SensoTech

Sulfuric acid and oleum

Inline analytical technology for:

- concentration & density
- blending
- warning limit detection

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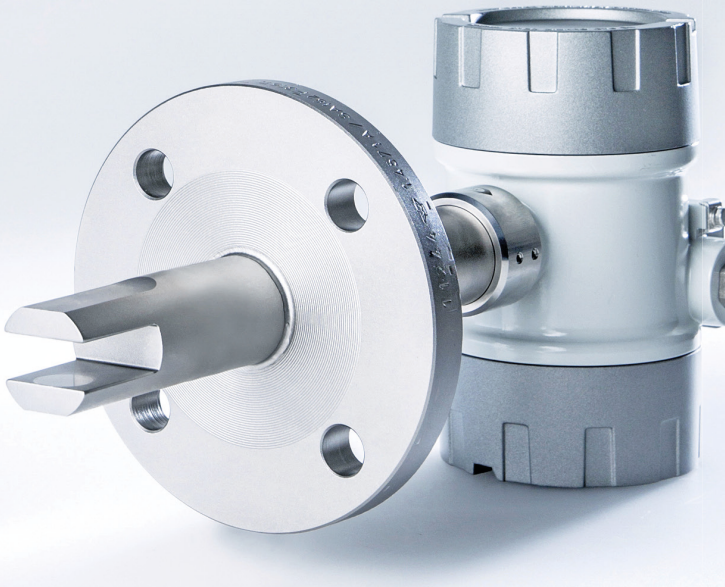
Robust, ac



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:

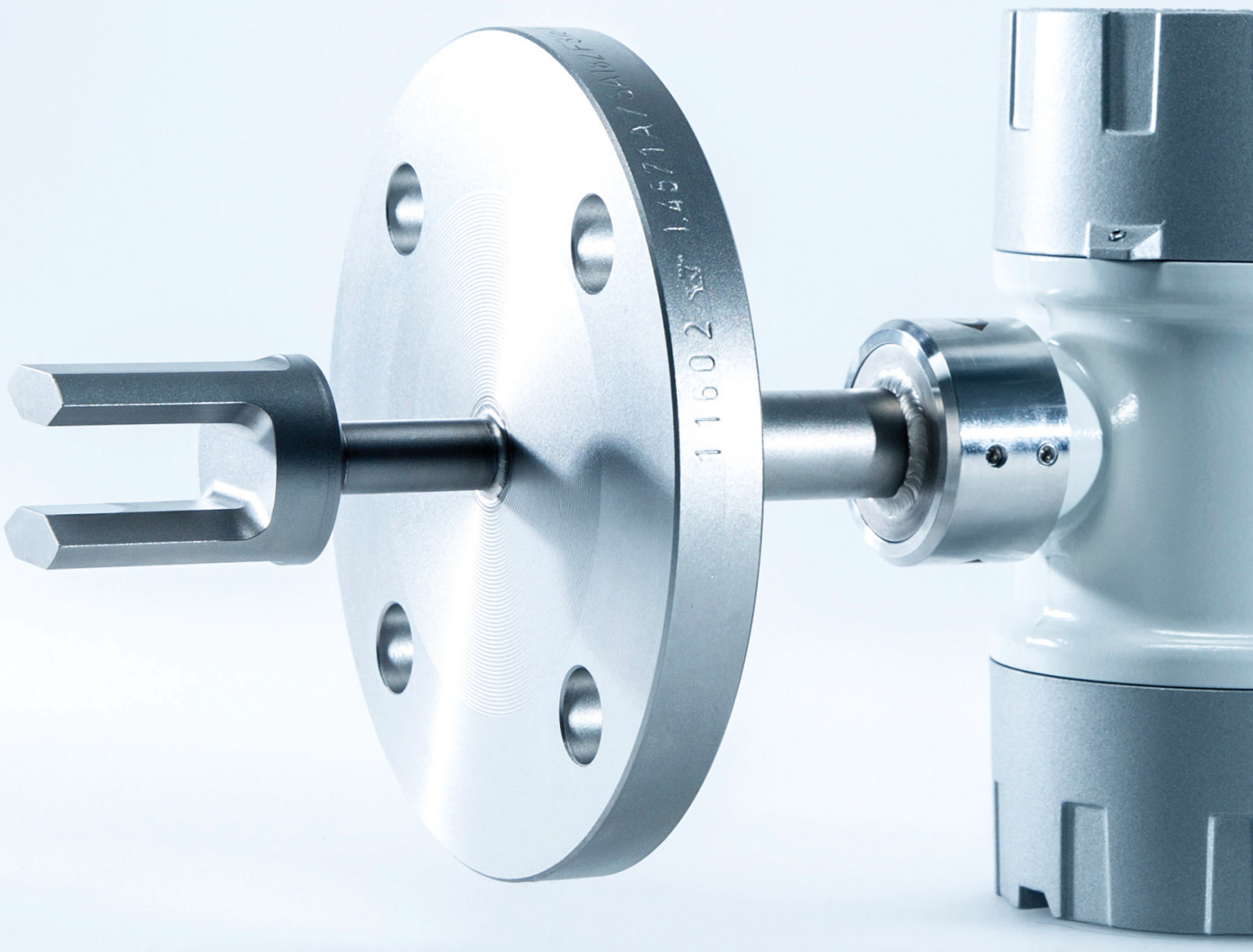
- optimal plant control through online and real-time information about process states
- maximized process efficiency
- increased product quality
- reduced lab costs
- immediate detection of process changes
- energy and material savings
- instant warning of irruptions in the process water or process liquid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

