



# Bath monitoring

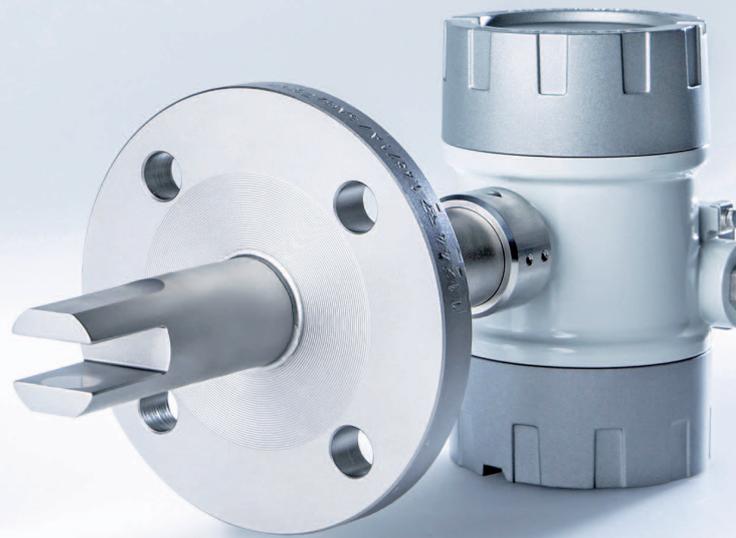
Inline analytical technology for:

- cleaning
- rinsing
- treatment
- hardening
- coating

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**LiquiSonic®**

quality, **saving resources: LiquiSonic®.**

-value, **innovative sensor technology.**

curate, **user-friendly.**

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 interruptions 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-lived system.

Advantages of the measuring method are:

- absolute sonic velocity as a well-defined and retraceable physical quantity
- independence 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**

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# 1 Processes



The LiquiSonic® analyzer allows a continuous monitoring of cleaning, degreasing, quenching, rinsing and treatment baths in all common industrial surface treatment and cleaning processes.

Spray or immersion baths are used to remove film-type or particulate soiling from components. In baths for surface treatment, for example, anti-corrosion coatings are applied or surfaces are being densified or hardened by active substances.

Technologically, these processes are implemented in single baths or cascades. The graphic below shows an example of using the LiquiSonic® bath monitor in process. The analyzer is used for the bath preparation and bath maintenance.

## 1.1 Bath preparation

During the mixing of bath chemicals from supplied concentrates and the solvent (e.g. water), dilution control for target concentration is necessary as it ensures an efficient use of the materials used with consistent implementation of quality-related parameters. The dilution control can also be done directly in the bath in a separate storage tank.

## 1.2 Bath maintenance

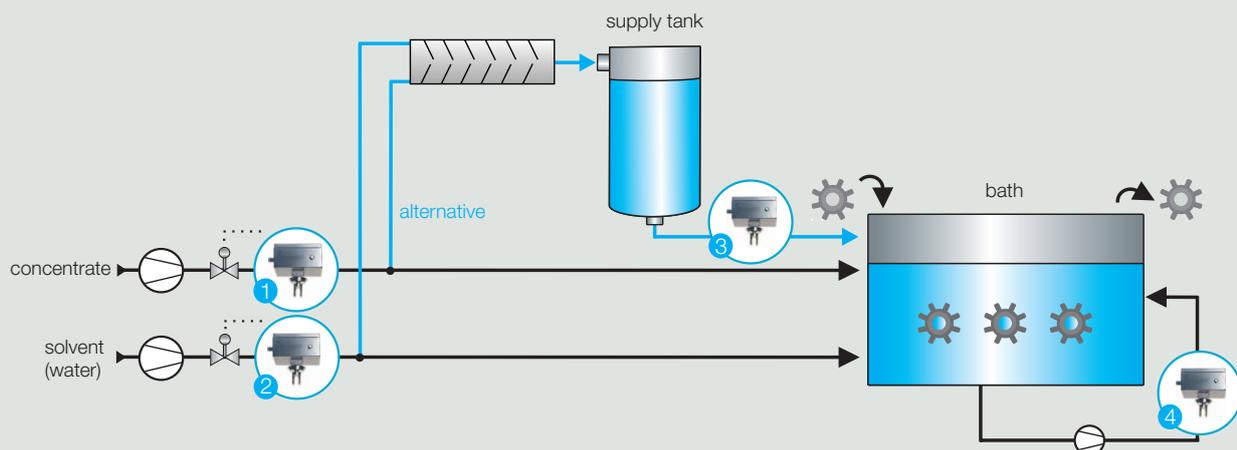
Process documentation is particularly important to have a proof of compliance with the quality related parameters „bath concentration“ and „bath temperature“ within the process chain.

The information on bath concentration is used to redose the cleaning agent or solvent, compensating carryover or evaporation-related losses.

Changing cleaning baths in batch processes, the determination of the contamination degree is important. When the maximum contamination level is reached, a bath change is signalled automatically. The change frequency is flexible and depends on the contamination of industrial parts and capacity.

The LiquiSonic® bath monitor is successfully used to measure the concentration of various types of cleaning agents, such as:

