Baumer
Passion for Sensors

Easy Level Detection in Centrifugation

In many industrial applications level detection is key when monitoring maximum and minimum levels in tanks as overflow and dry-run protection. The sophisticated technology of frequency deviation featured by the Baumer *CleverLevel*® sensor has proved to be successful particularly in sophisticated centrifuges. Frequency deviation in a compact design detects most different media, from cleaning agents to industrial sludge.



The original for simple and reliable level detection: The Baumer *CleverLevel*® offers intuitive and fast commissioning with maximum precision, even with frequently changing process media. Illustration: Baumer

For level detection there is a wide range of point level sensors operating on different technologies: vibrating level switches (vibrating forks), capacitive point level sensors, sensors with frequency deviation, floating switches or optical sensors. Point level sensor requirements differ with the application and the factors to be considered: foam, aggressive or inflammable media, adhesion and build-up, difficult installation conditions, dynamic filling processes, required measuring precision, etc. Conventional vibrating forks (vibrating level switches) are still very common in industrial applications of point level detection. Their operating principle is a rather simple principle: a piezo drive makes the two fork arms vibrate. In air, the fork's vibration is stronger than in liquids which have a damping effect. Electronics evaluate the change in vibration, and immediately when recognizing the damping effect on the fork there is a switching operation.

In some applications however, vibrating forks are not ideal due to their design and technology. Some of them include large components reaching far into the medium to be detected and therefore are not appropriate where installation space is tight. Viscous media tend to adhere to the fork arms while coarse-grained media get caught in between. Both may entail switching errors. Furthermore, vibrating forks are difficult to clean and the media to be detected (fluid, foam, powder, granule) may require individual designs.

Baumer offers an alternative approach for simplified point level monitoring. Point level sensor *CleverLevel*® is the smart solution for applications still using standard vibrating forks. Operating on the technology of frequency deviation perfected by Baumer and thanks to its special design, *CleverLevel*® does not present the drawbacks of vibrating forks but instead offers a lot of benefits:

- Media-independent detection – one sensor for all media
- Resistant to adhesion and foam
- Temperature stability up to process temperatures of 150 °C (ambient temperature up to 85 °C)
- Phase separation via switching outputs
- reduced immersion length for compact machines
- ATEX including Zone 0
- Fast reaction in vacuum containers

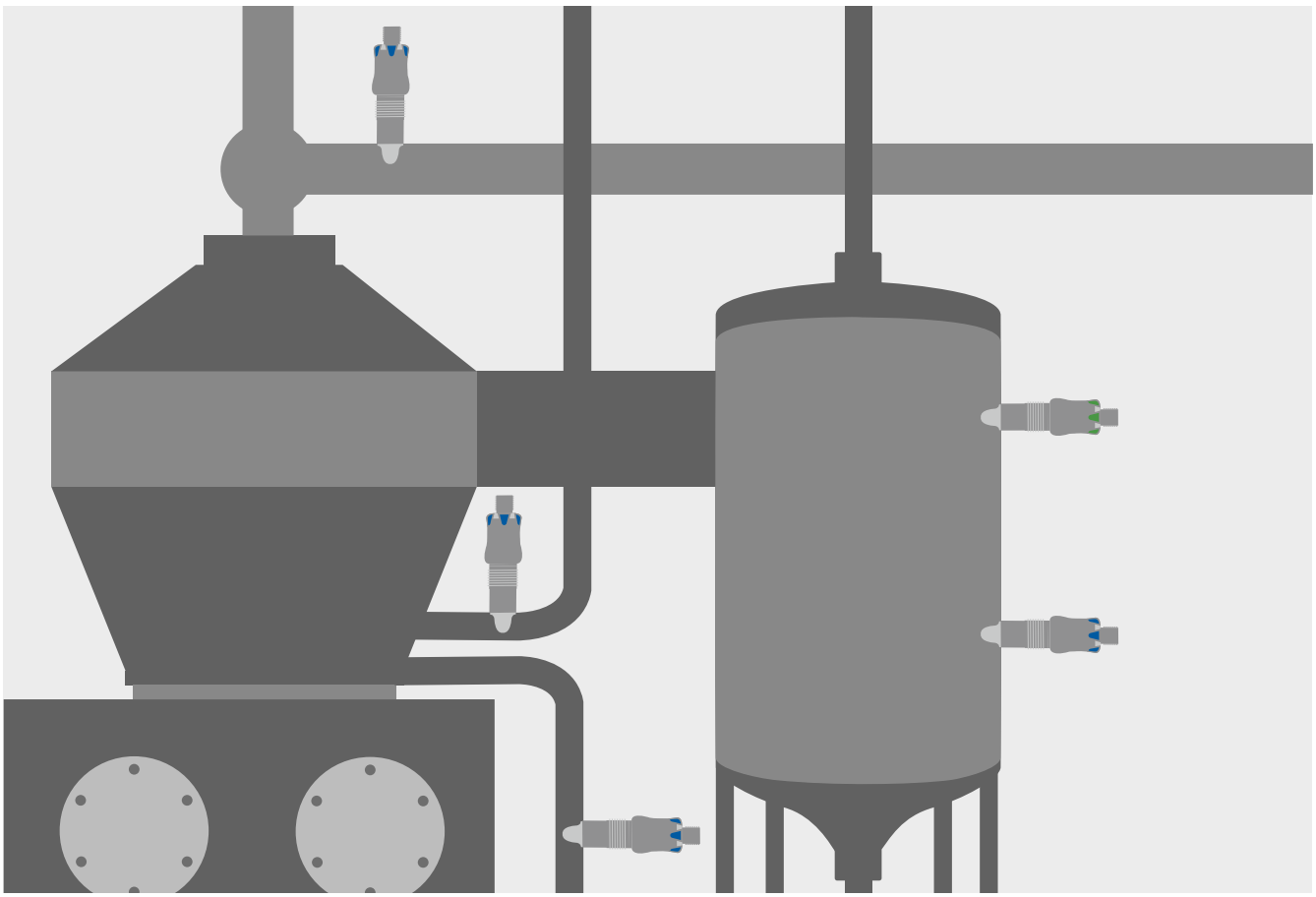
Industrial separation isolates the individual substances of a mixture – either on the basis of their physical or chemical properties. Particularly in the chemical and pharmaceutical industry, in food and beverage and environmental technology separation is key for further processing, re-use, analysis or disposal of the individual substances in a mixture.

