control the speed of rotation of extruders and pumps, but also represent an indispensable control variable when it comes to achieving high-quality melt filtration.

Despite this central function, the importance of pressure sensors is almost overlooked in many extrusion operations: quality attributes receive very little attention during purchasing. Untrained personnel often handle them improperly and this quickly leads to destruction of the pressure sensors.

The extent to which defective or low-quality pressure sensors affect costs is often underestimated in the real world. In many cases, only the direct costs are taken into consideration when purchasing a new sensor. However, indirect costs caused by production difficulties resulting from missing or incorrect pressure measurements, or production interruptions that occur when a sensor must be changed are much more important.

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NTX Technology Displaces Mercury-based Sensors

Pressure sensors that contain mercury meet high quality standards. If handled improperly, however, this heavy metal poses a serious risk to the environment and is extremely harmful to health. As early as 2007, the European Parliament passed a resolution to "limit commerce with certain mercury-containing measuring instruments". In the next few years, the EU plans additional comprehensive measures as part of the already agreed-upon strategy to reduce exposure to mercury.

Using NTX technology, Gneuss Kunststofftechnik GmbH, Bad Oeynhausen, Germany, has developed a new mercury-free generation of pressure sensors. In contrast to mercury-containing sensors, they raise no health concerns and must not be disposed of as special waste. Additional benefits include the low zero-point offset and accuracy of up to 0.1 % of the final value. The sensors can be employed at temperatures up to 500 °C and are also suitable for use in the pharmaceutical and food processing sectors. Fig. 1 shows the zero-point offset free pressure sensors with different fill media between room temperature and 200 °C. It is obvious that the zero-point offset of pressure sensors utilizing NTX technology is less than that ▶

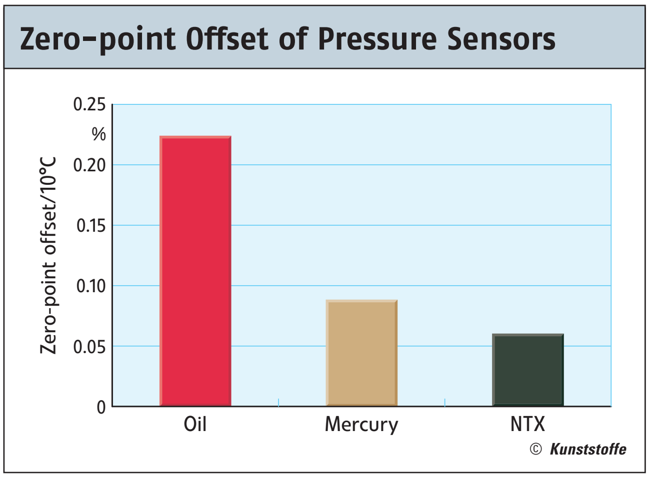

Fig. 1. Direct comparison of pressure sensors using different fill media

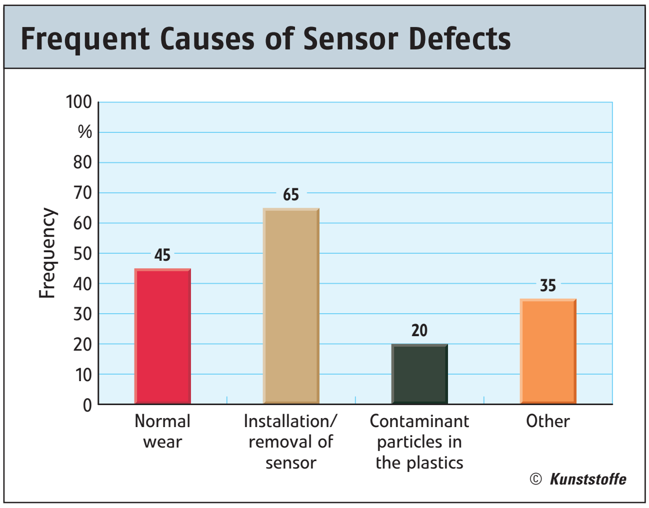

Fig. 2. Causes of defective sensors (from survey among 78 companies, multiple indications possible)

of mercury-containing pressure sensors. Sensors based on NTX technology thus represent more than just an alternative to mercury-containing sensors.

Causes of Sensor Defects

Analysis of sensor defects and the causes of these defects was the focus of a survey conducted by Gneuss among users of pressure sensors. A total of 78 companies participated in the survey. When asked about the frequency of problems with sensors, about half (52 %) stated that they were confronted only rarely with defective sensors. With regard to the consequences of a defective sensor, the situation became more critical: almost three-fourths of the companies (72 %) indicated that they have serious or at least moderately serious problems when sensors fail.