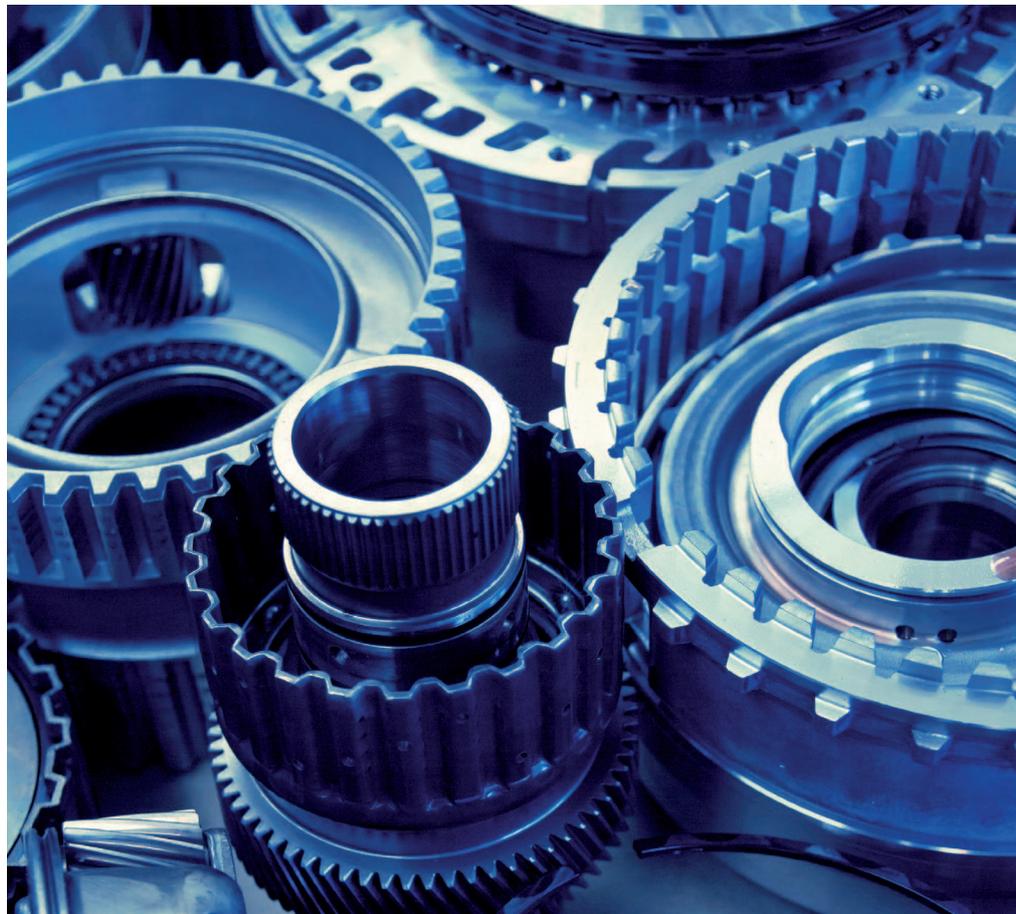
- aqueous cleaners, e.g. Vigon A201
- semi-aqueous cleaners, e.g. Axarell
- nonaqueous cleaners, e.g. n-propanol
- alkaline cleaners, e.g. Wigol VR X 621
- neutral cleaners, e.g. FeroClean N
- acidic cleaners, e.g. Septacid BN-PS



Measuring point	Installation	Measuring task
1, 2	pipeline	incoming goods control
3	pipeline	initial bath control
4	bypass	determination of bath concentration or contamination degree

Bath monitoring with the LiquiSonic® analyzer

## 2 Applications



## 2.1 Automotive and aircraft

In order to meet the cleanliness requirements of specific components and to ensure long-term reliability, impurities such as oil and mineral deposits are removed from finished components. Otherwise damages of the components arise, once they are used under extreme loads.

At high cleaning volumes, components are purified with aqueous cleaners such as Hakupur that consists of inorganic ingredients (builder) and tensides. These cleaners can remove oily ingredients well and disperse in the cleaning liquid.

For components with an complex geometry and very high cleaning requirements halogenated solvents, such as perchlorethylene, are often used. Due to their very high fat solubility, this solvents are common for complex components, including airbag generators, control elements and resonance accumulators. Additionally, the surface is dried and thus protected against corrosion.

In order to maintain the cleanliness, components are temporarily preserved before transport and storage. Depending on the duration of storage and type of preservative the protection lasts from a few

hours up to years. An inline concentration monitoring with LiquiSonic® allows a continuous quality control of the preservative, such as Hölteroil, and thus ensures the protection of the components.

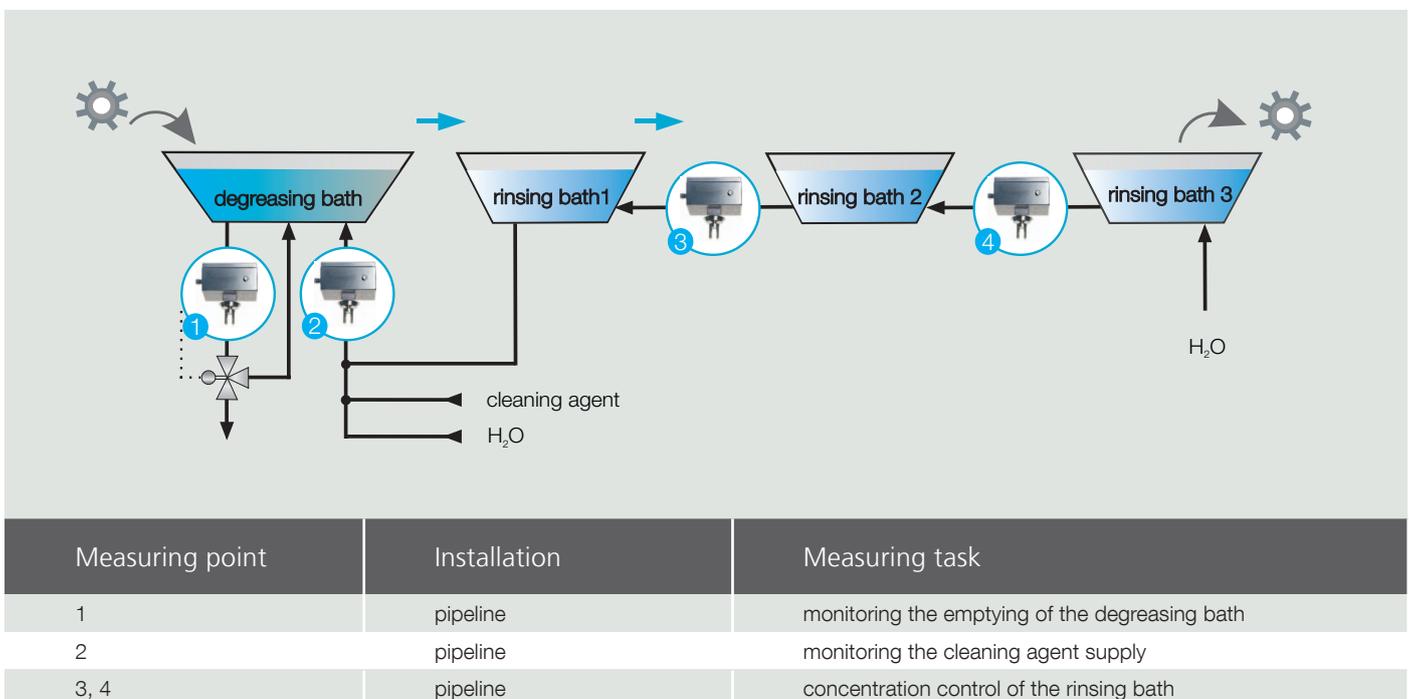
### Your benefits:

- detection of impurity levels in batch processes and thus display when rinsing bath change is required
- optimal concentration control and thus maximum cleanliness of the component
- fully automatic dosing through the incorporation of the measuring technology into the process control system

## 2.2 Metal processing

### 2.2.1 Cleaning

In the metalworking industry, different cleaning products are used depending on the cleaning method and surface contamination. These cleaning products usually consist of different components such as tensides and complexing agents, which have a high cleaning power in combination. Only the continuous concentration monitoring of these cleaners ensures a consistently good cleaning result.



Degreasing cascade

Depending on the material of the components, cleaning baths with aqueous or nonaqueous cleaners are used. Different baths are combined in order to achieve a high level of cleanliness of the components. In order to avoid transmission, rinsing baths are put between. Thus, the component is led through various cleaning stages in order to prepare it for coating, for example.

Furthermore, pickling baths are used to etch, modify, passivate or clean surfaces. Mostly, pickling solutions are used, which mainly consist of mineral acids such as hydrochloric acid. The concentration of these acids decreases during the pickling process, while simultaneously the proportion of interfering components such as dirt and contamination increases.

The same effect equivalent to pickling with strong acids occurs in the use of acidic and alkaline cleaners such as Gardoclean. These cleaners remove light oxide layers on the surfaces.

After pickling the metal surface, the acid residues will be removed that eventually accumulate in the rinsing liquid. The cleaning is necessary to stop the surface process and prevent uncontrolled surface activities.

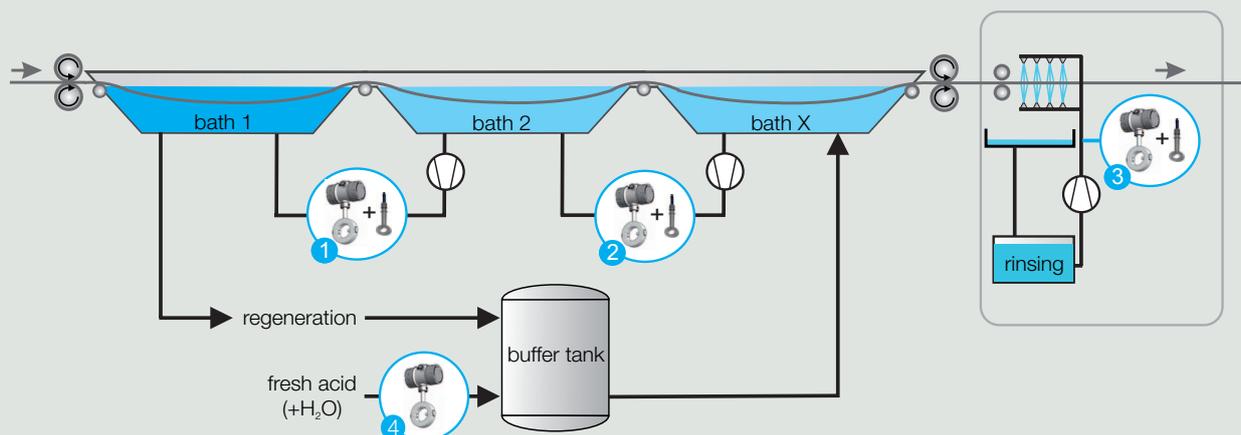
#### Your benefits:

- chemical resistance of the LiquiSonic® sensors through the use of special material (e.g. Halar)
- no running costs, as LiquiSonic® works completely maintenance-free
- reduction of manual sampling and laboratory costs
- signaling when rinsing bath change is required
- avoidance of overdosing and danger of component damages.

### 2.2.2 Hardening

Hardening is the process of heating a component to hardening temperature of quench and subsequent rapid cooling (quenching). During this process the component's structure changes, resulting in a significant increase in hardness. For example, saline solutions or oils are used as quenchant.

There is a high correlation between the concentration of the quench liquid and its efficiency. For example, an underdosing can lead to a too strong quenching effect. Consequently, this can cause cracks in the material, which reduce the quality of the final product in terms of the required hardness.



Measuring point	Installation	Measuring task
1, 2	pipeline or bypass	monitoring the pickling bath
3	pipeline	monitoring the rinsing bath
4	pipeline	concentration measurement and fresh acid redosing control

The concentration of the quenchant greatly varies by evaporation or discharge of the hardened parts. The use of the LiquiSonic® online monitoring shows significant advantages, because an undesirable decrease in the concentration will be detected in real time. So a rapid intervention, for example a dosage, in the ongoing process is possible, while reducing the risk to produce products of poor quality.

#### Your benefits:

- avoiding incorrect dosages
- preventing cracking
- insufficient hardening in case of overdose
- reproducible results through constant quenching
- targeted and efficient process control
- ensuring optimum hardness of products

### 2.2.3 Coating

Ensuring an effective and efficient coating by monitoring the concentration and quality of the coating materials requires inline analysis in coating processes with liquid substrates such as adhesion promoters or corrosion protection.

A corrosion protection of metallic materials can be ensured through the application of protective

agents such as Wigol. These inhibit the formation of rust over several weeks. The temporary protection enables a longer storage of the products between the processing steps.

