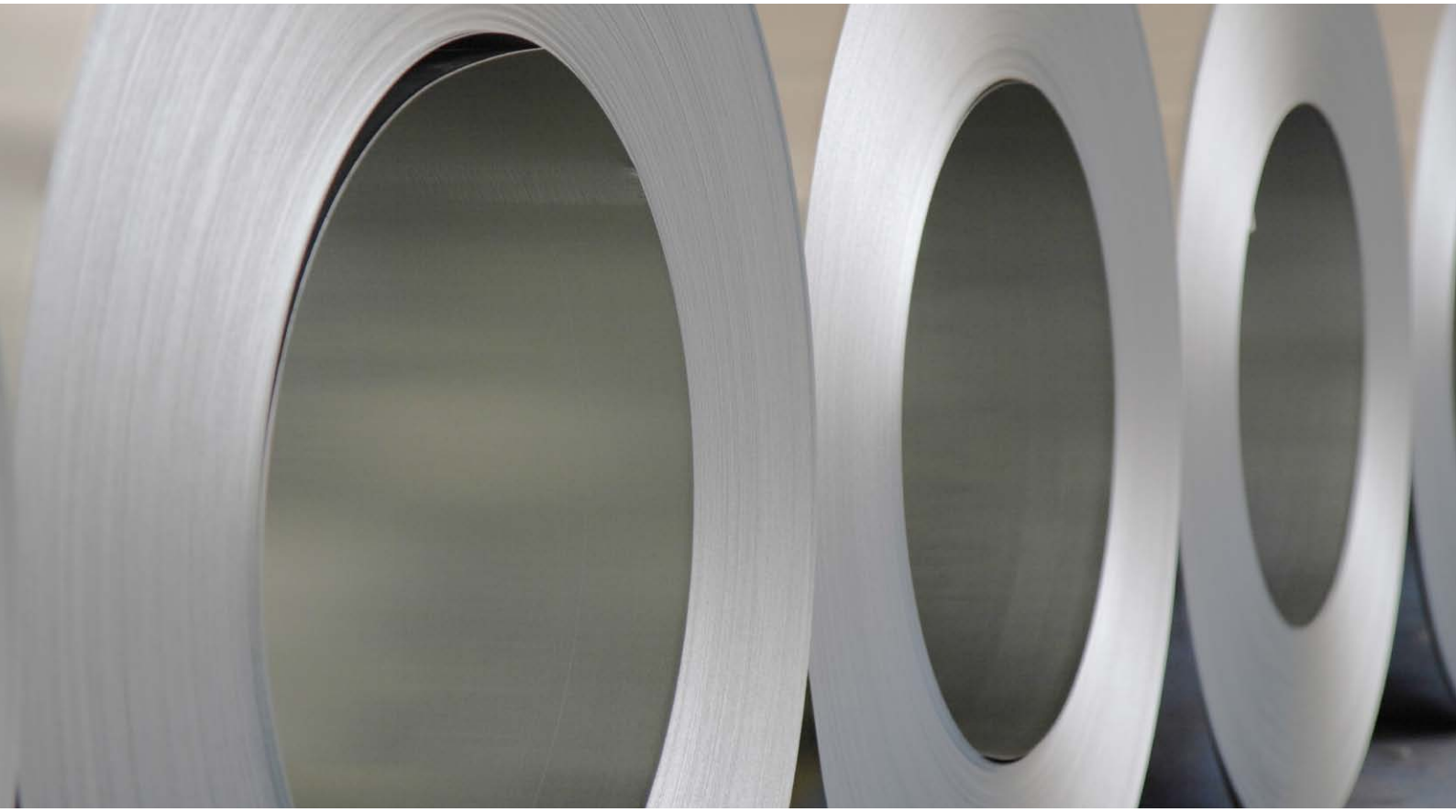
SensoTech



Steel and rolling mills

Inline analytical technology for:

- monitoring of pickling bath
- acid regeneration
- emulsion control
- electrolytic galvanizing
- roller chrome plating

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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 running process and without delay. The device is based on high-precision measurement of the absolute sonic velocity and process temperature and thus allows the calculation and monitoring of concentrations.

Benefits for the user include:

- optimal plant control through online information about the state of the process
- maximization of efficiency of processes
- increasing of the product quality
- reduction of costs for laboratory measurements
- immediate detection of process failures
- saving of energy and material costs
- immediate detection of leakages or different oil inrush in emulsions
- reproducible measuring results

Using the latest digital signal processing technology ensures a highly accurate and fail-safe measurement of the absolute sonic velocity and the concentration.

In addition, integrated temperature sensors, a sophisticated sensor design and the know-how resulting from numerous series of measurements and many applications guarantee a high reliability of the system with a long lifetime.

Advantages of the measuring method are:

- absolute sonic velocity as a well-defined and retraceable physical value
- independent of color, conductivity and transparency of the process liquid
- installation directly into pipelines as well as tanks or vessels
- robust and completely metallic sensor design without gaskets or moving parts
- maintenance-free
- corrosion resistance by using special material
- use at temperatures up to 200 °C
- high, drift-free measuring accuracy even with high concentration of gas bubbles
- connection of up to four sensors per controller
- forwarding of measuring results through fieldbus (Profibus DP, Modbus), analogue outputs, serial interface or Ethernet

Inline process analysis

Contents

1 Processes

1.1 Introduction

In the steel production, the LiquiSonic® measuring technology is used in numerous process levels to optimize operations. With this technology it is possible to save process chemicals, such as acids and cooling lubricants without influencing the surface finish negatively. Thus, the online measuring technology ensures a permanent and consistently high quality of products.

