SOLUTIONS FOR THE OIL & GAS INDUSTRY

Level, Multiphase Level & Density Measurement

BERTHOLD

Applications in the Oil & Gas Industry

Exploration and Production.

BERTHOLD TECHNOLOGIES radiometric instruments are perfectly suited for use in the offshore and onshore oil industry.

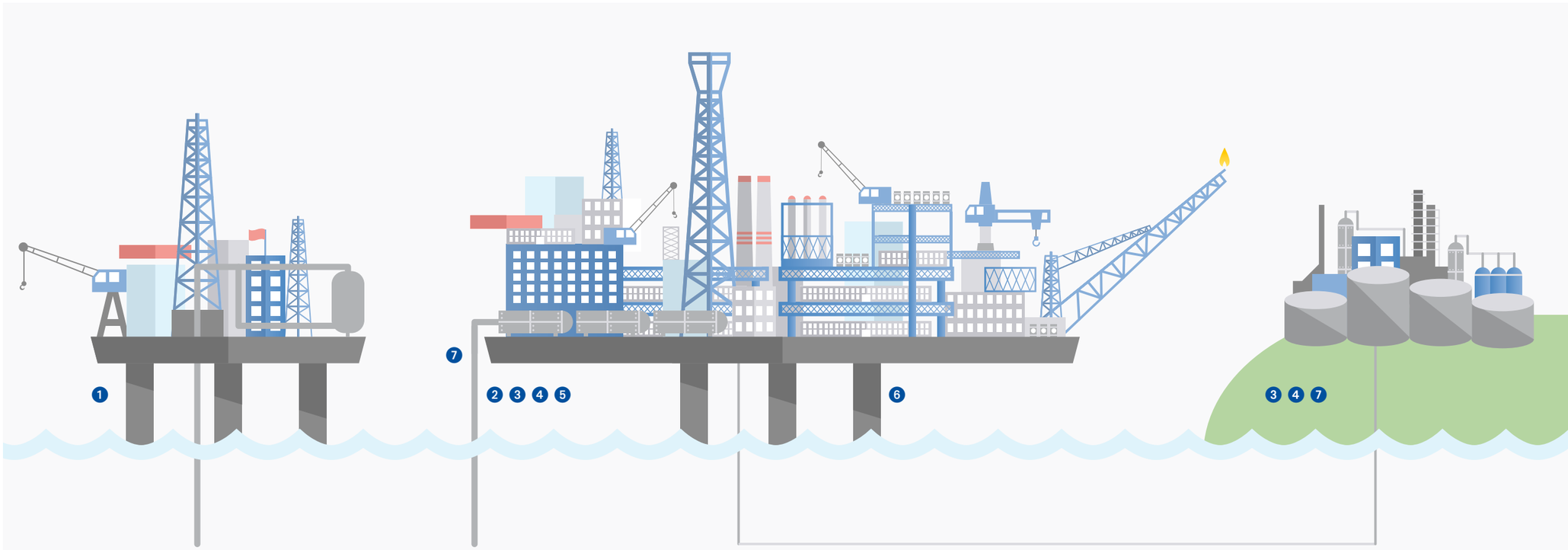
They are installed on Drilling Rigs, Production Platforms, FPSOs and Oil Terminals and provide highly accurate and repeatable readings, – the base for a profitable and safe operation.

Regardless whether
- a high level / low level alarm,
- a continuous level measurement,
- interface measurement or
- a density measurement

is needed – all of our detectors are characterized by an outstanding level of sensitivity and long-term stability – reducing radiation levels and maintenance to a minimum.

Non-contact perfect!

- Outside mounting of components
- Not exposed to the harsh process conditions
- Free of wear and maintenance
- Smooth handling and operation
- Lowest cost of ownership
- Easy to install on existing pipes or tanks without modifications
- Perfect for all high temperature, high pressure applications



Drilling Rig

1. *Measuring drilling mud density*
2. *Level alarm for safety application*
3. *Measuring oil level in separators*
4. *Multiphase level measurement*

Production Platform

5. *Measuring sand level*
6. *Measuring liquid level in wet gas scrubbers*
7. *Detecting slugs*

Oil Terminal

Measuring Drilling Mud Density

The composition of drilling mud is an important factor because it ensures stable conditions in the wellbore. An online density measurement at the feeding line provides real-time information on the mud density before it enters the wellbore.