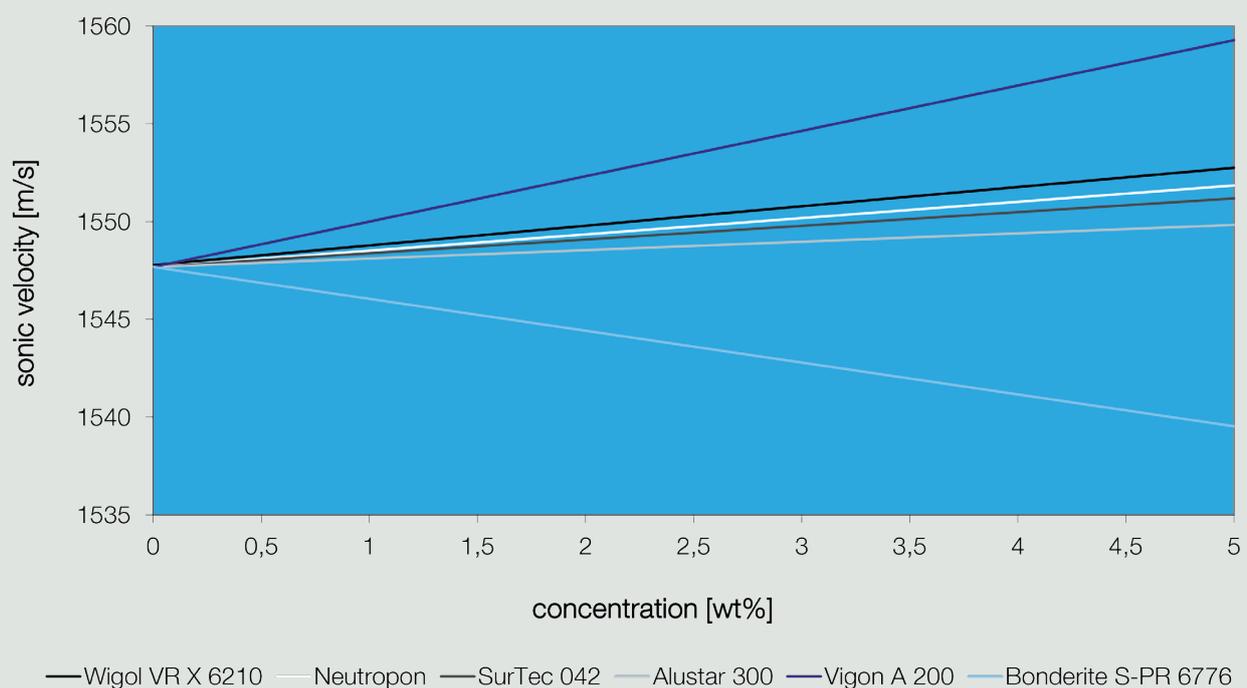
After the coating, another product cleaning is performed in order to remove excess coating material and thus ensure optimum surface quality.

In all these processes, a maximum process safety, a continuous process documentation and optimum use of energy and raw materials can be achieved through an inline concentration monitoring by the LiquiSonic® sensors.

#### Your benefits:

- flexible installation of sensors even in small plants
- avoidance of overdosing and danger of component damages
- optimal set up of the concentration for a resource-conserving handling
- low investment costs as up to four sensors can be connected to one LiquiSonic® controller
- chemical resistance of the LiquiSonic® sensors by using special material (e.g. Hastelloy C2000)
- traceability through a continuous documentation of the process control in the internal memory

### Aqueous cleaning and coating agents



## 2.3 Electronics

In the electronics industry, residues of flux, resin and solder pastes are removed from components and printed circuit boards (PCB) through the use of different types of detergents.

**Aqueous cleaners**, such as Vigon and Atron, have the advantage of a very low VOC content (volatile organic compounds), which means they only have a few volatile components. Furthermore, there are no flash points, so cleaning facilities are not subjected to the requirements of explosion protection. In most cases, aqueous cleaners contain tensides as detergent substances, which assimilate the impurities and capture the cleaning liquid.

**Nonaqueous cleaner**, such as Henkel consists mostly of polar solvents, which very well dissolves resins and greases. Often several baths are combined with different solvents. Due to the prevalent requirements, LiquiSonic® sensors are applied that allow the use in potentially explosive atmospheres due to the ATEX / IECEx approval, zone 0 to 2.

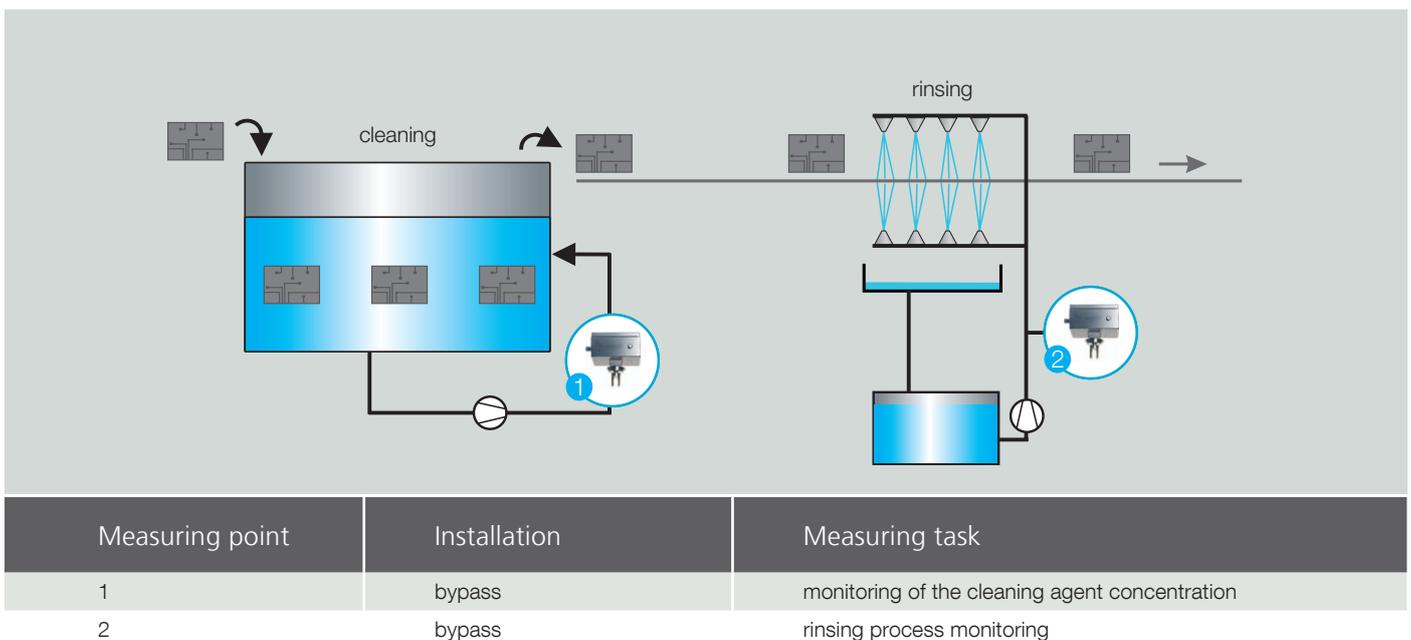
**Semi-aqueous cleaners** combine the advantages of both groups. These cleaners, such as Axarel remove flux residues particularly well and hold it in the cleaning agent. The LiquiSonic® bath monitor detects continuously the cleaner consumption. Furthermore, the measuring technology enables an automatic post-dosing, leading to enhanced efficiency of the cleaning system.