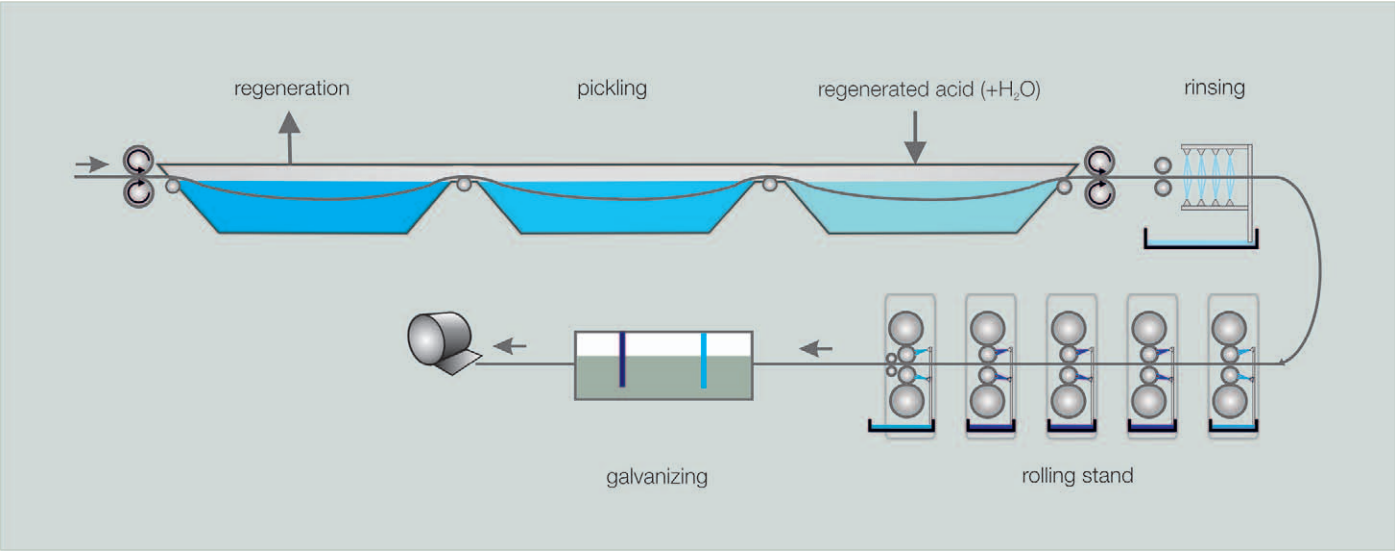
In the following, applications in pickling bath and cold rolling processes are demonstrated as examples, whereas related measuring tasks are used in further processes. Regarding the measuring technology, hydrochloric acid pickling solutions do not differ from sulfuric acid pickling solutions.
The surface finish is explained, for example, within the galvanizing process in the following.

For the concentration determination of different process liquids, the LiquiSonic® measuring technology is integrated into process engineering operations for the steel production.
The device is in two different versions available, the LiquiSonic® 30 and LiquiSonic® 40. Both devices detect the new process status within seconds and transfer the data volume to the Process Control System.

LiquiSonic® 30 consists of one or more sensors and a controller. Ultrasonic sensor has the actual ultrasonic measuring path and the highly precise temperature detection. The sensors are connected with the controller digitally to enable a fail-safe data exchange. The controller calculates and presents the concentra-tion as well as communicates with the user. A TFT color display and a membrane keyboard enable an easy handling. After system installation, the controller display shows directly the desired concentration.

For the measurement of tertiary blends, it is possible to calculate a further measured quantity, for example conductivity, in addition to the sonic sensor. In pickling solutions, the LiquiSonic® 40 system can detect the individual components, such as acids and metal salts, apart from each other.

LiquiSonic® has been proven at customers worldwide and performs the measuring tasks successfully over decades, as the advantages like robustness and being maintenance-free especially satisfy in rough environments of the steel production.



Overview about the specific process steps in the steel production

1.2 Pickling

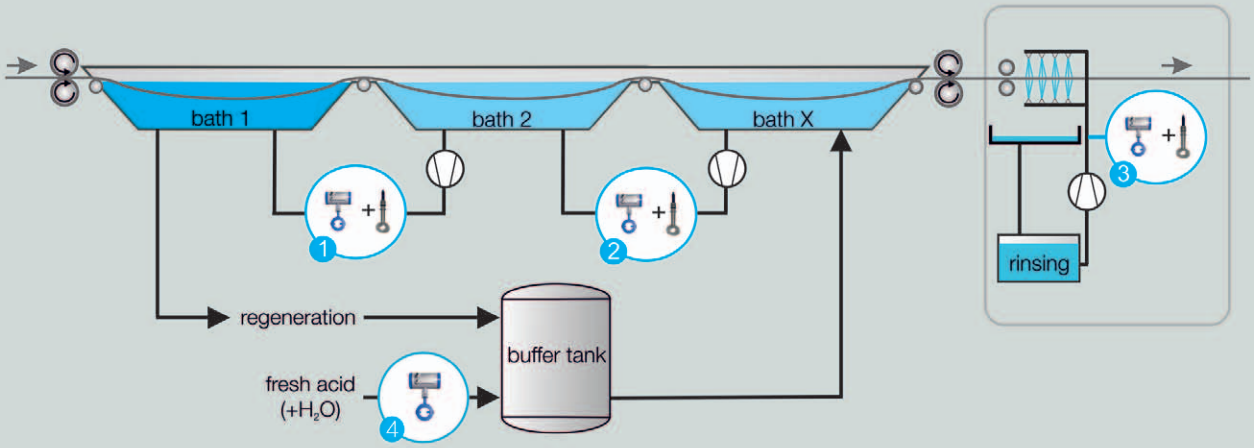
Pickling baths are used downstream of the hot rolling process, but also in many other fields of the metal-working industry to remove, modify, passivate or clean surfaces in a defined manner.

To this end, pickling solutions are employed, mainly consisting of a mixture of mineral acids. The concentration of these acids decreases during the pickling process, whereas the portion of disturbing components such as contaminations and carry-over increases.

The LiquiSonic® measuring technology provides a solution for online measurements of pickling bath concentrations facilitating redosing of the required quantity of fresh acid. This ensures a continuous, optimum pickling bath quality. Delays in time as a result of sampling and lab analyses are avoided.

To date, LiquiSonic® is used successfully for the pickling bath applications listed below:

- sulfuric acid (H_2SO_4)
- phosphoric acid (H_3PO_4)
- hydrochloric acid (HCl)
- nitric acid (HNO_3)
- hydrofluoric acid (HF)



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

Pickling process

1.3 Acid regeneration

In the regeneration, the used pickling acid is refreshed and removed from contaminations such as iron salt. The type of the procedure depends on the respective used pickling acid. A very known procedure is the crystallization for the recovery of sulfuric acid as well as the spray roasting or buttering-floating procedure for the recovery of hydrochloric acid. A further procedure, which is used for mixed acids, is the dialysis, but also ion exchangers are employed.