Contents

1 Applications

1.1 Introduction

Optimal and reliable process control requires fast information through robust and rapid process analytical technology. The use of the LiquiSonic® analyzer and its easy integration into existing plant technology results in an improvement of the asset utilization, process safety and product yield under relatively low project costs.

There are several industries where the LiquiSonic® systems for concentration measurement in sulfuric acid and oleum can be applied:

- sulfuric acid and oleum production
- synthesis gas drying in the chemical and petrochemical industry
- ·etching and pickling agents in the steel industry
- ore processing in mining
- raw material for sulphate fertilizer
- basic chemical for various chemical products

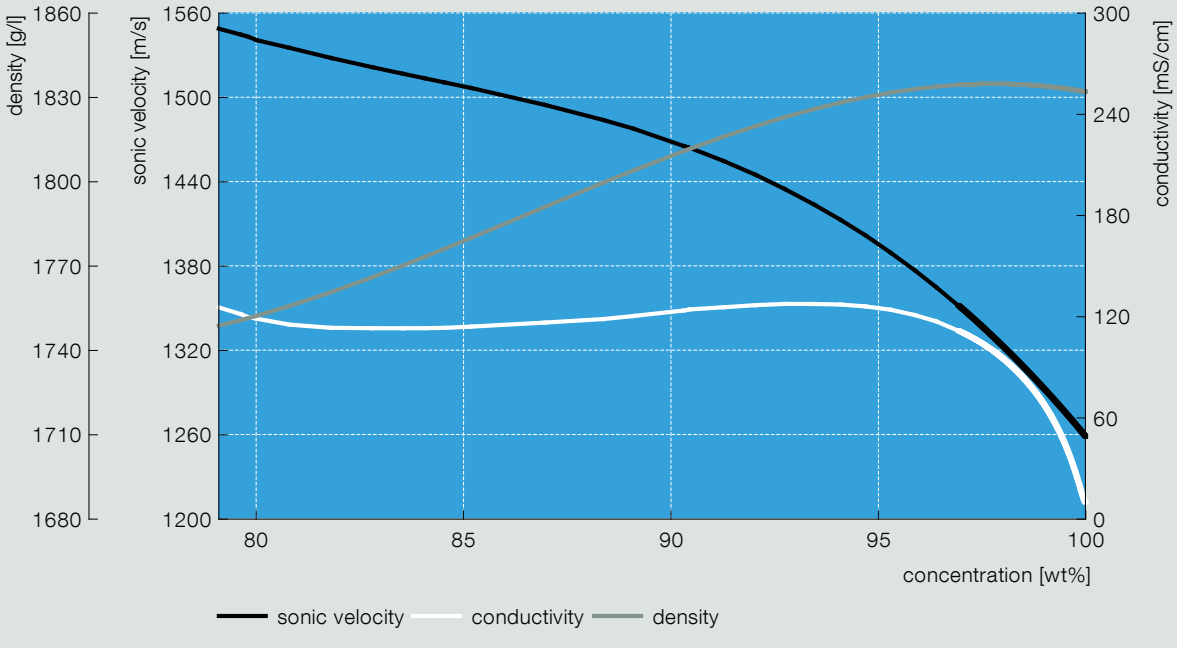
1.2 Sulfuric acid

Sulfuric acid is one of the most important basic chemicals and is used in many ways. Due to its hygroscopic character, sulfuric acid is for example used for drying of gases, in which the measuring range varies between 80 wt% and 100 wt%.