A second density system at the mud returning line is used for the measurement of solid contents referring to the cuttings in the flow. In combination with a flow meter the mass flow of cuttings can be determined.

Application Profile

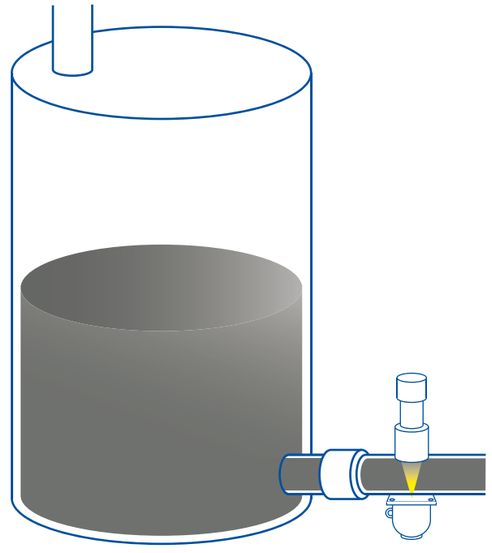
- **Measurement task**
  Density of drilling mud (Mass flow)
- **Location**
  Mud feeding / mud returning line
- **BERTHOLD Solution**
  Radiometric densitometer, clamped on the pipe e.g. SENSseries LB 480 (SIL2 / SIL3)

Customer Benefit

- Online, real-time process information
- Optimized mud mixing process to ensure ideal mud properties
- Improved control of mud processing
- Easy installation on existing pipes

Characteristics

- Clamp-on densitometer: quick and easy mount and dismount for each drilling job
- Non-contact measurement: No wear and tear, no disturbance in the flow
- Highly reliable, long-term solution
- Maintenance-free operation
- Robust design to withstand sea water atmosphere and all weather conditions
- Easy to install, without modifications to the pipe
- For all pipe diameters from 100...800mm



Clamp-on density system mounted on the mud feeding line.

Level Alarm for Safety Applications

The reliable control of high level and low level set points is very important for process safety in the oil and gas production. Separators especially have such a safety system that prevents from overfilling and ensures operability of following processes. The BERTHOLD instruments used for level switch applications ensure the highest degree of safety and reliability. The system is mounted on the outer tank wall and therefore not exposed to the high pressure and high temperature conditions inside the tank. Existing tanks can be easily retrofitted by the BERTHOLD point level systems, without any modifications or process downtime. As a matter of fact the high level and low level switches are certified for SIL2 and SIL3 applications.

Application Profile

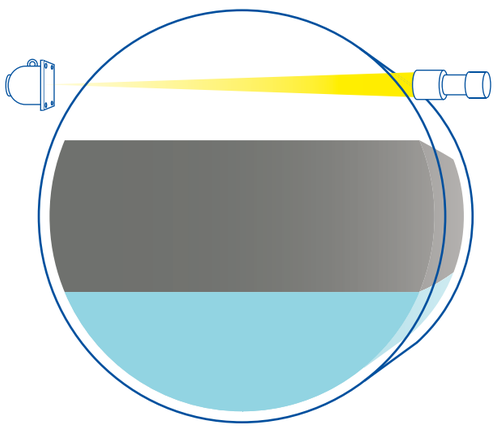
- **Measurement task**
  High level, low level alarm
- **Location**
  Separator, Slug Catcher, Knock Out Drum
- **BERTHOLD Solution**
  Radiometric level switch (SIL2 / SIL3)
  e.g. SENSseries LB 480

Customer Benefit

- Highest operational safety in critical applications
- Reliable and stable measurement, not affected by pressure, temperature or foam
- Subsequent installation on existing tanks, easy to calibrate during on-going process
- Real-time information on wall build ups
- Safe control of high level and low level set-points

Characteristics

- Detector and source are mounted on the outer tank wall
- Transmission of tank on pre-defined level
- Use of high-sensitive scintillation detectors
- Lowest source activity needed
- Maintenance-free



Level switch arrangement with narrowly collimated radiation beam.