Before the used pickling acids will be cleaned, they are evaporated to concentrate the acid. After that the acid is separated, whereas the cleaned acid will be added to the pickling process and the resulting metal oxides are used as valuable raw materials in other industry sectors.

In most of the pickling baths, hydrochloric acid (HCl) is used, whereas iron salt ($FeCl_2$) arises during the process. The resulting used pickling acid will then be refreshed in the spray roasting procedure. The following chart demonstrates the application of LiquiSonic®.

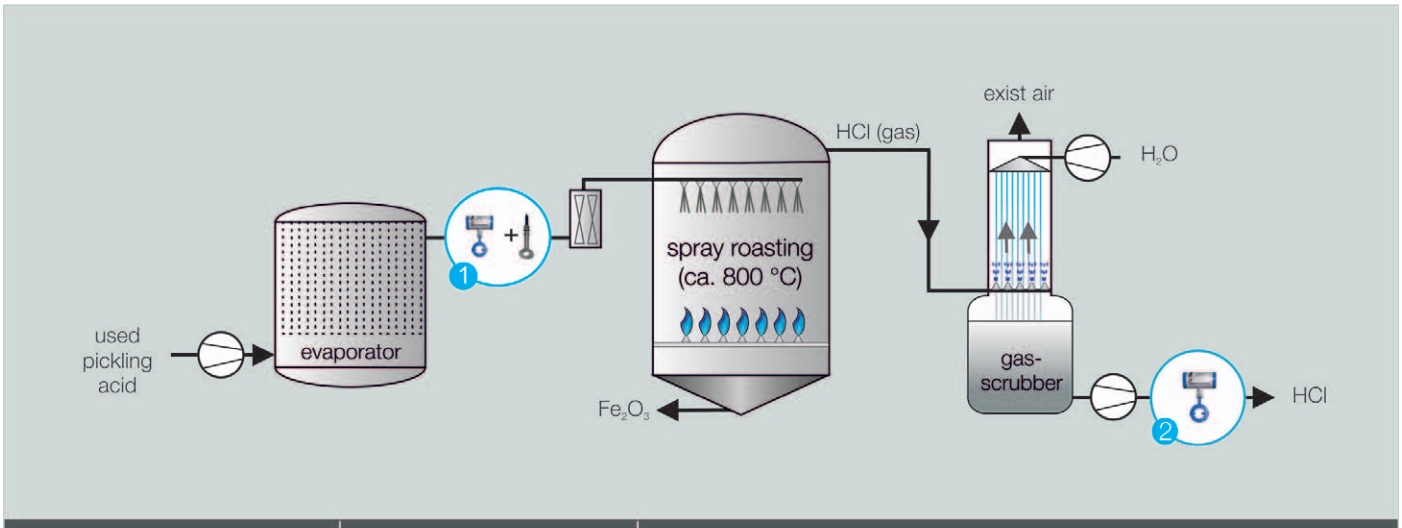
After the evaporation, the LiquiSonic® 40 system is used to determine the acid and the metal salt apart from each other. At the end of the regeneration, the LiquiSonic® 30 system is used to detect solely the acid concentration, as the metal salts have been removed before.

1.4 Cold rolling

During the cold rolling process (40 and 70 °C), the thickness of the rolling stock will be reduced. Process technical liquids such as rolling oil emulsions, temper rolling liquids or process detergents. Typically, these process liquids are circulated and regenerated in closed circuits.

SensoTech offers tried and proven solutions to ensure continuous quality control of these liquids for numerous typical suppliers such as Quaker, Henkel or Houghton. LiquiSonic® for rolling mills are successfully employed for all types of rolling stands and treatment plants for stainless steels, but also for carbon steels and non-ferrous metals.

In a specific application such as reversing mill and tandem mill, the concentration of the rolling oil-in-water emulsion is directly measured in the transport pipeline from the emulsion tank to the rolling stand and controlled at a constant concentration level. This prevents variations in the quality of the rolling stock caused by over and under lubrication. Such effects mainly occur as a result of unavoidable water loss and foreign oil carry-over, like morgoil and hydraulic oil.

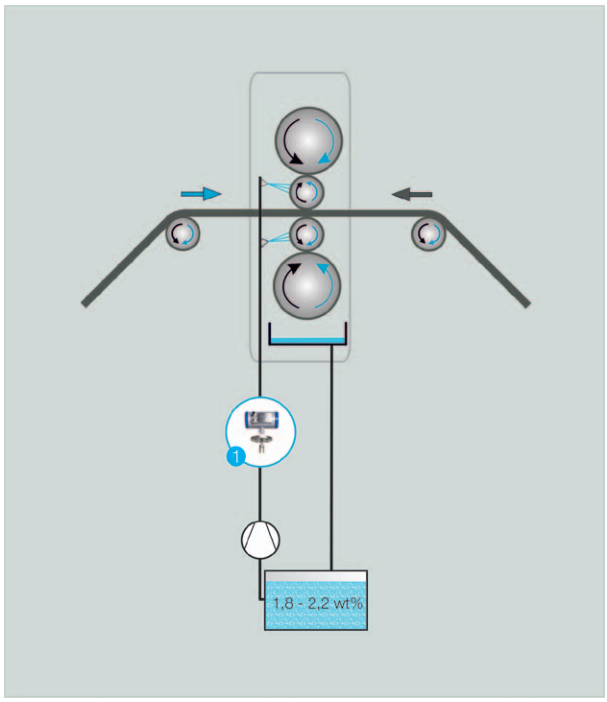


Measuring point	Installation	Measuring task
1	pipeline	3-component measurement, e.g. HCl and $FeCl_2$ in H_2O
2	pipeline	control the fresh acid

