Ultrasonic Slurry Density Analyser for Real-time monitoring

Slurry density monitoring and process control with ceramic ultrasonic sensors in metals & mineral processing plants, dredging and drilling applications
Arenal Process Control Solutions works closely with customers to increase the efficiency of their operation by offering accurate and highly reliable real-time measuring data from ultrasonic density probes.

The ultrasonic ceramic density sensors are preferred by our customers, because they are more reliable, accurate and environmental safe. In addition, they do not require maintenance and also have a longer lifespan.

The ongoing R&D program at Arenal guarantees a continuous improvement of measurement technology and the development of other new technologies and applications.

Quality control

Each Arenal product is designed, manufactured and delivered according to the quality assurance program ISO 9001 and tested at different production stages. After start-up and commissioning, the system will be monitored to ensure that the product delivers maximum performance and meets the process requirements.

Economic

Arenal offers density monitoring solutions for a lower price than nuclear analysers. In addition, the systems save costs by improving reliability, safety and accuracy while reducing maintenance needs.

Fast delivery

New analysers are available from stock and generally have a short delivery time. An immediate response can be provided when old nuclear analysers break down and density measurement is critical for your process control.

Local service

Our specialized and well trained sales and service teams offer worldwide support with services like field calibration, training and start-ups. If needed, the systems can be remotely monitored and controlled through the internet.
Ultrasonic spectroscopy is at the basis of all Arenal Ultrasonic Density Analysers. The field of ultrasonic spectroscopy looks at the behaviour of propagation of ultrasonic waves, and changes of waves due to changes in process conditions. In most monitoring situations, ultrasonic pulses are shot into the medium and the returning echo signals are analysed in a computer. The principle of ultrasonic spectroscopy is used in many industrial measurement applications like in density, temperature, level, flow, psd, concentration, viscosity, and non-destructive testing.

Non nuclear - Ultrasonic Slurry Density Analyser

Until now, real-time slurry density monitoring in the mining industry is done with risky, expensive and often inaccurate nuclear densitometers. With the introduction of the Arenal Ultrasonic Slurry Density Analyser the density recording can now be performed in a more secure, user-friendly and highly accurate manner. In addition, faster interventions are possible and the system ensures savings in maintenance costs.

Arenal is the first and only producer of ceramic ultrasonic spectroscopy sensors in the world for the determination of density, specific gravity, total suspended solids and temperature of abrasive and high concentration slurries. The ceramic sensor construction not only provides the best acoustical physical properties but it also provides the highest degree of hardness ensuring optimal wear-resistance for the most demanding applications in the industry. This makes the reliable ultrasonic technology in combination with the extremely durable sensor very suitable for monitoring a wide variety of mineral slurries.

Ultrasonic Spectroscopy

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Specifications:

- **Density range:** 0–4000 g/l
- **Density accuracy:** up to 3 g/l
- **Temperature range:** 3–55°C and 3–130°C
- **Temperature accuracy:** ≤ 0,01 °C

Mounting:
- Strong and durable aluminium enclosure with powder coating.
- Remote mounting up to 200 meters from the measuring point.
- Wall mounting without opening lid.

Features:
- Data logging of monitored data
- Control of ultrasonic transmitters
- Control sample taking and ID tracking
- Time trend graphs
- Echo scope functions
- Alarm screens
- Network connectivity

Connectivity:
- (2x) 4–20 mA output and 2x mA input
- Ethernet, Modbus TCP/IP
- 2-wire RS485 Modbus RTU
- Hart, Fieldbus, Profibus optional

Model SDA is designed to monitor Slurry Density and Mass Flow of heavy industrial slurries. The controller consists of an advanced industrial PLC based HMI, which offers great flexibility with advanced settings and clear screens and graphs for interaction with the user.

The standard measuring screen starts showing Specific Gravity, Density, Total Suspended Solids and Temperature. The user can select different start screens like a cross-meter in dredging applications. The controller communicates with the field transmitters and two measuring points can be connected simultaneously.