As a consequence of the high dependency of sonic velocity on the sulfuric acid concentration, the measurement with LiquiSonic® can reach an accuracy of ± 0.03 wt%. Compared to conductivity and density measurement LiquiSonic® generates a clear signal in the concentration range and therefore provides reliable process information at any time.

Additionally, concentration-dependent parameters such as sonic velocity, density or conductivity are strongly temperature-dependent. In contrast to many other analyzers, LiquiSonic® is equipped with a static and dynamic temperature compensation.

Advantage of sonic velocity over conductivity and density



1.3 Oleum

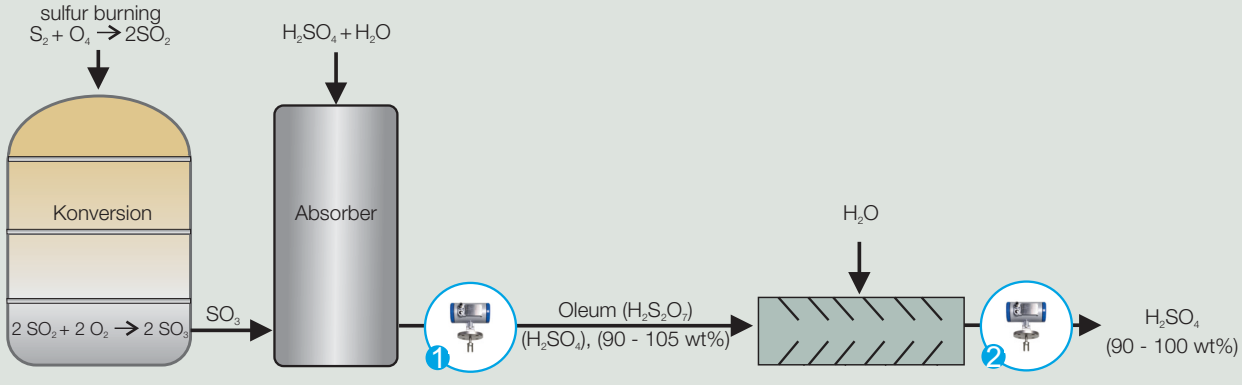
Oleum is produced by dissolving of SO_3 (sulfur trioxide) in 100 % sulfuric acid. Often it is also referred as fuming sulfuric acid or disulfuric acid. In free SO_3, typical measuring concentrations are from 0 wt% to 60 wt%, and for H_2SO_4 from 100 wt% to 115 wt%.

Oleum is used in the following applications:

- setting up of highly concentrated sulfuric acid
- production of caprolactam and nylon
- nitration processes in combination with nitric acid

For example, $S0_3$ is produced in the contact process by sulfur combustion. Thereby SO_2 (sulfur dioxide) arises, which oxidize to SO_3. Eventually, SO_3 has to be collected in sulfuric acid as due to the intense exothermic reaction, a collection in water is not possible. The resulting oleum can be monitored inline by the LiquiSonic® analyzer, so that the process can be optimally controlled.

Monitoring of oleum production by using LiquiSonic®



Measuring point	Installation	Measuring task
1	pipeline	concentration determination in the SO_3 absorber up to oleum
2	pipeline	monitoring the blending to get the requested concentration