Roasting process

1.4.1 Reversing mill

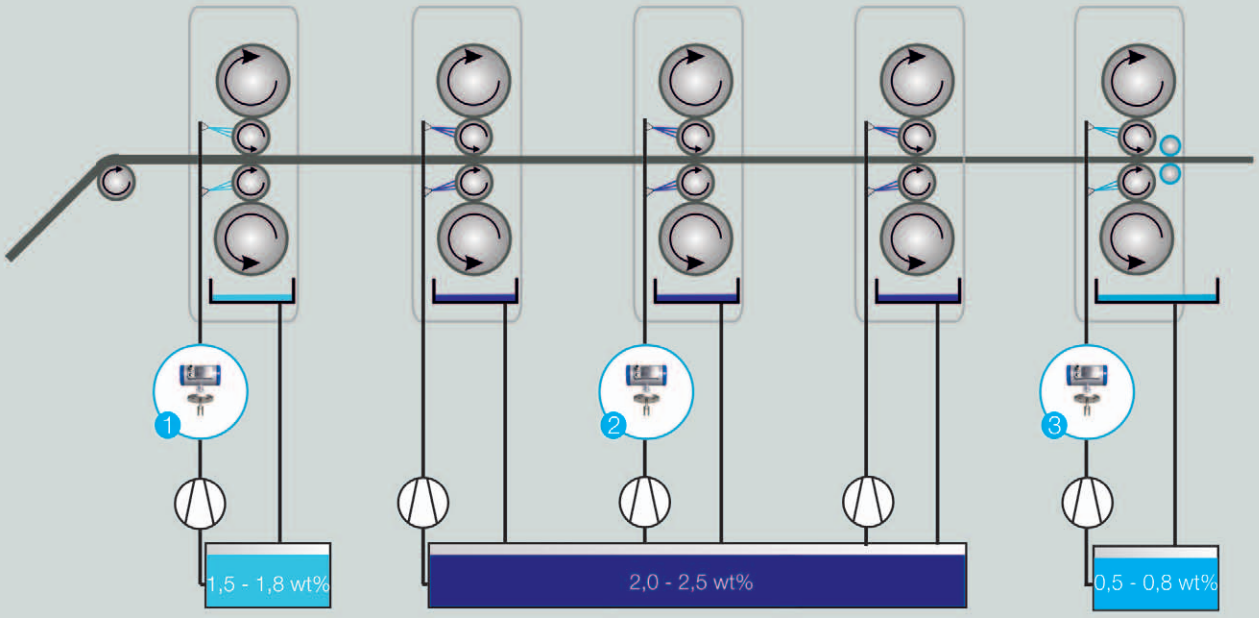
In reversing mills, the rolling oil will run for several times through the mill (passes). This is beneficial for production plants with low capacity and for having of a better microstructure.



Application area of LiquiSonic® at the reversing mill

1.4.2 Tandem mill

The tandem mill is used in larger production plants, as the metal strip is running continuously to ensure a higher throughput. By using different emulsion concentrations an optimal surface finish can be guaranteed.



Measuring point	Installation	Measuring task
1, 2, 3	pipeline	monitoring the concentration of the rolling oil-in-water-emulsions

Application areas of LiquiSonic® at the tandem mill

1.5 Electrolytic galvanizing

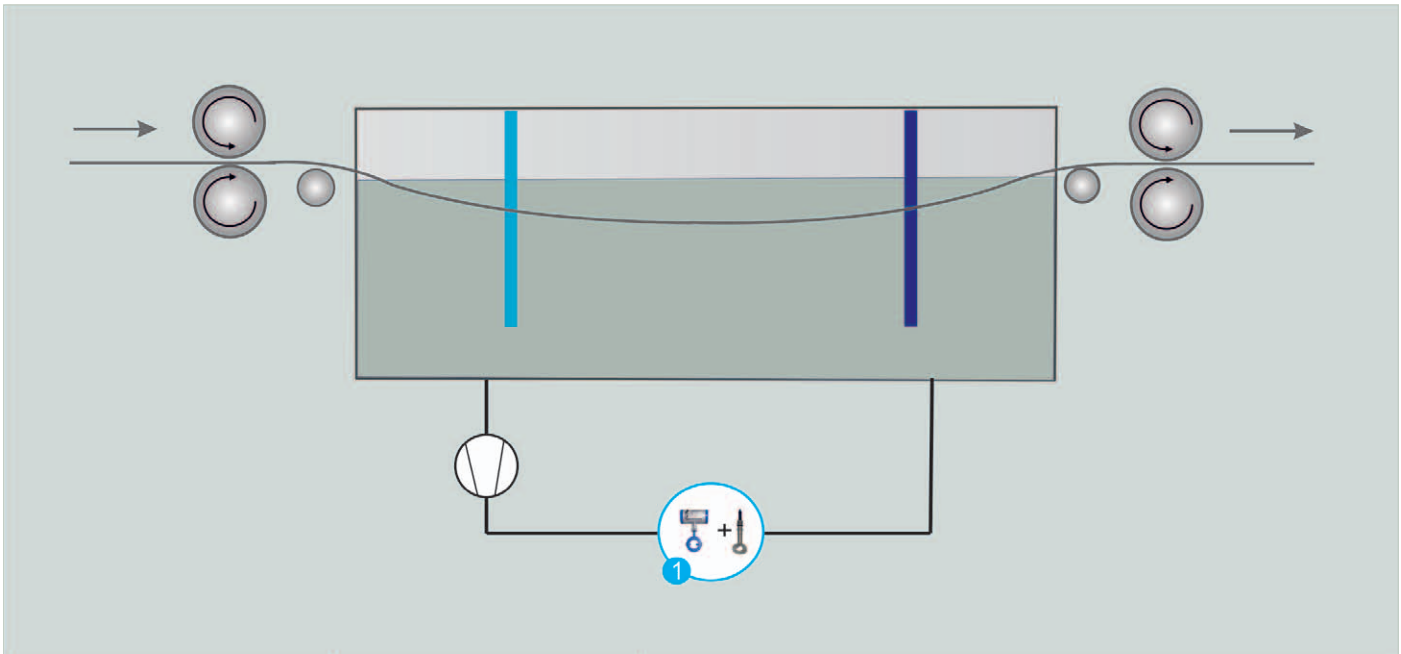
In order to modify the surface of steel concerning properties, such as corrosion resistance, it is required to galvanize the steel. There are different possibilities, such as electrolytic galvanizing or hot galvanizing.