Accuracy graph between 4 and 40°C
Ultrasonic spectroscopy relies on the determination of physical properties with ultrasonic waves, and does not require any nuclear sources. As the sensors are made from one of the hardest ceramic material on earth, sintered silicon carbide, there is no requirement for maintenance. Arenal offers a wide variety of mounting solutions. This allows the density probes to be installed in existing situations without redesigning.

By measuring different physical acoustical properties, drift in the density range from 0 to 4000, is physically not possible.
The response–time is less than one second, so changes in the slurry density are observed immediately.
Arenal also offers sensors for submersed mounting in tanks or vessels. The sensor can be fixed mounted or combined with an automatic winch.

Remote monitoring
All probes in the field are remotely controlled by the SDA via the Modbus RTU communication protocol. After the SDA is connected to a VPN router or to a laptop with TeamViewer® via the Internet, the R&D team of Arenal PCS can take over any analyser in the field and assist during commissioning.

Analysis & Recording of Ultrasonic signals
Acoustical Physical Properties (APP) of materials (like acoustic impedance, time of flight, speed of sound, attenuation, ultrasonic spectroscopy) are related to their physical and state properties (density, temperature, dry solids concentration, viscosity, particle size). With Ultrasonic Spectroscopy we measure the APP’s and by reverse modelling of physical laws, the physical properties of the liquid are calculated. A measurement of acoustic impedance, time of flight and temperature enables us to calculate specific gravity and density. Speed of sound and temperature are correlated to a concentration of a dissolved solid. Acoustic waves are generated after applying a high voltage pulse to a piezo element. By means of the piezo electric effect, the element vibrates. This movement of the element is transmitted into the ceramic part of the sensor and then to the slurry, in which the ultrasonic waves are transmitted and reflected. By measuring the reflected waves, Arenal can determine the APP’s.

Oscilloscope function in the SDA analyzer
**Ceramic Ultrasonic Probes**

**In-line probes**
The Arenal ultrasonic probes are fit to be applied in high density abrasive slurries with flows up to 7 m/s. The ceramic sensor is made from one of the toughest materials on earth: Sintered Silicon Carbide (SiC). They are much more wear resistant compared to all other ceramics. Secondly the acoustical and physical properties of SiC are perfect for the applications in abrasive slurry density monitoring.

**Three mounting versions of the in-line probes are offered**
- Model SPC is only used in most demanding applications in spool pieces with PU lining. The small flange on the top of the SPC sensor is coated with Wolfram Carbide to prevent erosion. After more than three years of operation, this solutions has proven itself as maintenance free.
- Model WFC is applied in spool pieces, Saddle Type Flanges and Wafer Cells when the sensor is mounted from outside to inside the pipe.
- Model PRC is selected in all other applications, like in process nipples and tank walls.

**Submersible probe**
Submersible ultrasonic sensors are often used in applications where the density of a slurry in a tank has to be determined. The SiC ceramic probe is heavy enough to reach the bottom of the thickening tank. Its fully polished round shape prevents scaling on the surface and the SiC material offers you fast responses within 1 ms.
Spool piece / saddle type

To measure the density of abrasive slurries in pipes, Arenal offers complete spool pieces with PU lining. The SPC sensor is flush mounted from the inside to outside of the pipe and fixed in a saddle type flange.

Arenal also offers spool pieces without lining for any pipe size and flange reference. In this case, the WFC probe is used and mounted from the outside to the inside of the pipe and fixed in the same saddle type flange.

Steel Wafer Cell

The Steel Wafer Cell is designed for high pressure (up to 600 bar) and paste applications. Mounting is between the two flanges of the pipe. It is our latest technology with sensor-less configuration: there is no sensor in contact with the medium. The stainless steel cell has a wolfram carbide coating on the inside. Optionally, this system can be used to measure the wear in pipes, when it is assumed that the erosion of the pipes is similar to the erosion of the wafer cell. In any case, it does not influence the measurement of density.

Standard Wafer cell

The standard wafer cell is made from UPE-1000 (high molecular weight polyurethane). It is clamped between two flanges of the pipe. This cell is designed for low pressures (up to 7 bar) and low temperatures (up to 55 °C). Wafer Cells are designed for each pipe individually, as the size of the flanges and the inner diameter of the wafer cell must correspond. A well designed wafer does not wear out.
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