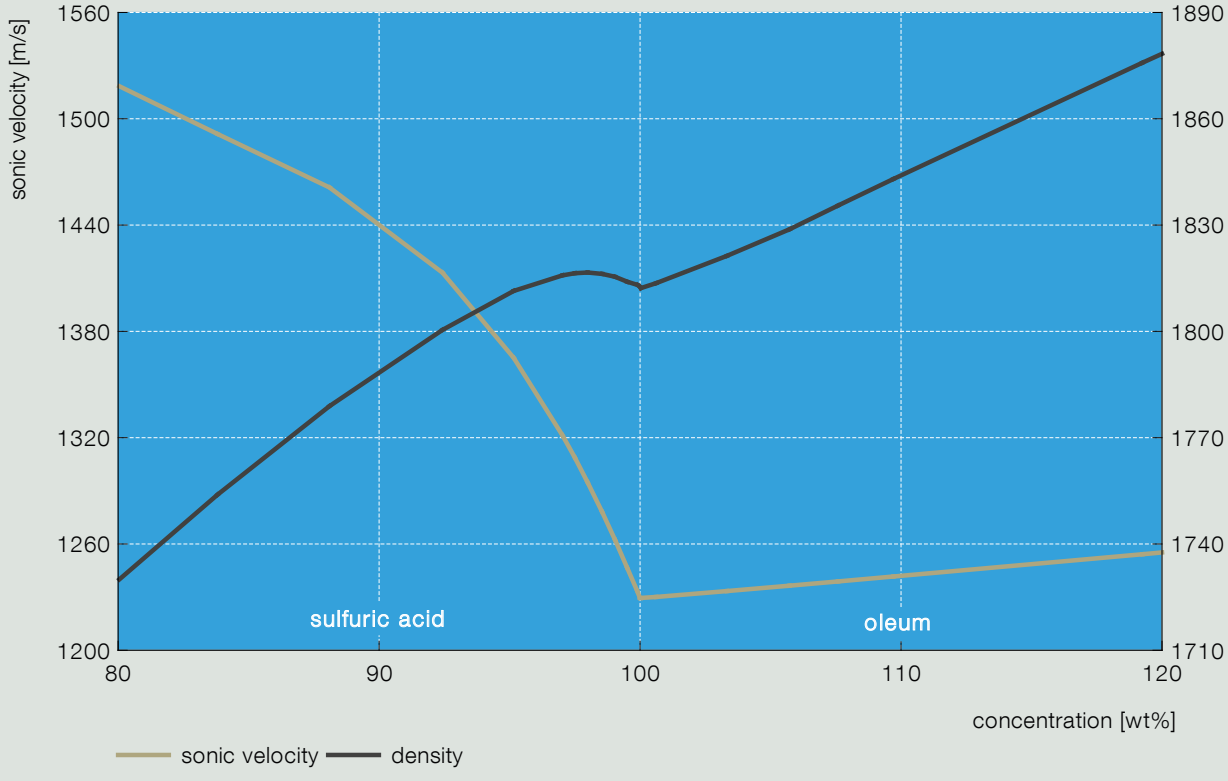
1.4 Sulfuric acid and oleum

By mixing sulfuric acid with oleum, any concentrations of high concentrated sulfuric acid can be adjusted. The adjustment requires a continuous inline monitoring of the concentration. Furthermore, the oleum entails a potential hazard and should not occur in certain absorption processes. The warning signals integrated in the LiquiSonic® analyzer signalize this prematurely and the information will be sent to the process control system by the periphery of the analyzer.

The course of the sonic velocity shows an inflection point at 100 wt%. Therefore, one sensor is not enough to achieve a definite measurement in the process fluid sulfuric acid / oleum. For that reason, the LiquiSonic® 40 system includes an additional density sensor that enables an accurate measurement together with sonic velocity in sulfuric acid and oleum as well. Thus, a precise and reliable concentration measurement is guaranteed.

The ultrasonic sensor incorporates two temperature sensors determining accurately the temperature, that will be forwarded to the LiquiSonic® controller calculating the concentration. Therefore, the LiquiSonic® 40 analyzer operates temperature compensated and highly accurate, even at strong fluctuations in the process conditions.