The ultrasonic measuring technology has been established particularly in the continuous electro-galvanizing to achieve layer thickness from 2.5 to 7.5 µm. By means of direct current in an aqueous solution, the steel strip is coated with zinc from 18 to 54 g/m^2. The electrical fields of the zinc bath have no influence on the measuring technology.

The composition of the electrolyte is of essential importance for the coating result, whereby zinc salt is the principle component that should be applied on the surface of the steel. Depending on the application, the electrolytes are either acidly or alkaline and contain additives in traces to optimize the coating result.

When using the LiquiSonic® 40 system, concentrations of the electrolyte can be determined separately. By determining the zinc salt and the acid, it is then possible to control the re-dosing in order to keep the zinc bath in the optimal concentration and to ensure a high quality of coating.

By using special materials and coatings, such as HALAR (also known as E-CTFE) or PFA having a chemical resistance against a number of liquids, the sensors determine the concentration maintenance-free over years.



Measuring point	Installation	Measuring task
1	pipeline	determination of the acid and zinc salt concentration

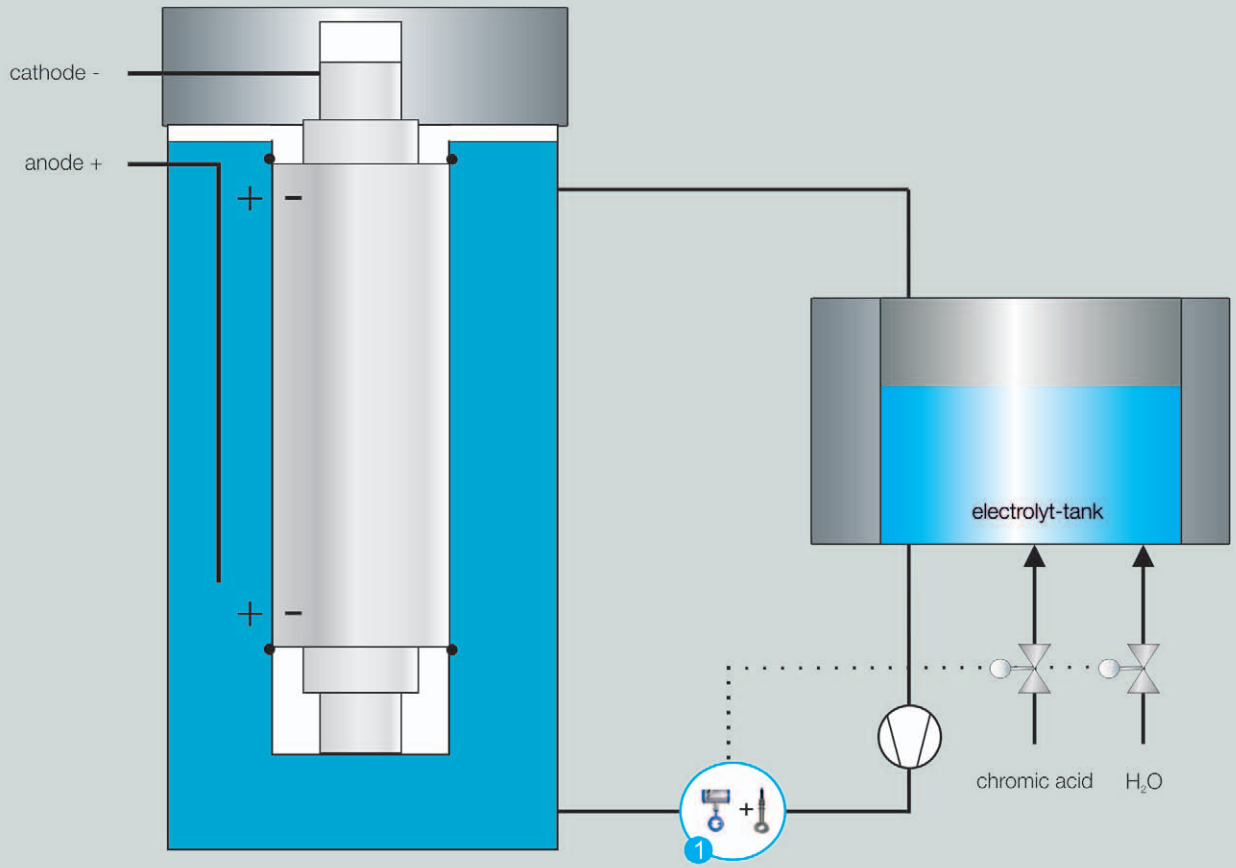
Galvanizing plant

1.6 Roller chrome plating

There are different methods of the plating process for working and skin pass rolls, which are used for the forming process in the steel industry. By performing these plating processes, the roll surface becomes harder and the wear can be reduced. Beside this, it is also possible to generate targeted surface structures of rolls, which cause optimal embossing characteristics on the roll product. This is important for downstream processes like galvanizing or painting of the roll product to ensure excellent adhesive properties. In the forming process, lubricating and slip properties are also dependent on the quality of the roll surface, because adhesive properties can be improved.

The most famous methods for roll plating are melting and galvanization or electroplating. The electrolytic chrome plating is widely used specifically in the galvanic process. Here, the rolls are inserted in a chrome bath filled with a chrome electrolyte, in which are several anode electrodes. As the roll is used as a cathode, the chrome ions are deposited metallically on the roll surface.

The LiquiSonic® measuring technology detects the individual components of the chrome electrolyte, such as chrome acid and sulfuric acid. Therefore, the process safety can be increased as well as the continuous sharpening can be automated and optimized.



