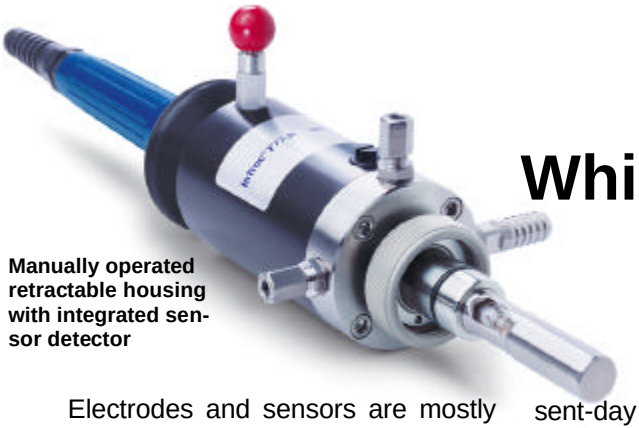

Manually operated retractable housing with integrated sensor detector

Which material for which application

Electrodes and sensors are mostly introduced into a process through a housing in order to protect them during rigorous measuring tasks and cleaning processes (CIP/SIP), but also for a whole range of other technical and operational reasons, such as in continuous processes (e.g. ease of maintenance/exchange, calibration, etc.).

However, protection measures must not alone relate to electrodes or sensors, but also to the processes generally, not forgetting personnel operating the equipment and plant.

Safety

A major contribution to process safety is made by the retractable housings of the InTrac® series supplied by METTLER TOLEDO. This comprehensive range of housings covers applications in pipes, reactors, fermenters, pressure vessels and the like, and has a proven record in the field of inline measurement of pH value, redox potential, turbidity and conductivity in continuous processes The retractable housings allow manual or automatic insertion/withdrawal of electrodes and sensors without interrupting the ongoing process. This enables service, maintenance, exchange, cleaning and calibration of electrodes and sensors independent of duration and sequence of a process.

During the development of these housings, the focus was on achieving safety, precision and flexibility in use, with a particular emphasis on reliability and low cost of ownership for industrial users.

Accidents in the past - luckily in most cases without serious consequences - happened from time to time due to the forceful escape of reaction medium during exchange or checking of sensors. The present-day housings InTrac® 776 and InTrac® 777 fulfill all safety criteria placed on housings used in process applications. The patented design of the immersion tube guarantees complete separation of process medium from the environment at every position. This protection feature enables safe maintenance of the measuring point even under conditions where harmful and aggressive process media exist, as well as at high process overpressure. An additional safety feature prevents the sensor from being removed from the housing when in measuring position. The so-called sensor detector ensures that it is not possible to insert the immersion tube into the process when there is no electrode fitted inside the housing.

A variety of housing materials

The question now arises regarding the selection of the most suitable housing material for each specific process.

The above mentioned InTrac housings are available in three different versions. Depending on requirement, the housing is supplied with wetted parts made either of PVC, PVDF or stainless steel (1.4435). Special versions using Hastelloy®, titanium, tantalum, zirconium, etc are available on request.

When selecting the material, it is absolutely necessary to know the exact process conditions. Not only are pressure, temperature and pH value important, but also, as will be shown in an example below, the composition of the reaction medium relative to its aqueous and organic components. Most mistakes are made at this point by choosing to use polymer housings. The diagram shows the pressure and temperature resistance of the materials of the standard housing types. Steel displays excellent temperature-resistance in relation to pressure, PVDF possesses good temperature resistance (up to 120°C) at normal pressures. PVC on the other hand should only be employed at relatively low process temperatures.

Polymer housings

PVC and PVDF possess good resistance properties to commonplace acids. PVC is also resistant to lyes. PVDF on the other hand is only conditionally resistant to caustic soda. These properties can, however, change dramatically in the presence of even a relatively small amount of organic solvent.

A customer reported that his PVDF retractable housing would no longer insert or retract. After dismounting the housing, there was a great deal of astonishment. The immersion tube was still mechanically stable but it had become wider (in diameter).This phenomenon was rapidly explained. The process medium, an aqueous solution, contained a whole series of different organic solvents.

The phenomenon of swelling

Most solid polymers tend to dissolve in specific low-molecular liquids at certain temperatures. The process begins with a swelling of the polymer in relation to the rate of diffusion of solvent into the polymer, followed by the formation of a high-viscosity gel which can subsequently dissolve if the amount of solvent present is sufficient and if the polymer is not cross-linked. (Cross-linked polymer has the advantage that it can only absorb a limited amount of solvent.) The swelling of the submersion tube was due to this phenomenon. Potential swelling should always be taken into consideration when selecting polymer materials for use in chemical processes. Relative tables

as contained in the Polymer Handbook should be consulted for details.

O-rings

When it has finally been decided which housing material is to be applied, the next big question concerns the choice of O-ring material. Ever more aggressive cleaning and sterilization procedures call for ever more efficient materials for O-ring seals.

The following factors determine the choice of material: process medium, pressure, temperature, as well as concentration of the cleaning and disinfection solutions. The most common materials for O-ring seals are EPDM, silicon, Viton® and Kalrez®.

These seals, all of which are used by METTLER TOLEDO, accord to the guidelines of the US FDA (Food and Drug Administration) and the German Health Authority, and can be employed in equipment for the manufacture of pharmaceutical and food products. In such processes, we do not recommend the use of traditional types of elastomer, since these are often to be classified as dubious with regard to toxicity. Under extreme conditions, such as for example at high temperatures or in the presence of aggressive media, certain substances which are against regulations can be washed out of the sealing elements.

A particularly strong feature of Kalrez® is its almost complete resistance to chemicals and the rubber-like characteristics of this elastomer generally. Kalrez® is used particularly under conditions where high temperatures and aggressive chemicals combine and it is able to withstand extended exposure to temperatures up to a maximum of 260°C.

EPDM displays good heat resistance up to 135°C and can be used for short periods at 150°C. It also has good resistance features against the acids and lyes used in CIP procedures.
If fats and oils are being processed, silicon O-rings are widely used, although they do have poor resistance to elevated temperatures.

Viton® material belongs to the group of fluorine elastomers. It displays excellent chemical resistance qualities, in particular to fuels. However, it has weaknesses in the presence of alkalis.

Advice needed?

About 800 construction materials are today employed in the erection of chemical plants; forty of these are standard materials, primarily both ordinary and corrosion-proof steel qualities. Additionally, special materials such as superaustenic steel and nickel-based alloys, aluminum alloys and special metals such as titanium, tantalum and zirconium are also used, with polymer and composites materials on the increase.

Due to the wide variety of materials available nowadays, it is essential to harmonize the choice of individual materials with the specific chemical process, for in the end, it is process safety and product quality that are at stake. In all these considerations, the price of the chosen material has to be taken into account in relation to the benefits offered. And this is where individual advice is certainly called for.