Characteristics of sonic velocity and density in liquid of sulfuric acid and oleum



2 LiquiSonic® system

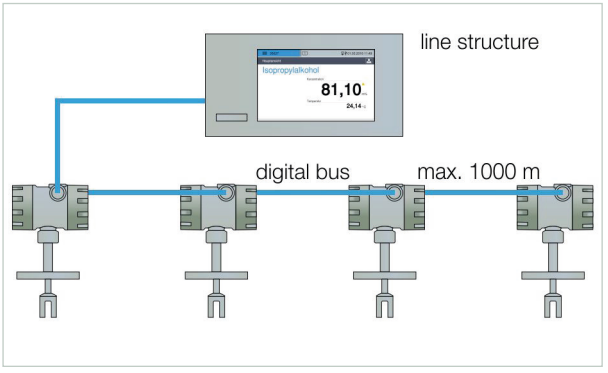
2.1 LiquiSonic® 20 and 30

The LiquiSonic® system consists of one or more sensors and a controller.

The ultrasonic sensor has the actual ultrasonic measuring path and the highly precise temperature detection.

The controller 30 is a highly efficient device which includes up to four sensors. They can be installed in different steps with a maximum distance of 1,000 m between controller and sensor.

The controller 20 is a variant with a reduced scope of functions and only one sensor connectable.



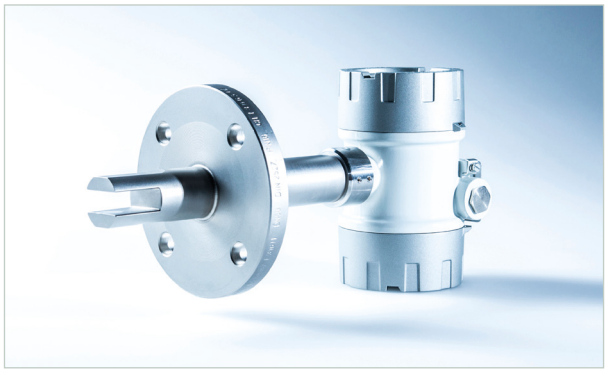
Controller with connection of maximum four sensors

Each sensor works autonomous and can be used in different applications. The liquid-wetted parts of the sensor are made of stainless steel DIN 1.4571 as standard. The rugged and completely enclosed design does not need 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 significantly. A special high power technology ensures stable measurement results, even at high portions of gas bubbles and strong signal attenuation by process liquid.

The sensor electronics is integrated in a closed die-cast housing with a protection degree of IP65 and enables the cleaning of process systems, for example, through a high pressure cleaner.

The immersion sensor Ex 40-40 is especially used in hazardous areas and is approved by ATEX and IECEx certification zone 0 to 2. The sensor can be delivered with explosion protection type II 2 G EEx de IIC T3, T4, T5 or T6.



Immersion sensor Ex 40-40

The controller 30 manages the measuring data and is the interface to the operator by displaying the concentration values. The displayed value can be adjusted to internal reference values through a calibration function. All process data or related values will be refreshed every second. If the measuring values are either within or outside the threshold, it will be shown immediately in the display. System information and error messages are also clearly shown on the display.

The measuring data can be transmitted via several adjustable analog or relay outputs as well as via different fieldbus interfaces to process control systems or computers.

The controller has a data log that stores up to 15,000 datasets each with 32 measuring values. The software SonicWork facilitates to read-out the data log and to create its own process reports in an easy manner.

An additional function integrated in the controller is the event log. This feature documents events like manual product switch, changes on date, time or system states.

3 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 centre 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.

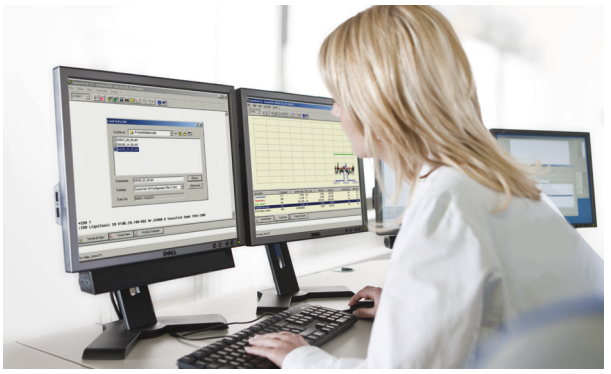
Creative research is another pillar of our company. The specialists in our research and development team provide valuable new ways to optimize product attributes, such as testing new types of sensor designs and materials or the sophisticated functionality of electronics, hardware and software components.

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 analyse 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

liquids, **we set the measure.**

ovative **sensor technology.**

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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.
1341 Hamburg Tpk.
Wayne, NJ 07470
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 上海, 中国
China
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.

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