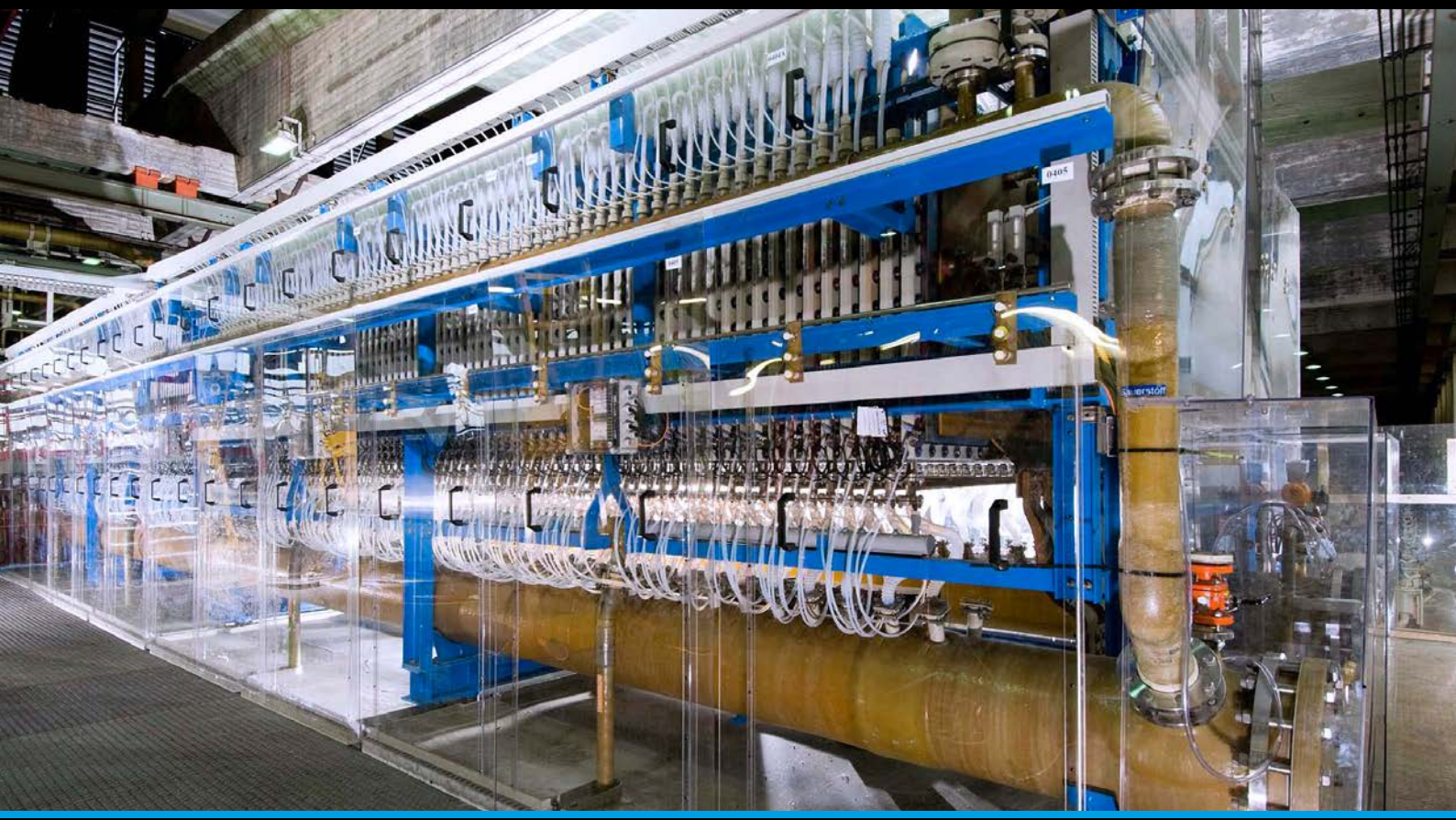
SensoTech



Chlorine-alkali electrolysis

Inline analytical technology for:

- brine purification
- electrolysis
- chlorine gas drying
- NaOH concentration
- hydrochloric acid production

Increase quality, save resources: LiquiSonic®. With high-quality, innovative sensor technology. Robust, precise, user-friendly.