Especially with high-end components and chip fabrication, the quality of cleaning and thus the bath maintenance is of high importance in order to avoid electrical failures and corrosion.

Through the cleaning process, the electronic components are prepared for further processing such as wire bonding, encapsulation or coating. After cleaning, the components are rinsed in several steps in order to remove the detergent. Thereby, rinsing baths are enriched with cleaners. The use of LiquiSonic® enables, for example, the signalization of changing the rinsing bath to avoid a carryover.

### Your benefits:

- optimal adjustment of the detergent concentration for a resource-conserving handling of the cleaners
- signaling when rinsing bath change is required
- traceability through a continuous documentation of the process control in the internal memory
- use of LiquiSonic® in potentially explosive atmospheres due to the ATEX / IECEx approval
- low investment costs as up to four sensors can be connected to one LiquiSonic® controller
- flexible sensor installation even in small plants
- space-saving installation, especially in compact cleaning baths through optional remote sensor electronics



Printed circuit board cleaning

## 2.4 Plastics

In the production of plastic components and polymeric intermediates, surface contaminations such as release agents, abrasion and dust are removed in order to further process the components in subsequent processes. These include, for example, gluing, coating or painting.

For other products, monomers, inhibitors and other additives must be removed from polymer. Mostly pure solvents like propanol are used to dissolve residual monomers in an optimal way. Often, different cleaning baths are combined with various solvents to achieve the maximum cleaning effect. In order to avoid transmission rinsing baths are put between to ensure that the detergent is being removed from the plastic component.

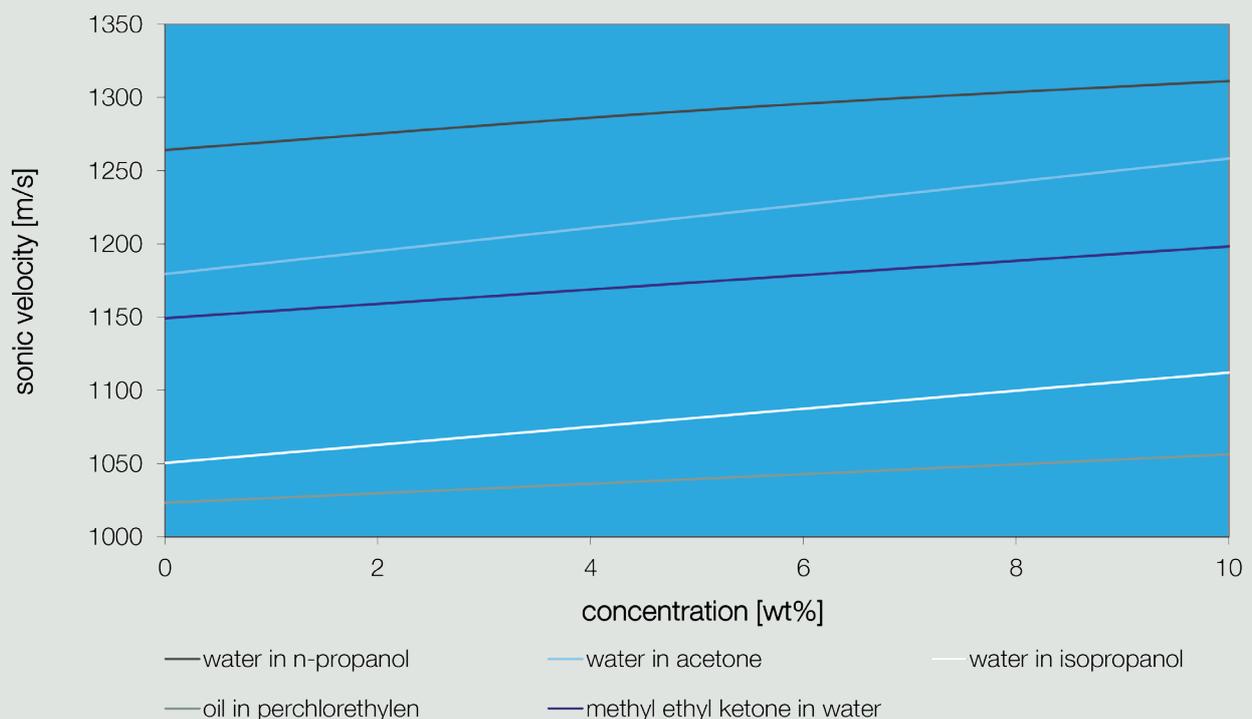
Plastic components are led through activation baths in order to prepare their surface for painting and coating. Thereby, the reactivity of the surface increases.

Further surface treatment baths include the application of functional layers, whereby components are for instance immersed into or sprayed with antistatic agents such as Markstat or Antifrog. Especially the food industry and medical technology is experiencing a greater demand of surfaces with anti-bacterial effect.