Measuring Oil Level in Separators

The separation process is the basic part of hydrocarbon production. To achieve good, stable separation, the total liquid level should be controlled with accurate measurement gauges. BERTHOLD level transmitters are used to monitor measuring ranges, from a few millimeters up to several meters. The radiometric level measurements are non-contacting and non-intrusive and operate with constantly high accuracy and repeatability throughout the whole time of operation. As the components are mounted on the outer wall, they do not come into contact with the measured material and are therefore not exposed to wear and tear.

Application Profile

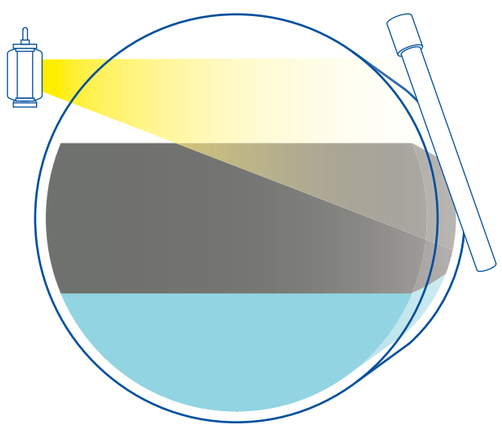
- **Measurement task**
  Continuous level measurement of liquids
- **Location**
  Separator, Slug Catcher, Knock Out Drum
- **BERTHOLD Solution**
  Radiometric level transmitter (SIL2 / SIL3)
  e.g. SENSseries LB 480

Customer Benefit

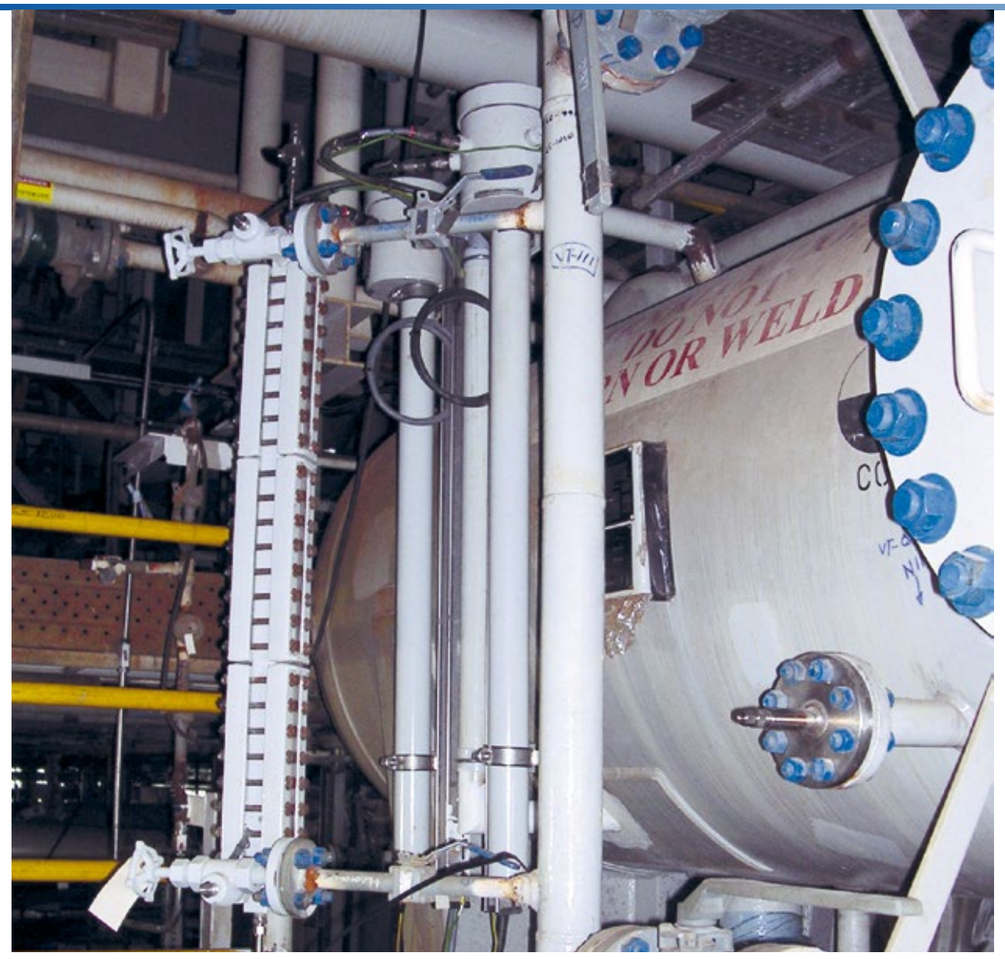
- Online, real-time level information
- Optimized utilization and improved control of tank capacity
- Increased process efficiency
- Trend monitoring and data logging