LiquiSonic®

LiquiSonic® is an inline analytical system for determining the concentration in liquids directly in the production process. The analyzer is also used for phase separation and reaction monitoring. Sensor installation within the product stream means an extremely fast measurement that responds immediately to process changes.

User benefits include:

- optimal plant control through online and real-time information about process states
- maximized process efficiency
- increased product quality
- reduced lab costs
- immediate detection of process changes
- energy and material savings
- instant warning of irruptions in the process water or process liquid
- repeatable measuring results

LiquiSonic's® ‚state-of-the-art' digital signal processing technology guarantees highly accurate, fail-safe measuring of absolute sonic velocities and liquid concentrations.

Integrated temperature detection, sophisticated sensor design, and know-how from SensoTech's extensive measurement history in numerous applications promises users a highly reliable, long life system.

Advantages of the measuring method are:

- absolute sonic velocity as a well-defined and retraceable physical quantity
- independent from conductivity, color or optical transparency of the process liquid
- installation directly into pipes, tanks or vessels
- robust, all-metal, gasket-free sensor design with no moving parts
- corrosion-resistant by using special material
- maintenance-free
- use in temperatures up to 200 °C (390 °F)
- accurate, drift-free measurements
- stable measurements even amid gas bubbles
- controller connection capacity reaching up to four sensors
- data transmission via fieldbus (Profibus DP, Modbus), analog outputs, serial interface or Ethernet