Measuring point	Installation	Measuring task
1	pipeline	determination of the concentration of chromic acid and sulfuric acid

Chrome bath with LiquiSonic® measuring point in the transmission line

1.7 Further applications

The range of LiquiSonic® applications in the steel production is wide. Besides pickling and chrome baths, acid regeneration, cold rolling and electrolytic galvanizing the LiquiSonic® systems have been tested and used successfully in the following applications:

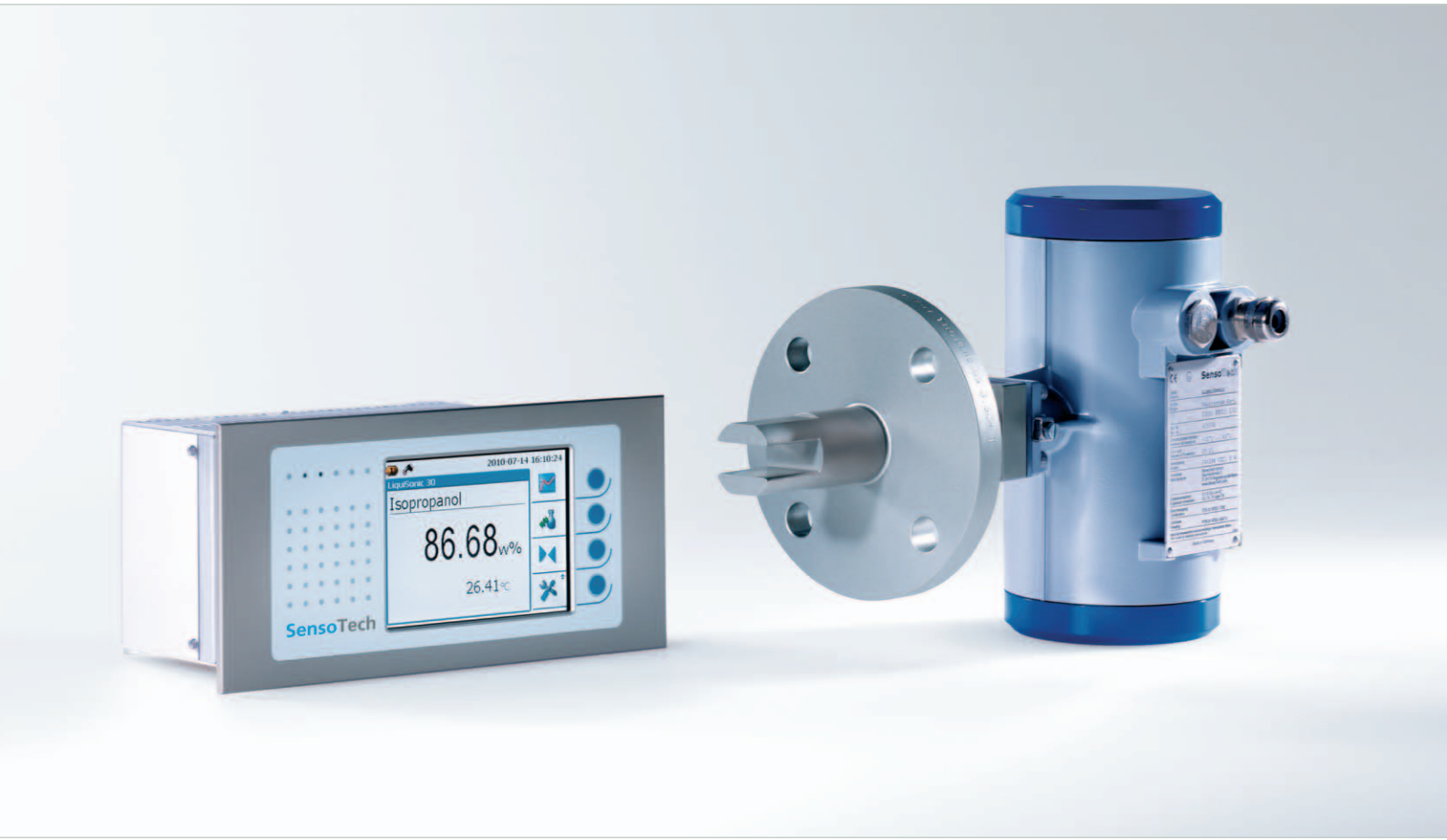
- concentration monitoring of temper fluids
- emulsion control of cutting and drilling fluids
- detection of flotation and decomposing agents for the production of raw materials
- detection of leakage in waste water
- quenchant control
- cooling bath control in power plants

Even for new applications, we provide the best possible solutions. With our unique technical knowledge, we are the specialists for ultrasonic measuring systems in the field of innovative measuring and analytical processes. This knowledge is also adapted in tailor-made and customized applications to develop solutions.

The extensive knowledge and the experiences increased from numerous applications of our well-educated employees help to devise unexpected solutions for new challenges.

The application specialists of SensoTech have detailed knowledge of the specific requirements to the fields of application and fully immerse themselves in the tasks demanded by customers. Each SensoTech device is perfectly adapted to industry-specific conditions of the installation place, so that we ensure the suitable solution with high quality even for extraordinary measuring tasks and applications under difficult conditions.

2 LiquiSonic® system

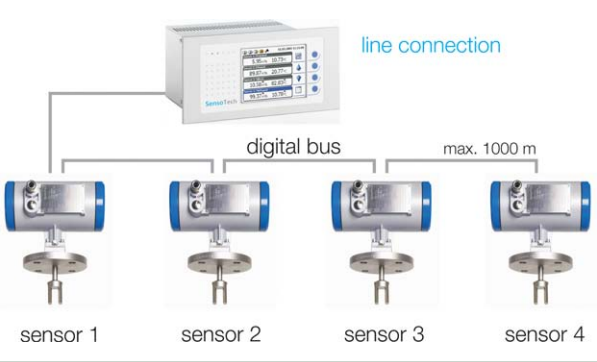


2.1 LiquiSonic® 30

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

The ultrasonic sensor includes the measuring path as well as the highly precise temperature detection. The controller 30 is a highly efficient device that manages up to four sensors. These sensors can be installed in different stages of the tandem mill.

Even in reversing mills, it is also possible to operate several sensors with one controller, as the maximum distance between controller and sensor is 1000 m.



Controller with connection of maximum four sensors

Each sensor works self-sufficiently and can be operated in different applications. The liquid-wetted parts of the sensor are made of stainless steel 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 such as the flow stop monitoring and the full/empty liquid monitoring increase the customer’s benefit significantly. A special high power technology ensures stable measuring results, even at high contents of gas bubbles and strong signal attenuation by the process liquid.

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

The controller 30 analyzes the sensor data and is the interface to the operator by displaying the concentration values. The displayed value can be adjusted to internal reference values through the calibration function.

The process data or related values will be refreshed every second. When the measuring values are moving within or even outside of the limit range, the display will show this immediately. System information and error messages will also be displayed in detail as text.