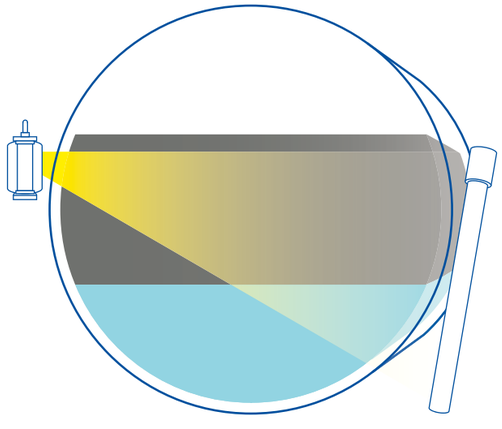
Characteristics

- Non-contacting
- Long-term stable and highly accurate (typically below 0.5%)
- SIL2 / SIL3 certified detectors for safety critical applications
- Maintenance-free operation
- No re-calibrations required

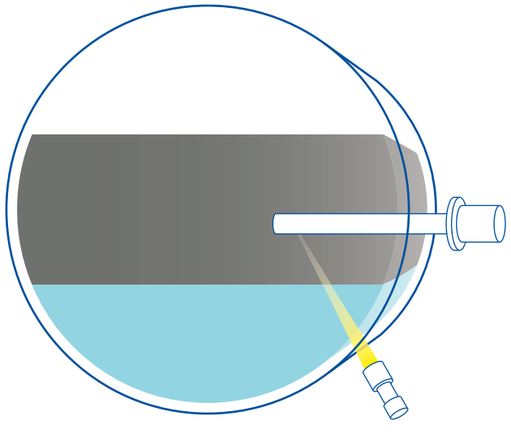


Continuous level measurement using rod detector and wide radiation beam.





External arrangement with rod detector.



Arrangement with point detector. The source is inserted in a dip pipe.

Measuring Oil/Water Interfaces

During the separation process, the interface between oil and water has to be determined. A reliable control of this interface is very important because it prevents oil from entering the water outlet and ensures that water is not reaching the oil side.

BERTHOLD interface measurements are used in horizontal and vertical separators ensuring maximum safety and reliability in the prevailing high pressure and high temperature processes.

Application Profile

- **Measurement task**
  Oil/Water interface
- **Location**
  Separator, Slug Catcher, Knock Out Drum
- **BERTHOLD Solution**
  Radiometric level transmitter (SIL2 / SIL3) e.g. SENSseries LB 480

Customer Benefit

- Online, real-time interface information
- Improved separation efficiency
- Ideal control of water and oil outlets
- Avoiding water carryover to the oil side
- Minimize oil content in the water outlet line