Inline process analysis

Contents

Processes

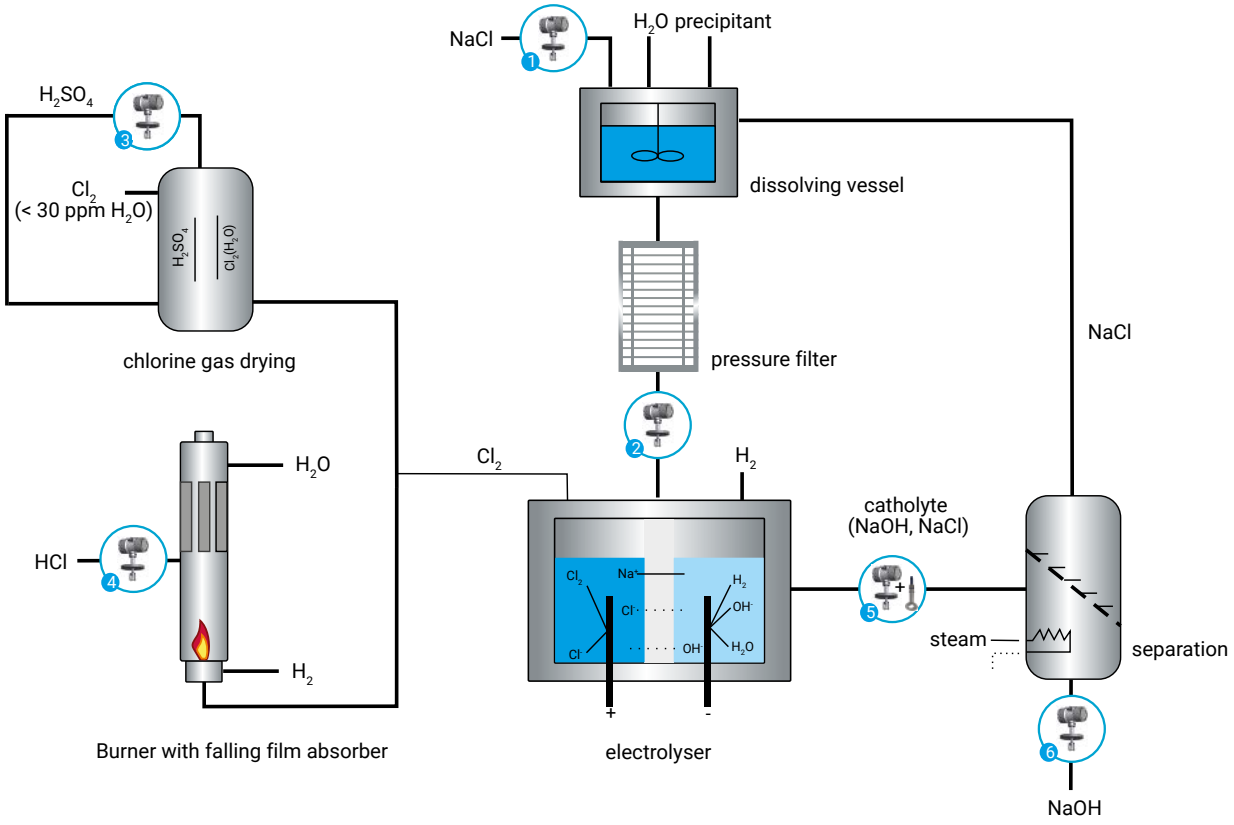
Introduction

The chlorine-alkali electrolysis is an important procedure in the chemical industry. Here the products chlorine, hydrogen, hydrochloric acid and caustic soda are generated from sodium chloride. There are three manufacturing methods: the diaphragm, the membrane and the amalgam process.

The LiquiSonic® analyzer provides an advantageous utilization in the varied process steps of the three methods.

Foremost, the customer gains the advantages of a reduction in raw material and energy consumption, as well as an increase in the yield.

The diagram below shows the typical processes and LiquiSonic® applications in the chlorine-alkali electrolysis, which is illustrated in a sample diaphragm method.



Measuring	Installation	Measuring task
1 2	pipe	monitoring of the delivered brine to the agreed target concentration, monitoring of the dissolving station to the maximum salt saturation
3	pipe	determination of the sulphuric acid concentration during the chlorine gas drying to avoid too strong dilution
4	pipe	determination of the required final concentration of HCl
5	pipe	maximizing of the effectiveness degree of the electrolyzer, through the determination of the catholyte concentration
6	pipe	determination of the required final concentration of NaOH

LiquiSonic® measuring points in the processes of the diaphragm method of the chlorine-alkali electrolysis

Dissolving station and brine purification

The raw material sodium chloride (NaCl) is gained by either the vaporizing of sea water, mechanical or solution mining of salt deposits. The raw brine contains contaminants and calcium or magnesium salts, that clog the fine pores of the diaphragm or the membrane during the electrolysis and can thereby visibly reduce their lifespan. It is for this purpose that the contaminants are precipitated in the agitation plant containers (dissolving vessels), through the addition of caustic soda. After the precipitating, the contaminants are separated with the aid of a pressure filter.

The purity of the brine concentration is especially important for the subsequent electrolysis. The LiquiSonic® analyzer offers the ability to determine a very precise brine concentration at any time. The installation takes place in the dissolving station in the case of mechanically mined salts, or at the brine suppliers' transfer point in the case of cavern mining.

Your advantage:

- avoiding of quality failures during the brine purification
- extending of the membrane's lifespan
- incoming goods inspection (in cavern mining)
- reduction in water and/or steam consumption (during the salt dissolving)
- reduction in electrical energy consumption

LiquiSonic® optimizes the lifetime of membranes in electrolysis

Electrolysis

With the help of electrical power, the salt (NaCl) is broken down into chlorine (Cl_2), caustic soda (NaOH) and hydrogen (H_2). For this purpose, two methods are primarily utilized: the diaphragm and the membrane method.

With both methods, the same electrochemical reaction occurs: The NaCl flows into the anode chamber of the cell, where the Cl_2 separates as chlorine gas. Subsequently, the solution reaches the cathode chamber, where H_2 and NaOH are formed.

The deciding difference in both methods, lies in the technical execution of the anode and cathode separation, which is crucial for the purity and concentration of generated caustic soda.