Separation aims at:

- Purity: maximum possible substance purity as required in medicine (extraction of active substances), in chemical synthesis (pure ethanol) and in food and beverage production (sugar, oil, proteins, etc.).
- Recovery of reusable substances: recovering reusable substances from a mixture, e.g. for plastics or metal recycling, recovery of solvents, oil-water separation
- Elimination of unwanted substances: separating impurities or pollutants, e.g. wastewater treatment, isolating heavy metals in drinking water, CO2 separation from flue gas emissions
- Process preparation / optimization: separation is often a pre-stage in production, e.g. removing solids prior to a reaction, separating liquids or changing concentration.
- Improved product quality: beverage bottling, production of paint, cosmetics. Wherever clear fluids, substance purity and the correct consistency are required

Centrifugation requires reliable sensor technology

Centrifugation is the proven principle for phase separation. Fast rotation of a mixture imposes different centrifugal forces on its ingredients. Separation is by centrifugal force which on heavy ingredients (high density) is higher than on lighter ones (lower density). This is a proven and rapid method for emulsions or the separation of fine particles. Centrifugation is either a continuous process – with constant material feeding – or a discontinuous process batch by batch. The example is separation by batch.



Deposits and sediments may cause switching errors and hence pose a challenge to level detection in centrifuges. *CleverLevel*® is insensitive even to severe adhesion. Illustration: Baumer

Applications in centrifugation

- Food: skimming of milk, clarification of fruit juices
- Chemistry: separation of crystals from solvents
- Pharmaceutical: extraction of active ingredients, cell separation
- Biotechnology: separation of micro-organisms or proteins
- Environmental technology: sludge separation in wastewater treatment plants

Every step of the automated centrifugation process, from monitoring the inflow to product and sludge discharge, relies on precise and reliable sensor technology. Smart sensors provide real-time data on flow rate, pressure, conductivity, temperature, fill levels and rpms to control the centrifugation process for optimal phase separation. Point level and media detection in centrifugation is quite challenging the sensors. Some examples: different properties (phases, concentration, content of solids in process media before and after separation) and last but not least short response times required for reliable detection of rapidly changing phases. Another difficulty in point level detection in centrifuges are deposits and sediments, which my lead to switching errors.

Adhering media and rapidly changing phases

The following example of an industrial marine application makes it clear. In a sludge separation unit, the point level sensor must perform two tasks. In the first place, it is expected to report any sludge having already settled. Second, the sensor must detect each phase during centrifugation. Such demanding conditions – adhesive media and rapidly changing phases – narrowed down the choice of appropriate sensors. Tests proved *CleverLevel*® ideal for this application, since thanks to the compact housing it meets all requirements:

- Reliable sludge detection in any media
- Resistant to even severe adhesion
- Two switching outputs and analog output for media separation and layer detection (process monitoring)
- Also appropriate for application in explosive atmospheres (ATEX/IECEx etc.)
- Chemical resistance. Furthermore, robust *CleverLevel*® is free from maintenance.

Conclusion

Easy point level monitoring with the technology of frequency deviation perfected by Baumer in *CleverLevel*®, has decisive benefits. Most, *CleverLevel*® featuring automatic media recognition without need for parameterization will ease work enormously. Whether bulk material, powder, fluid, foamy, sticky, viscous or watery. *CleverLevel*® will detect cleaning agents just as easily as industrial sludge. More typical applications are overfill protection or selective detection suppressing foam or separating layers. Space-saving *CleverLevel*® will masters all these tasks by a single, user-friendly sensor technology.

CleverLevel®: Functional principle and commissioning

What is the principle of the technology of frequency deviation utilized by *CleverLevel*®? Every medium, no matter of its consistency, has a specific dielectric strength. Therefore, in the electrical field built by *CleverLevel*®, the medium's behavior at a certain temperature will always be the same. This is utilized by the technology of frequency deviation. Depending on the measured resonance frequency, the sensor recognizes whether it is immersed in a fluid, a solid medium or in gas. This is the reason why *CleverLevel*® is capable of ignoring adhesion or foam at the sensor head. High sensitivity throughout a wide dielectric range from constant 1.5 to more than 100 allows for point level detection in all types of powders, granules and fluids. Commissioning is easy. Even with default parameterization most media are reliably recognized. When in doubt, use the teach-in function. More complex parameterization tasks are simplified with the intuitive software Baumer Sensor Suite allowing the user to see what the sensor is seeing. The switching window can be adapted to the requirements, e.g. hiding foam for maximum and minimum point level detection. The same applies to adhesion at the sensor head which is ignored. Electrostatic adherence often present in powdery media is also ignored by parameterization of a corresponding switching window.

Learn more about Baumer *CleverLevel*®:
www.baumer.com/c/13561



Author
Julian Budde

Strategic Product Manager
Process Sensors
Baumer