Characteristics

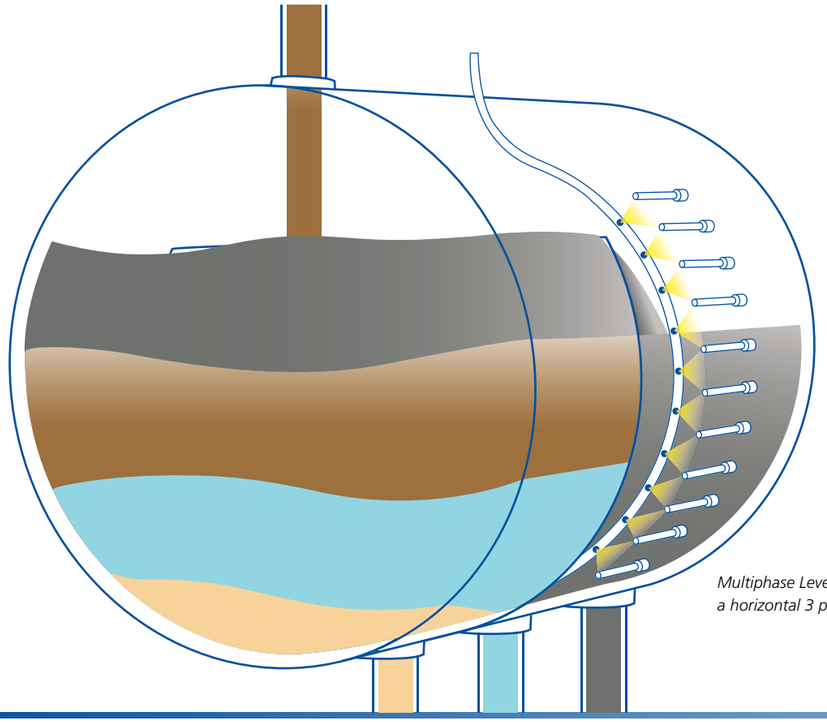
- Based on the density difference between oil and water the interface can be measured
- Precise interface determination, typical accuracy below 0.5%
- Use of high sensitive scintillation detectors and therefore significant reduction of source activity
- SIL2 / SIL3 option for safety critical processes

Multiphase Level Measurement

With the Multiphase Level Measurement system from BERTHOLD the operator receives a live picture of the highly complex separation process taking place inside the tank. Continuously and over the whole measuring range the instrument measures the level and the thickness of the different product layers: oil, water, emulsion, sand, gas. It provides real time values and a graphic display for trending in order to improve important control parameters like residence time and the addition of chemicals.

Application Profile

- **Measurement task**
  Multiple layers (Oil, Water, Emulsion, Gas, Sand)
- **Location**
  Separator, Settling tank, Storage tank
- **BERTHOLD Solution**
  Radiometric density profile measurement MPLM



Multiphase Level Measurement on a horizontal 3 phase separator.

Customer Benefit

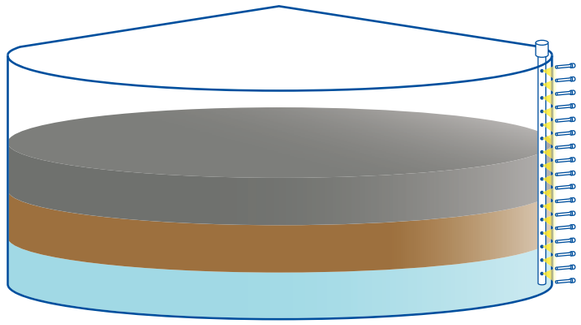
- Ideal picture of the on-going separation process
- Level and thickness of all different layers
- Achievable accuracy ≤ 20mm level
- Improved addition of chemicals e.g. anti-foam agent, demulsifiers
- Ideal control of all outlets and inlet
- Highest operational safety (SIL2 option)
- Trend monitoring and data logging
- Easy to use Control Unit with HMI (graphic display, measurement values and alarms)