The membrane and the diaphragm constitute a high cost factor within both methods. The LiquiSonic® analyzer is utilized for a precise determination of the catholyte concentration, in order to identify possible electrolyzer inefficiencies and to counteract them. This way, an optimum membrane lifespan can be achieved.

Depending on which method is utilized, the catholyte involves either a NaOH-solution (membrane method) or a NaOH-NaCl-solution (diaphragm method). The concentration measurement of the 3-component mixture is accomplished with the use of a Liquisonic® 40 analyzer, whereby the ultrasonic sensor is combined with a conductivity probe.

Your advantage:

- maximizing of the electrolyzer‘s effectiveness degree, through the continuous concentration measurement directly in the process
- energy saving and consumption optimizing
- reduction in labor intensive comparison analyses
- extending of the membrane‘s lifespan

LiquiSonic® eliminates the need for time-consuming sampling

Preparation of end products

Caustic soda concentration

The market ready caustic soda (NaOH) typically has a concentration between 45 wt% and 50 wt%. Due to the fact that NaOH gained from electrolyzer cells only yields a concentration range between 12 wt% and 33 wt%, it is concentrated in cascade evaporators.

If next to NaOH the solution contains NaCl (diaphragm method), the excess salt in the caustic soda precipitates in a crystal form during the evaporation. This way, the NaOH-concentration is elevated to 45 wt% and 50 wt%.

The LiquiSonic® analyzer continuously determines the concentration of caustic soda at any time after the evaporator. A subsequent dilution of the caustic soda to a customer specific product concentration, can also be monitored.

Your advantage:

- continuous concentration monitoring of the caustic soda
- reduction in the energy costs during the evaporation

Hydrochloric acid production

The chlorine gas that is generated on the anode of the electrolyzer and the added hydrogen, form the base materials for the synthesis of hydrochloric acid. For this, both gases are fed into a burner and there they react to form hydrogen chloride. Subsequently, the formed HCl-gas streams from the burning chamber into the integrated isothermic falling-film-absorber. Here, the gas is absorbed with the help of water or diluted acid, whereby concentrated hydrochloric acid (37 wt% HCl) is formed.

Using the LiquiSonic® analyzer, a continuous monitoring of the hydrochloric acid concentration is possible. This affords the ability to recognize deviations from the target concentration and to react accordingly.

Ihre Vorteile:

- continuous concentration monitoring of hydrochloric acid (20-40 wt% HCl)
- ensuring of an extremely precise target concentration