The items presented in Fig. 2 were given as the causes for the defects in the sensors. It is noteworthy that installation and removal of the sensor were given as the most frequent causes for destruction of the sensor. Damage arising from contaminant particles in the melt is only of minor importance. Against this backdrop, the types of sensor damage presented in Fig. 3 can now be interpreted.

The most frequent damage by far occurs at the most sensitive spot in the sensor, namely, the diaphragm. Diaphragm damage can be caused by contaminant particles in the melt, among other things. Diaphragm defects occur most commonly, however, when the membrane adheres to already cooled plastic when being removed, or cooling melt shrinks and the diaphragm tears. This type of damage regularly results in contamination of the area as the result of leaking fill medium when mercury-containing sensors are used. Of the companies that reported complaints about diaphragm defects, about two-thirds stated they have such problems frequently or moderately frequently. In comparison, the majority of the companies seldom had problems associated with the remaining defects, although in this regard the sensor head appears to be the next most vulnerable components, probably because of the plug-in connector.

Extremely Rugged and Precise

Against the backdrop of the problems presented above, a pressure sensor was developed that is extremely rugged on the one hand, yet simultaneously permits simple installation and removal. On the other hand, the intent was to also achieve technical improvements. During development, Gneuss was able to draw on its decades-long experience as a manufacturer of pressure and temperature sensors. The result of this development is the new DAP pressure sensor (Fig. 4). The sensor is characterized by noticeably improved accuracy (±0.2 %) and a previously unattainable integrity. This is possible because of newly developed diaphragm technology.

Moreover, the sensor exhibits an extremely long service life. Special surface

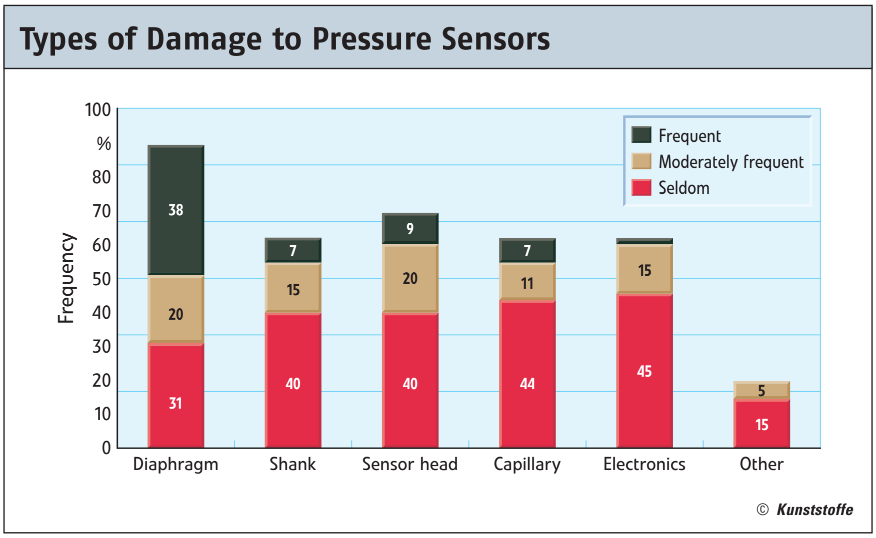

Fig. 3. Types of damage to the pressure sensor (from survey among 78 companies, multiple indications possible)

Fig. 4. The DAP pressure sensor is characterized by an extremely high accuracy of ±0.2 %

characteristics make the shank extremely rugged. This attribute is found also in the plug-in connections, where only especially strong metals are employed. The flexible capillary, which is manufactured from a special material, is protected in an ideal manner thanks to a unique, very rugged spring design and can thus withstand loads several times higher than conventional designs. The sensor is also available with a built-in amplifier.

Heated Sensor Tip

As the results of the survey have shown, pressure sensors face a particularly high risk of being damaged during installation and removal. To reduce the risk of diaphragm damage to a significant extent, the new sensor was fitted with a heating capability (Title photo). This allows the tip of the sensor to be heated in only a few minutes. Removing the sensor from an already cooled system thus poses no problems. In so far as problems are to be expected due to the shrinking melt when a system is shut down, the sensor can also be heated to avoid diaphragm damage. Overheating of the sensor is prevented by a heater controller. The built-in thermocouple is helpful in this regard, since it can provide a control variable. The risk of diaphragm damage or sensor failure is thus reduced to a minimum. This extends the service life of the sensor significantly.

Conclusions

The newly developed DAP pressure sensor provides very high accuracy. Because of its mercury-free design on the basis of NTX technology, and satisfies the most demanding standards for environmental protection. Furthermore, the sensor is characterized by exceptional ruggedness as well as an extremely long service life. This reduces the costs for replacement sensors and prevents indirect costs arising from production disturbances or even lost production attributable to sensor defects. ■

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