Characteristics

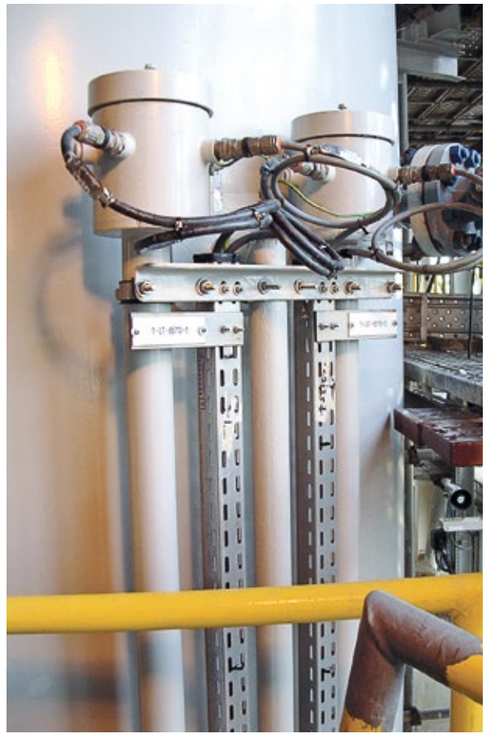
Several detectors are mounted outside the tank, while the radiation sources are inserted in a dip pipe. Each detector is used to measure the position of the interface layer in a very confined range (200-600mm). The use of high energy Cs-137 isotopes combined with the long distance between source and detector (>500mm), ensures highly representative results and a measurement that is virtually not affected by scaling and mineral build up on the tank wall or dip pipe.

State-of-the-art Scintillation Detectors

Due to their high density, the scintillation crystals used by BERTHOLD can absorb 100 times more gamma rays compared to traditional gas filled detectors. They can achieve a better measurement effect, which allows for a significant reduction of source activity and a better utilization of the gamma radiation. Further advantages of the scintillation detectors over gas filled tubes is their mechanical robustness and the fact that scintillation detectors don't degrade by time, ensuring an excellent measurement performance throughout the whole time of operation.



Multiphase Level Measurement on a vertical settling tank.

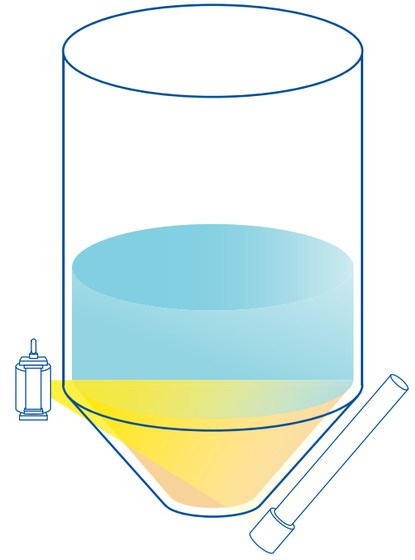


Measuring Sand Level

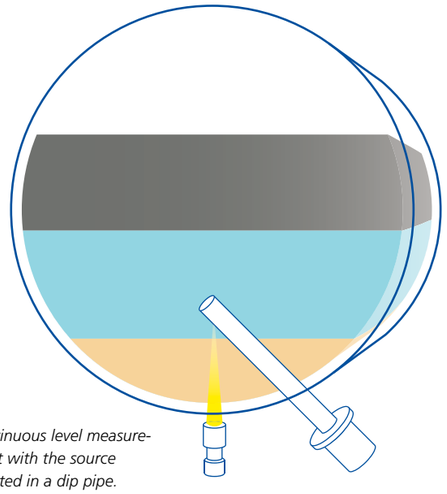
Sand is removed from the liquids in hydrocylones or in sand settling tanks. The sand level information is very important to control the desanding process. BERTHOLD radiometric level transmitters are ideal for monitoring the sand level, because of their non-contacting nature. Depending on the individual application and requirements the measurement can be realized either with multiple point level measurements or with continuous level measurements.