Absorption towers

Chlorine gas drying

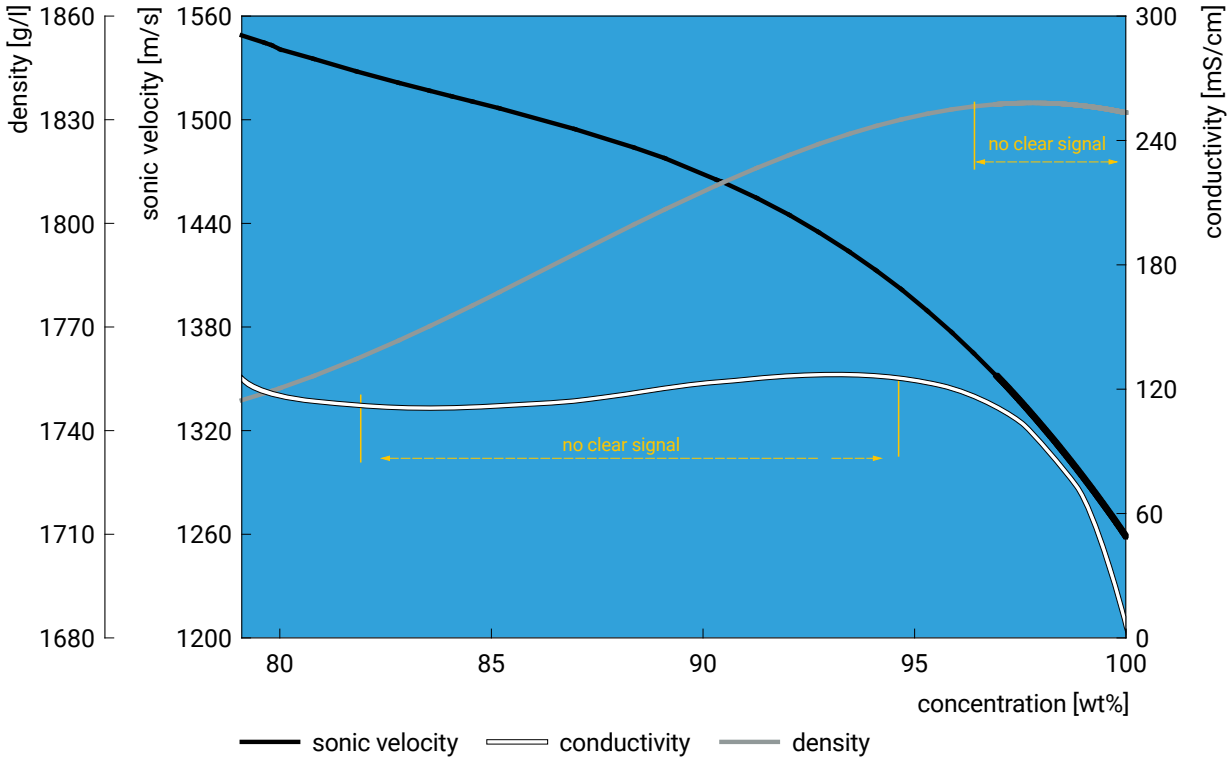
The chlorine gas must be freed of its water content before it is further processed, due to the fact that its corrosiveness elevates at a moisture content of over 30 ppm. For the drying, the chlorine gas is routed into the absorption towers, where the water content in the chlorine gas is absorbed with highly concentrated sulphuric acid (80 – 99 wt% H_2SO_4).

The effectiveness of this drying process significantly influences the productivity and quality of the gas. This is why a reliable measurement of the H_2SO_4-concentration is especially important. The LiquiSonic® analyzer offers a continuous and safe monitoring of the H_2SO_4-concentration, in opposition to conductivity and density measurement.

Your advantage:

- elimination of labor intensive sampling
- continuous monitoring of H_2SO_4-concentration
- clear concentration determination signal between 80 wt% and 100 wt% H_2SO_4
- ensuring the desired Cl_2 dryness to avoid corrosions in the system

Advantage of sonic velocity as compared to conductivity and density in sulfuric acid



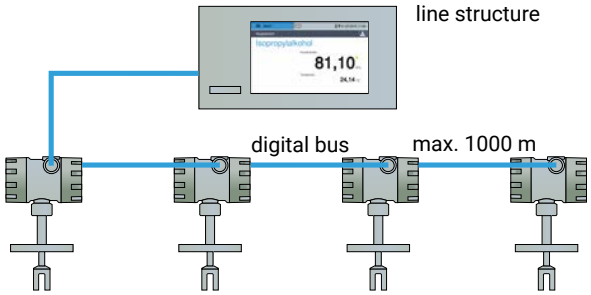
LiquiSonic® System

LiquiSonic® sensing is available in three systems: LiquiSonic® 20, LiquiSonic® 30 and LiquiSonic® 40.