Simple and intuitive controller operation

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

The controller has an internal data memory to store a capacity of up to 15,000 datasets with respectively 32 measuring values. With the software SonicWork, it is possible to readout logbooks and to create easily own process reports.

An additional feature is the event logbook that is integrated in the controller. This logbook stores the documentation of events such as manual product switch, changes of date and time or system states.

2.2 LiquiSonic® 40

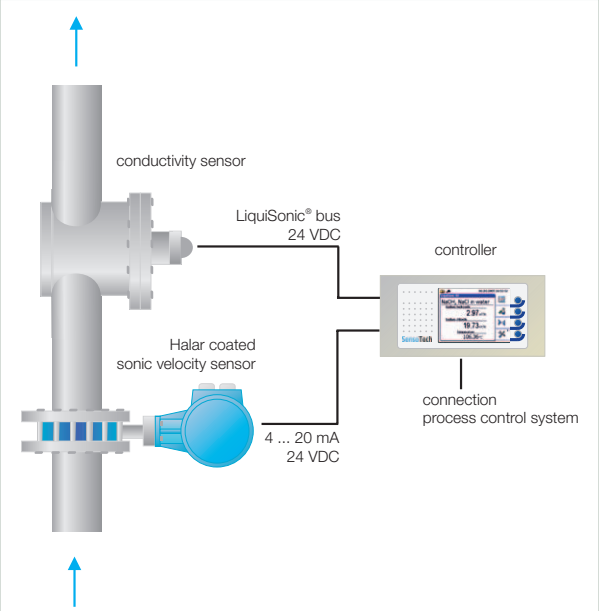
The LiquiSonic® 40 analyzer enables the concentration measurement in 3-component liquids. Thus it is possible, for example, to determine the concentration of the pickling solution and of the salt in a pickling bath separately.

The measuring principle is based on the different effects exerted by changing concentrations of a liquid's individual components on physical variables such as sonic velocity, conductivity and density. These features are stored as a calculation model in the evaluation unit (controller) to convert physical variables into concentrations.

For pickling and chrome bath applications LiquiSonic® 40 is equipped with a Halar (E-CTFE) coated flange sensor and a PFA or PEEK coated conductivity sensor as standard. These are chemically resistant to numerous fluids.

Concurrent measurement of two physical variables (sonic velocity and conductivity) facilitates the determination of two concentrations at the same time. The concentration values are made available to the user or the process control system via analog outputs and fieldbus.

The flange sensor comprises highly efficient ultrasonic ceramics ensuring high reliability of measurements even if the content of gas bubbles in the fluid is high. As an alternative to the Halar coated flange sensor, an immersion sensor made of titanium is also suited for chrome baths.



LiquiSonic® 40 measuring point

LiquiSonic® controller and Halar coated flange sensor

2.3 Accessories

In order to install the LiquiSonic® systems appropriately and to facilitate the integration into the respective Process Control System, we offer individual possibilities. The following additional products have proven to be beneficial in the steel production.

2.3.1 Plastic housing

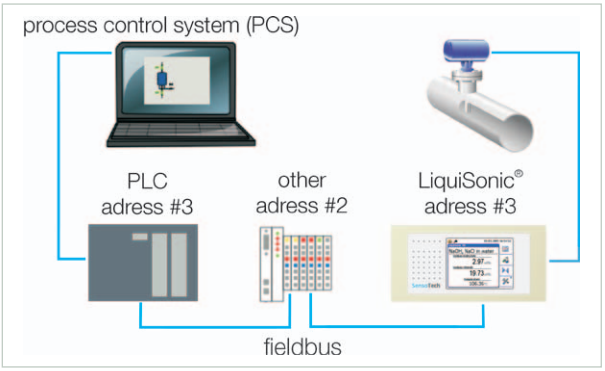
The controller is designed for rack-mounted systems. In order to be able to mount the controller into the field, the plastic housing is available, which comply with on-site conditions in an optimal way.

Plastic housing for the LiquiSonic® controller

material: plastics
protection degree: IP56 (Nema 12)
dimensions: 500 x 500 x 300 mm
window: acrylic glass
application: in aggressive atmospheres

2.3.2 Fieldbus

The fieldbus option provides the possibility to integrate the controller into a Process Control System (PCS) or to automate the process run via programmable logic controller (PLC). Beside the transfer of measuring values like the concentration or temperature, it is also possible to exchange parameters and control data (e.g. product switch).



Connection points

The controller supports different fieldbus systems and follows the standards recommended by the respective standards organizations. Typical versions are Modbus and Profibus DP.

2.3.3 Network integration

The LiquiSonic® controller has an Ethernet interface, with which via a SMB protocol the integration into a Microsoft Windows network is possible.

All controller integrated into the network appear in the “network environment“ within the group “LiquiSonic®“. After entering the user name and password the access to the stored logbooks is possible.

Furthermore, the Telnet protocol can be activated. Thus, all functions of the program SonicWork (e.g. remote control, query of status information, transfer of product datasets and calibration of products) are available in the network.

2.3.4 Modem

With a modem, it is possible to communicate with the controller via a phone connection. In doing so, the controller and the computer are respectively connected with a modem.
This remote connection provides the following advantages:

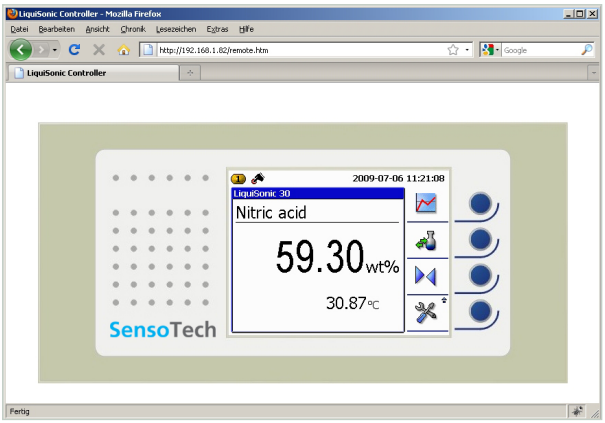
- downloading new product datasets on controller
- reading out the controller logbooks, e.g. to record product data for unknown liquids
- monitoring of all system functions via remote access
- configuration of controller and sensor via remote access
- worldwide and fast customer support by our service

Typical versions are GSM Modem and the analog modem.