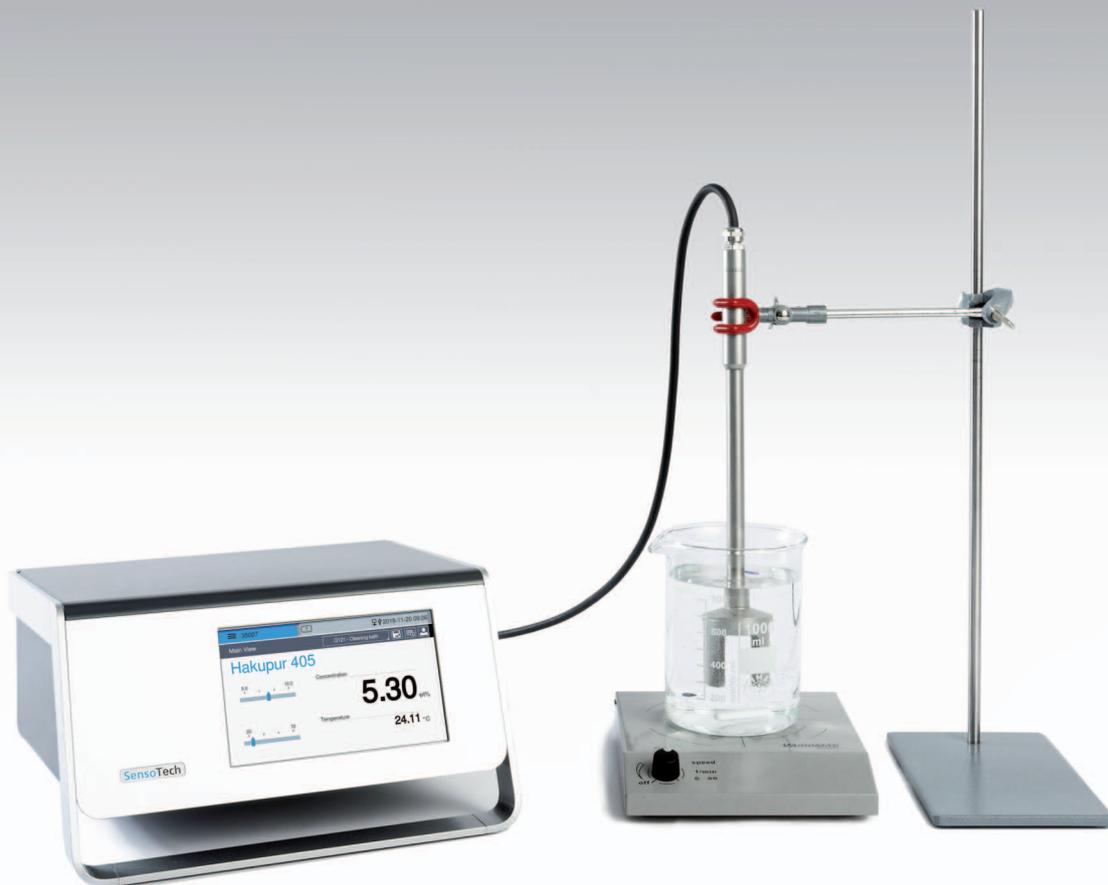
### Your benefits:

- use of LiquiSonic® in potentially explosive atmospheres due to the ATEX / IECEx approval
- signaling when rinsing bath change is required
- optimal concentration regulation and thus a maximum cleanliness of the components
- low investment costs as up to four sensors can be connected to one LiquiSonic® controller
- traceability, especially in medical technology through a continuous documentation of the process control in the internal memory

### Solvent-based cleaning



## 3 LiquiSonic® QC



### 3.1 LiquiSonic® QC in the production

For processes and systems in which an inline measurement is not feasible and the quality monitoring thus requires sampling, SensoTech has created a clever solution.

Especially with small volumes, an inline measurement is often not reasonable and entails expensive conversions.

Thus, **LiquiSonic® QC**, the especially developed **central quality test site**, is perfectly suitable in such systems.

**LiquiSonic® QC** is adjusted to the individual concentration ratios at the relevant measuring points in the production system. The system optionally comprises accessories. These complete the measuring station and ensure that it is immediately ready for use – without complex installation or commissioning.

The sensor electronics are integrated in the splash-proof controller. The latter provides for analysis and visualization of the sensor data. For aggressive process liquids, the sensor can moreover be made of different, resistant materials.

### 3.2 In two steps to the result

**LiquiSonic® QC** ensures error-free examination of different samples.

The measurement is completed in two easy steps:

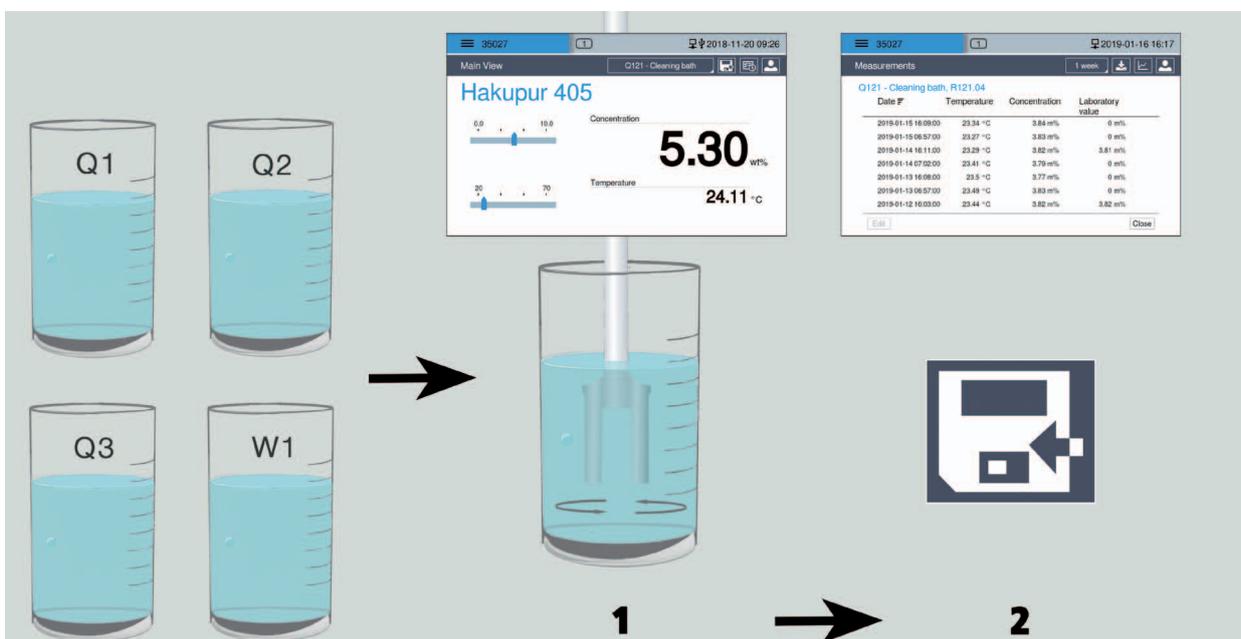
1. Select the corresponding measuring point at the controller and immerse the sensor into the stirred sample.
2. After few seconds, the measured value stabilises and the measurement is saved by pressing the corresponding button.