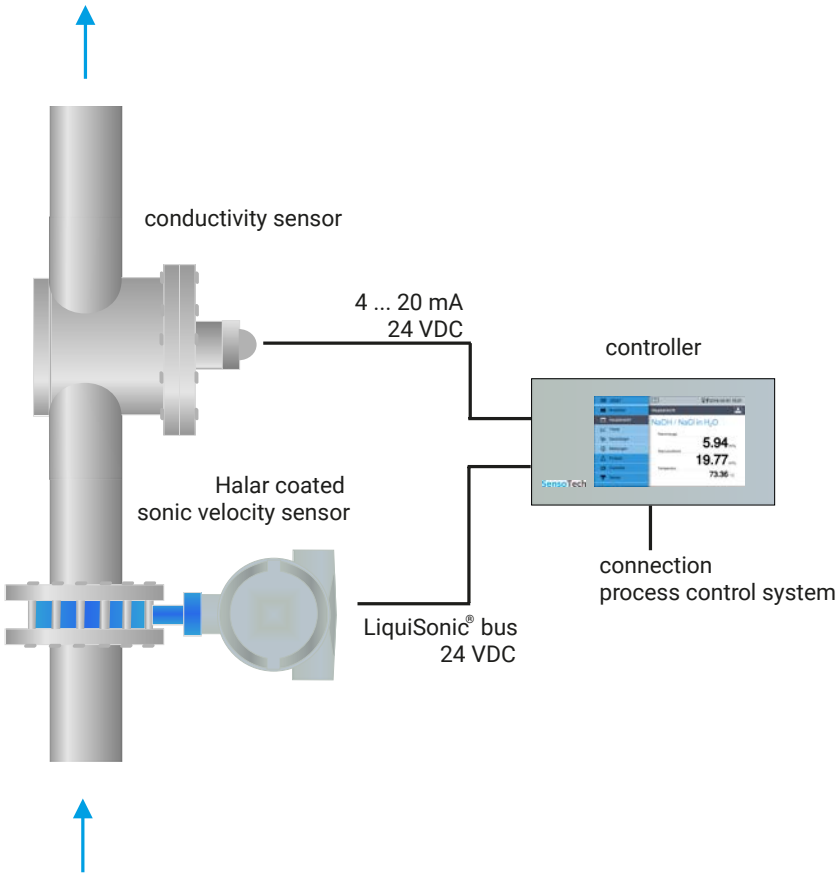
LiquiSonic® 30 is a highly efficient device that includes one controller with connection up to four sensors that can be installed in different locations.

LiquiSonic® 20 is a variant with reduced functionality and an economical single-channel solution.

LiquiSonic® 40 enables the simultaneous determination of two concentrations in one liquid mixture by tracking a second physical quantity in combination with sonic velocity. In chlorine-alkali processes, the LiquiSonic® 40 system includes a conductivity probe as second physical value.



Controller with connection of maximum four sensors



LiquiSonic® 40 application

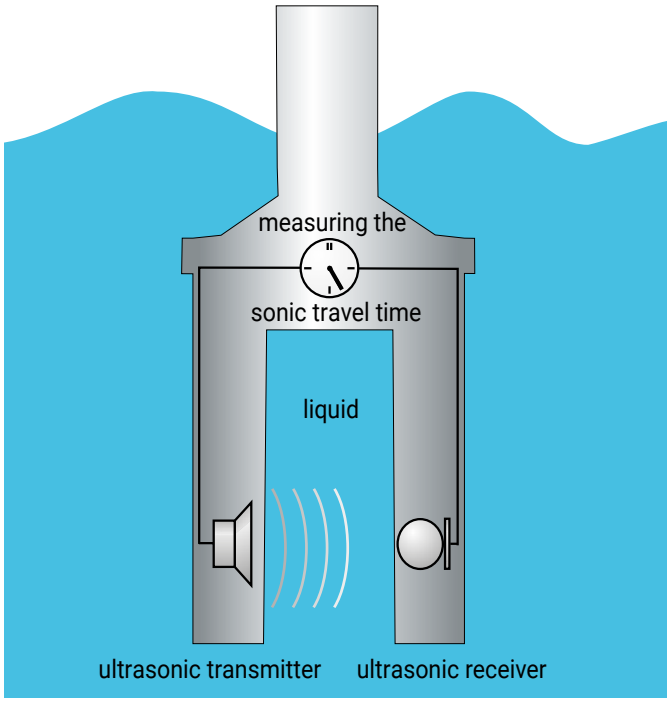
Measuring principle

The LiquiSonic® ultrasonic analyzer can determine liquid parameters such as concentration or density, as well as being useful for phase separation and reaction monitoring.