Application Profile

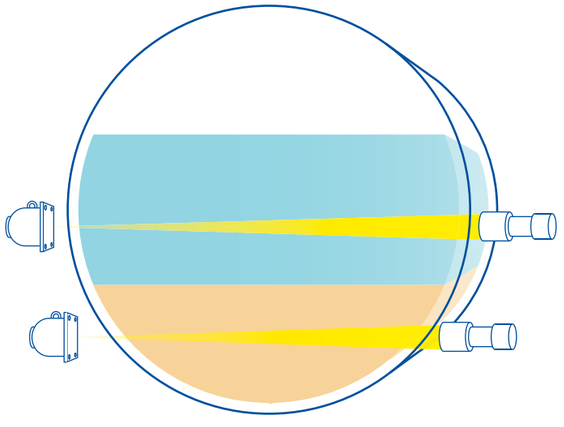
- **Measurement task**
  Sand level measurement
- **Location**
  Separator, Sand settling tank, Desanding unit
- **BERTHOLD Solution**
  Radiometric level transmitter / density switch (SIL2 / SIL3) e.g. SENSseries LB 480



Continuous level measurement on a conical tank.



Continuous level measurement with the source inserted in a dip pipe.



Multiple point level measurements installed as high level and low level switch.

Customer Benefit

- Online, real-time level information
- Improved control of sand jetting systems and sand outlet
- Ideal utilization of tank capacity
- Optimizing settling time

Characteristics

- Non-contacting, non-intrusive measurement
- No abrasion, long-life solution
- Maintenance-free, no moving parts
- Highly repeatable measurement

Measuring Liquid Level in Wet Gas Scrubbers

Wet Gas Scrubbers are used for the separation of mist and liquid droplets out from the gas stream. The liquids are collected in the bottom of the vessel and have to be measured by a reliable measuring system. BERTHOLD level measurement gauges are used to measure the total liquid level in a gas scrubber. Due to their high stability and repeatability the systems are maintenance-free and do not require re-calibrations.

Application Profile

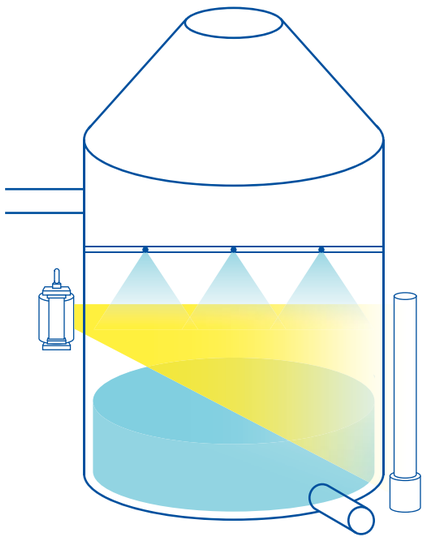
- **Measurement task**
  Continuous level measurement of liquids
- **Location**
  Wet Gas Scrubber
- **BERTHOLD Solution**
  Radiometric level transmitter (SIL2 / SIL3) e.g. SENSseries LB 480

Customer Benefit

- Online, real-time level information
- Optimized utilization and improved control of tank capacity
- Increased process efficiency
- Safe control of high level and low level set-points
- Trend monitoring and data logging

Characteristics

- Reliable & accurate level measurement, not affected by process pressure and temperature
- Non-contacting, non-intrusive technology
- Outside mounting of components
- Maintenance-free
- Highly repeatable
- SIL2 / SIL3 certified detectors as an option



Typical level arrangement on a wet gas scrubber

Detecting Slugs

Severe problems can be caused by slugs on offshore platforms. Examples include disturbance in separators, excessive flaring and reduction of production capacities. In order to reduce the adverse effects an early detection of an arriving slug is essential. The slugs are measured by means of radiometric densitometers with shortest response time to guarantee an early warning and initiation of appropriate measures.