Afterwards, the measured values can be edited or – in case of faulty measurements – hidden via the tabular view for the data export.

**LiquiSonic® QC** moreover offers the possibility to directly store the measured values in the controller and to export them for further use, e.g. documentation or evaluations. The clear user interface and menu structure allow for easy control of the functions as well as intuitive system operation without extensive manual reference.

#### Your benefit:

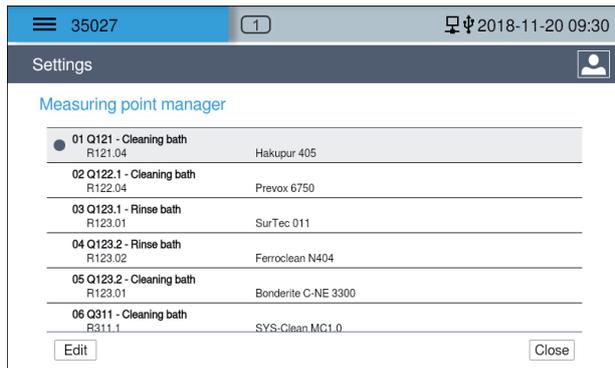
- fast, precise measurement
- reliable documentation of the data
- measured value overview (history) for quality check
- fast, intuitive operation by means of touch screen
- multi-language menu navigation
- data export into Excel (e.g. via USB)



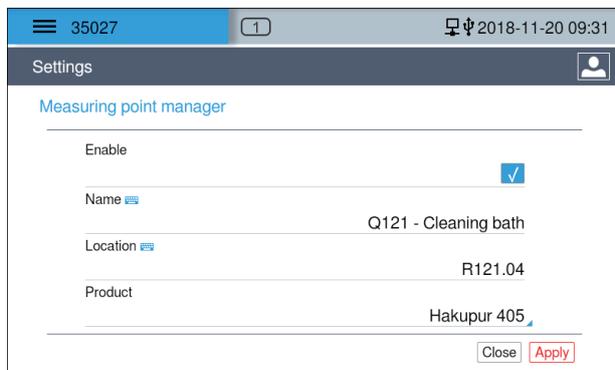
In two steps to the result

### 3.3 Measuring point management

The clear measurement point management is perfectly suited for the management and easy selection of the samples/measurements with only two clicks. In production systems, there are usually several measurement points that are to be checked; consequently, one digital measurement point is created in the device for every physical one.



LiquiSonic® QC is able to manage 20+ different measurement points. For each, 1,000 measurements can be saved. Every measurement point has an individual configuration and can be field-adjusted. Name, product to be measured and the room designation are freely adjustable. Apart from that, a laboratory value as reference and a comment can be assigned.

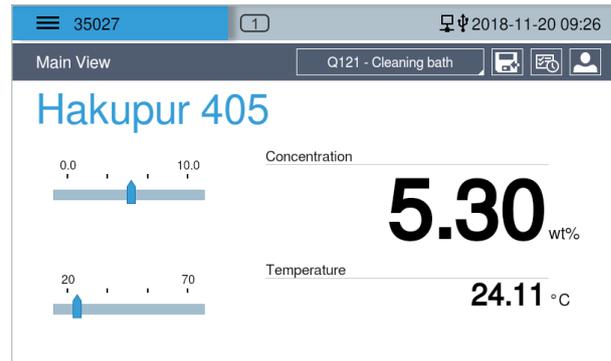


### 3.4 Limit value display

The fast and early identification of quality deviations prevents unnecessary costs. As support, the display of the **central quality test site** has a visual assistance.

The controller shows the limit value display in the left part of the screen. Deviations from the tolerances are identifiable at first glance due to the color marking.

If the value measured in real-time is outside the admissible limits, this is signaled by means of a warning and the deviation is documented. High quality of the cleaning, texture, flushing and preservation baths or the delivered products is thus guaranteed.



### 3.5 Data history

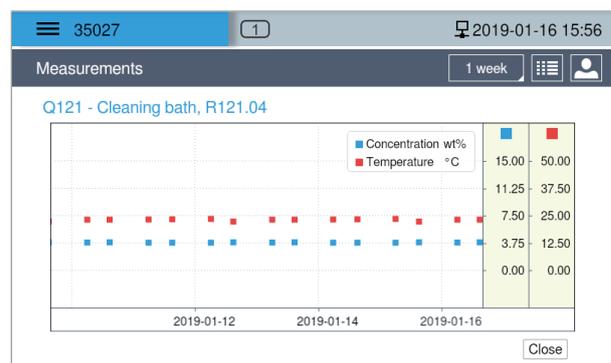
In the controller, the history of the measurements can be shown for any one of the 20+ measurement points in tabular and in graphical view. Both views are perfectly suited for getting a fast overview of the completed measurements.

One first, fast analysis of the data simplifies the detection of quality fluctuations at one glance. Subsequent, more detailed analyses are possible after the data export at a computer.

#### 3.5.1 Graphical view

In addition to the tabular view, the controller is able to display measurements in a clear form in a diagram. The modern, high-resolution color display allows for the easy identification of trends and developments in the course of time.

Deviations can also be easily detected in the course of time of the measurement points. These data can be exported for documentation purposes or downloaded to a computer in the form of a data sheet.



#### Your benefit:

- clear visualization of the measured values
- intuitive sorting function and reference value for analyses
- separate overview for every measurement point
- easy detection of outliers and faulty measurements

35027		1	2019-01-16 16:17		
Measurements		1 week	Download	Graph	User
<b>Q121 - Cleaning bath, R121.04</b>					
Date	Temperature	Concentration	Laboratory value		
2019-01-15 16:09:00	23.34 °C	3.84 m%	0 m%		
2019-01-15 06:57:00	23.27 °C	3.83 m%	0 m%		
2019-01-14 16:11:00	23.29 °C	3.82 m%	3.81 m%		
2019-01-14 07:02:00	23.41 °C	3.79 m%	0 m%		
2019-01-13 16:08:00	23.5 °C	3.77 m%	0 m%		
2019-01-13 06:57:00	23.49 °C	3.83 m%	0 m%		
2019-01-12 16:03:00	23.44 °C	3.82 m%	3.82 m%		

Table view (Controller)

### 3.5.2 Tabular view

Due to extensive processing options, measurements can be hidden, e.g. in case of faulty measurements. The intuitive sorting function by means of which all data can be displayed in ascending or descending order is also very helpful.