The measuring principle is based on the determination of sonic velocity in liquids. The sensor distance (d) between the sonic transmitter and receiver is known, so it is possible to determine sonic velocity (v) simply by clocking the travel time (t) of the sonic signal (v = d / t). Since sonic velocity depends on substance concentration, they form a direct relationship to compute and control concentration levels.

The ultrasonic measuring method is independent of a liquid's optical transparency and features high accuracy, repeatability and reliability.

Complementing the sonic velocity measurement, the LiquiSonic® analyzer includes a fast, accurate temperature measurement for temperature compensation – offering great benefits for many applications where conventional measuring methods are limited.



Measuring principle of sonic velocity

Sensor

The LiquiSonic® sensor continuously senses both concentration and temperature in pre-defined ranges for updating all process-related information every second.

The liquid-wetted parts of the sensor are made of stainless steel or corrosion-resistant material such as Hastelloy C-2000, Halar or PFA.

The rugged, completely enclosed design requires no gaskets or „window“, making it totally maintenance-free.

Additional sensor features such as flow / stop or full / empty pipe monitoring greatly advance process control.

Special high-power technology stabilizes measuring results, even when facing gas-bubble accumulations or large-scale signal attenuation through the process flow.

Controller

The controller processes and displays the measuring results. The operation via the high resolution touch screen is easy and intuitive. Secure network integration including web server allow operating the controller alternatively via browser with a PC or tablet.

The data can be transmitted in several defined analog-digital forms or through different fieldbus interfaces to communicate with process control systems or computers.

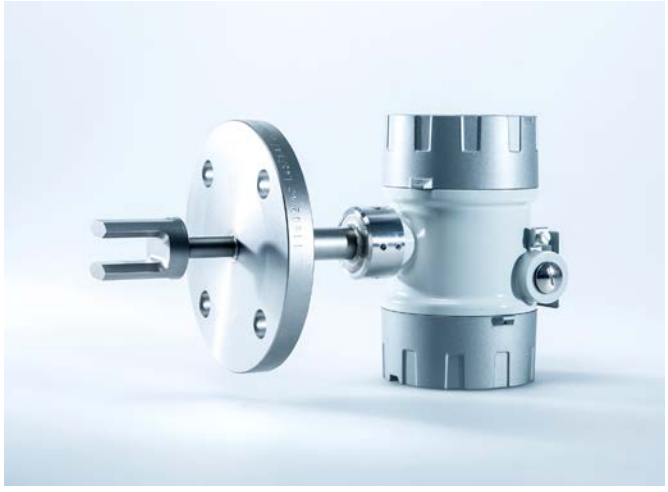
It is possible to create user-configured thresholds to regulate the process to avoid undesirable process states, including acid “runaway.”

The controller features an integrated data logger which can store up to 2 GB of process information with up to 32 (optional 99) data sets for different process liquids. For processing on the PC, the data can be transferred via network or USB port. In addition, the controller enables creating easily process reports for documentation purposes.

The event log records states and configurations such as manual product switches, changes to date and time, alarm messages or system states.

Accessories include:

- fieldbus
- UMTS router
- network integration & web server
- rack-mounted housing (anodized aluminium)
- wall-mounted housing (plastic or stainless steel)