Application Profile

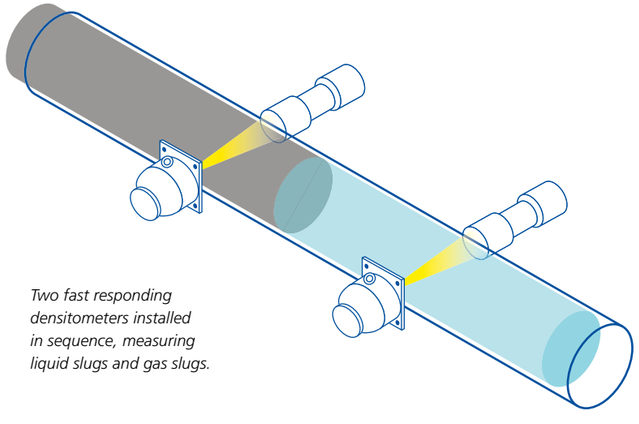
- **Measurement task**
  Detection of gas / liquid slugs
- **Location**
  Pipeline, Slug catcher inlet
- **BERTHOLD Solution**
  Radiometric densitometer with SpeedStar functionality e.g. SENSseries LB 480

Customer Benefit

- Early information on arriving slugs
- Ideal preparation of inlet separators and downstream processes
- Increased process safety and consistency
- Analyzing slug properties

Characteristics

A radiometric densitometer is installed on the pipeline prior to the separation or slug catchers. With an unmatched response time of 50ms the system is ideally suited for the detection of fast moving slugs. Two densitometers installed in sequence provide even more details about the slug properties, such as slug velocity and size.



Two fast responding densitometers installed in sequence, measuring liquid slugs and gas slugs.

SENSseries LB 480

Our Product Line for Oil & Gas Applications

The demanding processes in the oil & gas industry require measurement devices with top level performance and operational safety. The BERTHOLD SENSseries detectors are specifically designed to be used for such applications. The first-class radiometric detectors offer an excellent long-term stability and repeatability for each application like point level, continuous level, interface and density measurements. Moreover SENSseries LB 480 has been awarded SIL2 / SIL3 certificates for use in safety critical applications. In short: SENSseries LB 480 is the product our oil & gas customers can rely on.

FOCUS ON RELIABILITY, SAFETY AND QUALITY

- **Compact field device with integrated transmitter**
- **For level switch, continuous level and density**
- **SIL2 and SIL3 certified for all applications**
- **Process connection via HART**
- **Continuous self-monitoring and enhanced diagnostics**
- **Enhanced software functionality (Gas Properties Compensation, Wall Build-Up Alarm…)**

[SIL 2] [SIL 3] [EX]

When Reliability matters

The use of cosmic rays as a constant reference source ensures a very accurate and long-term stable performance of the detector, regardless of ambient temperatures. Even the degradation of electronic components is compensated for. Thus the detectors reach an unmatched repeatability below 0.5%

Radiation Safety

When radiometric measurements are applied, radiation safety is typically a big concern making the supply of high sensitive detectors with increased efficiency concerning gamma radiation BERTHOLD's main priority. The use of high-quality scintillators is only one reason that allows our detectors to be operated with 80% lower source activity.

Quality made in Germany

The SENSseries detectors are developed and manufactured in Bad Wildbad, Germany. Only high-quality steel and components are used to ensure long service life and maintenance-free operation. Before delivery all detectors undergo a quality and climate test.

Compliant to your standards

SENSseries detectors have achieved SIL2 / SIL3 certification for level switch, continuous level and density applications. Moreover the detectors comply to the NORSOK standard and are approved for the use in hazardous areas.

For technical details please see our Density and Level brochures.

THE EXPERTS
IN MEASUREMENT TECHNOLOGY

Berthold Technologies stands for excellent know-how, high quality and reliability. The customer is always the focus of our solution. We know our business!
Using our varied product portfolio, our enormous specialized knowledge and extensive experience, we develop suitable solutions together with our customers for new, individual measurement tasks in a wide variety of industries and applications. Berthold Technologies is specialised in radiometric process measurements for 75 years. This is our core competence with state-of-the-art and cutting edge products and solutions covering a vast range of industries and applications.

We are here for you – worldwide!
The engineers and service technicians from Berthold Technologies are wherever you need them. Our global network assures you fast and above all competent and skilled assistance in case of need. No matter where you are, our highly qualified experts and specialists are ready and waiting and will be with you in no time at all with the ideal solution for even the most difficult measurement task.

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