For quality assurance purposes, a reference value from an external laboratory can be stored in the controller. This value serves the fast comparison and identification of systematic measurement errors and thus contributes to safety and quality assurance.

### 3.6 Data export

For data back-up or for the further processing of the data, LiquiSonic® QC offers the possibility to export data, e.g. using Ethernet or USB. For every measuring point, one csv file is created which can then be used for further data analyses or documentation.

#### Your benefit:

- fast, easy export of the measured data
- continuous documentation of the measured data
- further processing of the data at the computer
- reference value can be stored as control
- documentation of the quality control
- flexible data processing

### 3.7 Optional accessories

As complete system, LiquiSonic® QC has optional accessories simplifying the measurements in the laboratory or at the measurement station.

#### Basic equipment

- variable tripod including clamp and cross clamp holder
- magnetic stirrer plate with five stirrers
- five beakers

Some process liquids require measurements under special conditions. For such cases, SensoTech provides a thermostat including hose and a temperature-controlled beaker, in addition to the normal equipment.



Complete equipment LiquiSonic® QC

## 4 LiquiSonic® system



The LiquiSonic® bath monitor consists of one or more sensors and one controller. The controller manages up to four sensors. These sensors can be installed in different steps, as the cleaning systems often includes several baths or cleaning lines.

## 4.1 Sensors

The ultrasonic sensor has the ultrasonic measuring path and the highly precise temperature detection. Each sensor is autonomous and can be used in different applications. The measurement signal is transmitted 32 times per second, thus ensuring a stable and effective measurement.

The liquid-wetted parts of the sensor are usually made of stainless steel 1.4571. The rugged and completely enclosed design does not require any gaskets or “windows” to the process and is thus completely maintenance-free.

Different additional functions integrated in the sensor like flow stop monitoring and full/empty liquid monitoring in pipes increase the customer's benefit.

A special high power technology ensures stable measurement results, even at high portions of gas bubbles and strong signal attenuation by the process liquid.

Using cleaning baths in hazardous areas, LiquiSonic® sensors approved by ATEX and IECEx, zone 0 to 2, can be installed.

The sensor electronics is incorporated in a closed stainless steel housing that is mounted directly on the sensor or remote. The electronics housing has a protection degree of IP68.

The sensors are preferably installed after the pump in circulating systems. Due to the option of separated electronics, the sensors can be installed in mini-plants with limited space. In case of low liquid flows, flow adapters having a minimum dead volume are used.



Immersion type sensor Clamp with separated electronics



Tri-clamp adapter for process connection in small pipes

## 4.2 Controller

The controller is an efficient and powerful evaluation unit that analyzes and visualizes the measuring data. Via touchscreen or web browser, the operator can configure the controller. If the measuring results exceed or fall below thresholds, a signal will be sent immediately. All process data will be updated every second.

It is possible to integrate the controller into the corporate network. The measuring data can be transmitted via adjustable analogue or relay outputs as well as via different fieldbus interfaces or network to process control systems or PCs. Thus, the redose of the cleaning agent or the change of baths can be regulated automatically.

The controller has a data log that fully stores the measuring results and serves as proof of compliance with the process parameters within audits. Via web browser or USB port, it is possible to read out the data log and to create easily process reports. If the process conditions change, the user can adapt or reload product data sets.

In addition, the controller includes an event log-book. In this storage, any events such as manual product change, alarm messages or system adjustments are documented.



LiquiSonic® bath monitor with stainless steel housing

## 5 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.



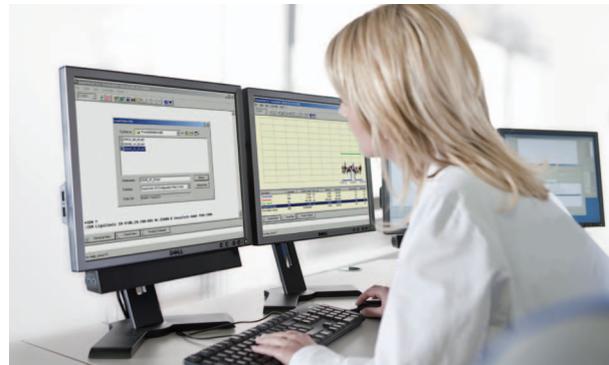
Creative research is another pillar of our company. The specialists in our research and development team provide valuable new ways to optimize product attributes, such as testing new types of sensor designs and materials or the sophisticated functionality of electronics, hardware and software components.

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 a 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.



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**SensoTech**

SensoTech

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Views

Main View

Chart

SonicGraph

Messages

Product

Controller

Sensor

Main View

2016-09-20 13:47

System test H<sub>2</sub>O

Concentration

**-0,01**

Temperature

liquids, **we set the measure.**

ovative **sensor technology.**

accurate, **user-friendly.**

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.



**SensoTech GmbH**

Steinfeldstr. 1  
39179 Magdeburg-Barleben  
Germany

T +49 39203 514 100  
F +49 39203 514 109  
info@sensotech.com  
www.sensotech.com

**SensoTech Inc.**

69 Montgomery Street, Unit 13218  
Jersey City, NJ 07303  
USA

T +1 973 832 4575  
F +1 973 832 4576  
sales-usa@sensotech.com  
www.sensotech.com

**SensoTech (Shanghai) Co., Ltd.**

申铄科技(上海)有限公司  
No. 35, Rijing Road, Pudong New District  
上海市浦东新区外高桥自由贸易区日京路35号1241室  
200131 Shanghai 上海  
China 中國

电话 +86 21 6485 5861  
传真 +86 21 6495 3880  
sales-china@sensotech.com  
www.sensotechchina.com

In liquids, we set the measure.