Immersion sensor 40-14

Controller integrated in the wall-mount plastic housing

Technical specifications

controller type	controller 20 controller 30 controller 40
sensor type	immersion sensor
sensor material	H_2SO_4: Hastelloy C-2000 NaOH: Stainless Steel HCl: Halar NaCl: Hastelloy C-2000/Titan NaOH/NaCl: Hastelloy C-2000/Titan & PFA coated conductivity probe
sensor length	customized
minimum process temperature	-20 °C (-5 °F)
maximum process temperature	120 °C (250 °F) optional 200 °C (390 °F)
maximum process pressure	250 bar (3626 psi)
process fitting	DIN ANSI others on request
interface	analog outputs: 4 × 4 – 20 mA Modbus RTU Profibus DP digital outputs: 6 × electronical relays
concentration range	H_2SO_4: 80 – 100 wt% NaOH before evaporator: 25 – 35 wt% NaOH after evaporator: 45 – 55 wt% HCl: 25 – 37 wt% NaCl: 15 – 27 wt% NaOH/NaCl: 0 – 15 wt% NaOH and 0 – 25 wt% NaCl
Ex approval	ATEX IECEx FM
protection degree	IP65 IP67 IP68 NEMA 4X NEMA 6P
ambient temperature range	-20 °C to 60 °C (-5 °F to 140 °F)
accuracy	sonic velocity: up to ± 0.1 m/s concentration: up to ± 0.05 wt%

Quality and Support

Enthusiasm for technical progress is the driving force behind our company as we seek to shape the market of tomorrow. As our customer you are at the center of all our efforts and we are committed to serving you with maximum efficiency.

We work closely with you to develop innovative solutions for your measurement challenges and individual system requirements. The growing complexity of application-specific requirements means it is essential to have an understanding of the relationships and interactions involved.

Creative research is another pillar of our company. The specialists in our research and development team provide valuable new ways to optimize product attributes, such as testing new types of sensor designs and materials or the sophisticated functionality of electronics, hardware and software components.

Our SensoTech quality management also only accepts the best production performance. We have been certified according to ISO 9001 since 1995. All device components pass various tests in different stages of production. The systems have all gone through an internal burn-in procedure. Our maxim: maximum functionality, resilience and safety.

This is only possible due to our employee`s efforts and quality awareness. Their expert knowledge and motivation form the basis of our success. Together we strive to reach a level of excellence that is second to none, with passion and conviction in our work.

Customer care is very important to us and is based on partnerships and trust built up over time.

As our systems are maintenance free, we can concentrate on providing a good service to you and support you with professional advice, in-house installation and customer training.

Within the concept stage we analyze the conditions of your situation on site and carry out test measurements where required. Our measuring systems are able to achieve high levels of precision and reliability even under the most difficult conditions. We remain at your service even after installation and can quickly respond to any queries thanks to remote access options adapted to your needs.

In the course of our international collaboration we have built up a globally networked team for our customers in order to provide advice and support in different countries.

We value effective knowledge and qualification management. Our numerous international representatives in the important geographical markets of the world are able to refer to the expert knowledge within the company and constantly update their own knowledge by taking part in application and practice-oriented advanced training programs.

Customer proximity around the globe: an important element of our success worldwide, along with our broad industry experience.

In liquids, we set the measure.
With innovative sensor technology.
Tough, accurate, user-friendly.

SensoTech

SensoTech is a provider of systems for the analysis and optimization of process liquids. Since our establishment in 1990, we have developed into a leading supplier of process analyzers for the inline measurement of liquid concentration and density. Our analytical systems set benchmarks that are used globally.

Manufactured in Germany, the main principle of our innovative systems is to measure ultrasonic velocity in continuous processes. We have perfected this method into an extremely precise and remarkably user-friendly sensor technology. Beyond the measurement of concentration and density, typical applications include phase interface detection or the monitoring of complex reactions such as polymerization and crystallization.

Our LiquiSonic® measuring and analysis systems ensure optimal product quality and maximum plant safety. Thanks to their enhancing of efficient use of resources they also help to reduce costs and are deployed in a wide variety of industries such as chemical and pharmaceutical, steel, food technology, machinery and plant engineering, car manufacturing and more.

It is our goal to ensure that you maximize the potential of your manufacturing facilities at all times. SensoTech systems provide highly accurate and repeatable measuring results even under difficult process conditions. Inline analysis eliminates safety-critical manual sampling, offering real-time input to your automated system. Multi-parameter adjustment with high-performance configuration tools helps you react quickly and easily to process fluctuations.

We provide excellent and proven technology to help improve your production processes, and we take a sophisticated and often novel approach to finding solutions. In your industry, for your applications – no matter how specific the requirements are. When it comes to process analysis, we set the standards.

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