# Rapid Response Time

## - The potentiometric level measurement -

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## The Future demands Quality

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by Wolfgang Gerster and Dieter Stotz

**If levels are measured in very small containers or also in tubes, then the usual hydrostatic pressure transmitters fail because of the small signals. Pasty or highly adhesive media equally frequently cause faulty measurements especially when using capacity level sensors.**
**The most suited for problems of this type is the potentiometric measuring, continuous level sensor NSK-... from Negele, that can capture levels up from 50mm.**

*Figure 1: The continuous level sensors NSK are deliverable in various versions and with different process connections.*

The so-called potentiometric measuring procedure is used by Negele in the continuous level sensor NSK and is especially suited to small levels. The sensor in its single rod variant can be used from above and if required from below in metallic containers of up to a level of 2 m. The sensor can be supplied variably in any rod length according to the height of the tank. For plastic containers, with slanting installation or irregular tank shapes there is also a two rod sensor with separate earthing rod, which replaces the metal sides of the tank.

As a measuring signal there is an adjustable 4...20mA signal directly on the sensor available to the user. Its special feature is the rapidly transmitted update of the measured values. With the NSK an updated level measurement is given 10 times every second. Because of this feature the sensor is especially well adapted to level control for containers of every type.

The process connection of the sensor is carried out with the tried and tested, elastomer-free, EHEDG and 3-A certified hygiene build-in unit from Negele. Additionally there are numerous suitable adapters such as TriClamp, Milchrohr (Milk tube), Varivent, DRD and may others available. Thus it is any easy step to adapt the sensor to existing process connections or to match it with an existing plant standard. The measuring rod consists of stainless steel 1.4404, the insulating element that simultaneously functions as a watertight cone is made of FDA approved PEEK plastic. Because of the high hygiene standard of the modular unit and choice of materials the NSK is therefore best suited for sterile applications and fully CIP-capable, and in the optional high temperature version, also SIP-capable.

The sensor with its robust stainless steel housing is resistant to even the toughest daily requirements of equipment in the foodstuffs industry.

## No Readjusting

Apart from hygiene and robust structure, the operational reliability of the sensor also, of course, plays an important role. The advantages of the potentiometric system are therefore obvious: Medium changes, precisely because of this measuring procedure, have no effect with the continuously measuring level sensor NSK, whereas capacity sensors have to be re-adjusted when a medium is changed because of the changing dielectric constant. Only a minimum conductivity coefficient of 1 µS/cm must be distributed in the medium homogeneously. A change in the conductivity does not come into play either on account of the measuring principle. Adhesions in the area of the measuring rod that always cause problems with capacity sensors, do not falsify the measured value with the potentiometric measuring NSK, since only the level existing in the container is relevant during the measurement.

## No Measuring Fault at Overpressure

The overpressure in pressurised tanks will also not be included in the measurement when measuring with the potentiometric measuring principle, which enables a highly precise measurement of very small levels in pressurised tanks. In these cases, where the hydrostatic measurement of pressure difference is often applied, the ratio between overpressure and hydrostatic pressure should not exceed approx. 4:1 in order to obtain a reasonable measurement. Even by adhering to this ratio there still remain considerable measuring errors with a minimal level in the container. Limitations such as these and the resulting loss in precision do not occur with the continuous level sensor NSK. This measures the level from the first millimetre constantly with highest precision irrespective of overpressure.

## Foamy Media

In froth-producing operations the potentiometric measuring process is able to demonstrate its strengths against the contactless (ultrasound or radar) processes. Apart from an incorrect measurement with foaming media, with contactless measurement there can be in the worst case no measurement whatsoever. The reason for it is that the electromagnetic waves transmitted are completely absorbed by some foam and therefore no reflection takes place.

Because of the considerably lower conductivity of the foam by comparison to the fluid medium, measurement errors with the NSK that are caused by foam are so slight that they are in practice negligible. Contactless measuring systems often cannot record rapid level changes because of their inertia. The rapid updating of measured values already mentioned with the NSK, by contrast records rapid changes too without difficulty.

## Limitations of NSK

It is a truism that no measurement procedure works correctly in every situation absolutely and with no hitches. This is of course also valid for conductive potentiometrics.

In homogeneous media it works excellently: as soon as the distribution of the conductivity in the medium becomes extremely inhomogeneous, there results a measurement error. Rises in temperature on the measuring rod itself have very little effect, due the an appropriate selection of the material, and are usually negligible. It must be noted that the medium should not fall below a certain, very low conductivity, because otherwise it would result in an empty signal for safety reasons. The system voltage would otherwise be affected by malfunction. Whereby for example distilled water can always still be measured without problem. In some extreme situations there can be especially on the upper rod end conductive bridges from the rod to the wall of the tank or to the device earthing, which then cause a faulty measured value. In this case however an optional insulation of the measuring rod at the upper rod end acts as a remedy in most cases.

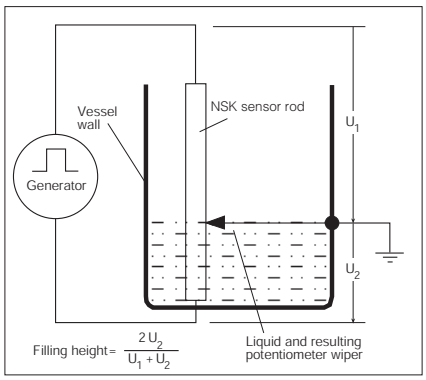


*Figure 2: Potentiometric measurement principle.*

*Figure 3: NSK level sensors in filling equipment for curd and yoghurt.*

## And so it works

The basic idea of potentiometric level measurement consists of applying voltage to a metallic conductive rod (potentiometer track). The medium in the tank acts as a potentiometer slider and gets partial voltage from the measuring rod (see figure 2) that can be measured on the wall of the tank. The measured partial voltage is put into the proportion to the voltage on the measuring rod and in turn directly from it comes the measurement for the relative level. The measuring procedure is in broad terms independent of the conductivity of the medium. Only a conductivity of 1 µS/cm has to be present in the medium.

The installation of the sensor from below is also possible.

## Possible Applications of NSK

The NSK continuous level sensor is usually applied for small pressurised tanks such as are found in breweries. As mentioned earlier, the hydrostatic measurement of pressure difference does not always fulfil the accuracy requirements of the users. A contactless measurement is often too expensive for such applications. A highly accurate and also more economical solution is the NSK continuous level sensor from Negele.

The main application of the NSK is in presettling containers of filling equipment and supplies an important parameter for the regulation of the feeding pressure there. Very accurate dosage procedures in filling equipment can be carried out with the NSK on account of its very short response time, since the changing level and its associated feeding pressure can be very rapidly adjusted on account of its short response time. Particularly for filling equipment containing changing and pasty products the NSK is most suitable, remembering the above mentioned reasons, for an accurate level measurement with the highest standards of hygiene.

The sensors in the application photo are installed into the presettling tanks of a filling machine in a dairy. Here they are utilised through optional milk tube adapters in the existing process connection. The sensors in this case carry out the level measurement which is the essential criterion for the regulation of feeding pressure. Here, media such as curds and yoghurt, for example, are being filled. It is important for successful operation that adhesions that always occur with such media do not corrupt the measurement. The NSK meets this requirement on account of the measurement principle.

When a medium is changed such as it is often the case here, the sensor can also contribute considerably to the flexibility of the user, since, as already described, no re-adjustments are needed when changing the product. This increases speed and thus the efficiency of the unit.

The short response time, together with proven filler unit technology is a guarantee that, tub by tub, the same quantity will be delivered.

## Further Information

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