2.3.5 Web server

With the web server, a remote access to the LiquiSonic® controller within a network is possible without installing special application software.

The web server enables the direct access to the controller with usual web browsers (e.g. Firefox or Internet Explorer).



Controller operation via web server

2.3.6 Software SonicWork

SensoTech offers the software SonicWork, which enables an optimal configuration and data exchange of LiquiSonic® analyzers. With SonicWork the access to all configurations is open and the data memory can be read out with a PC or laptop.

Loading of product dataset

If the process changes, it can be necessary to pass a new product dataset for a certain product subsequently to measuring system being already in use.

Loading of device configurations

If the measuring task of LiquiSonic® being already in use changes, it is possible to adjust the device by loading a corresponding file to this task.

Reading-out of memory

Each LiquiSonic® controller contains an internal measured data memory, which stores up to 15,000 data-sets (lines) with respectively 32 measured values.
After deactivation of the device, these data remain available. When the data are read-out, they are available in a CSV format and can be further processed, if necessary.
The memory is read-out in the department of research and development, because it is an optimal tool to evaluate reactions, trials and productions.

Remote Control of controller

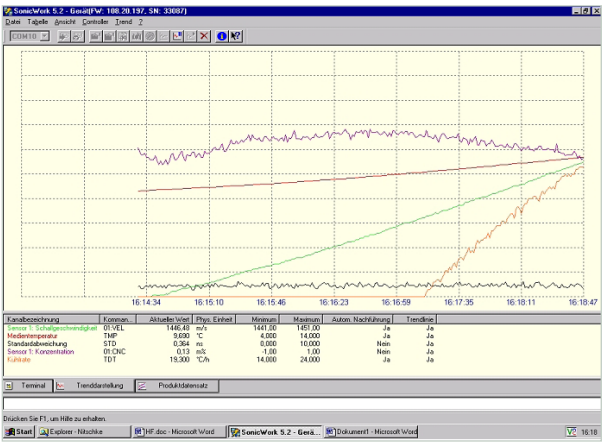
SonicWork enables the remote control of LiquiSonic® controller. With the integration of devices into a network (TCP/IP) or with the connection of a modem, the devices can be operated from any sites. The same range of functions can be used, as they are available for direct operation of the device.

Calculation of product datasets

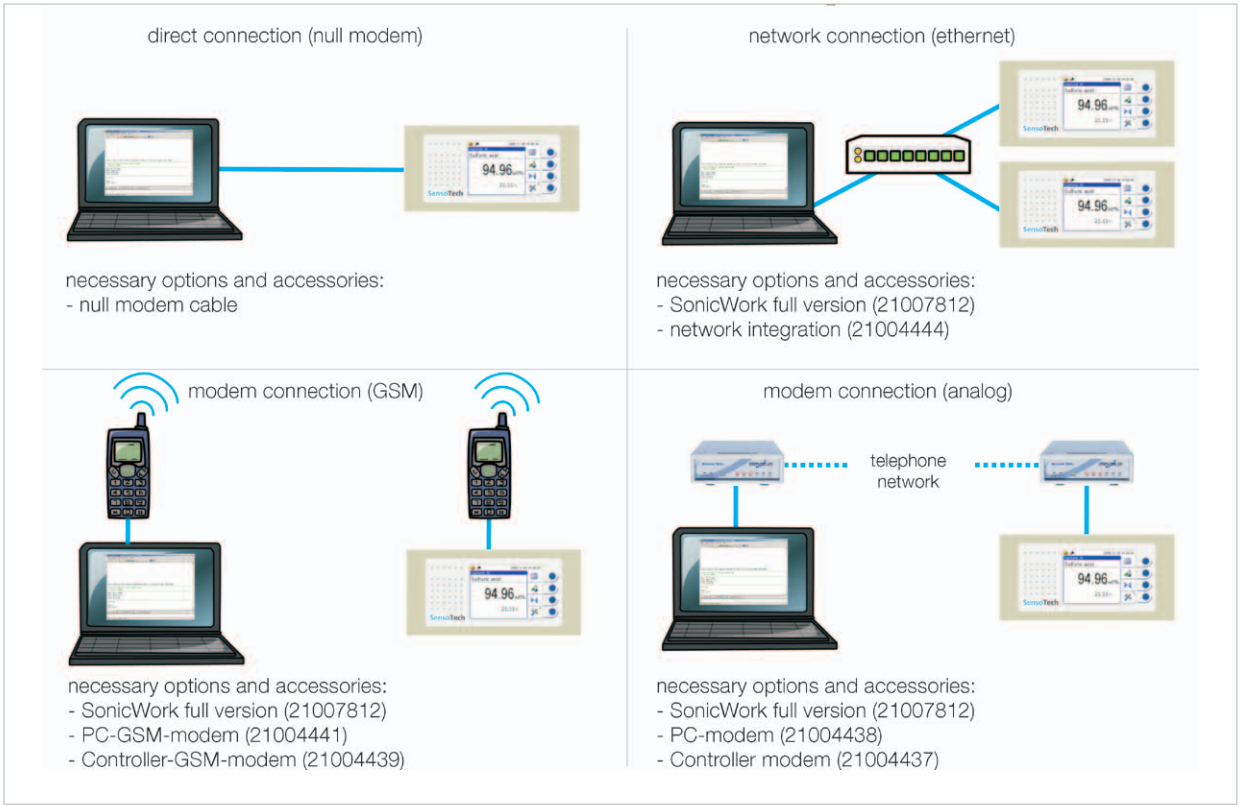
With the option „calculation of product datasets“ of SonicWork, the customer receives an effective tool, with which he can react quickly and flexibly on prod-uct changes or changes of product measuring ranges concerning their concentration and temperature. Therefore, it is possible to self-calculate the product datasets. Nevertheless, the employees of SensoTech are available at any time to assist you for validation of your product datasets to achieve a maximum accuracy.

Recording of process trends

With SonicWork, it is possible to display process trends. In doing so, different measured data can be visualized in real time during a laboratory measurement and these data can also be stored to the internal memory in addition.



Trend view via SonicWork



Connection paths with Sonic Work

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.

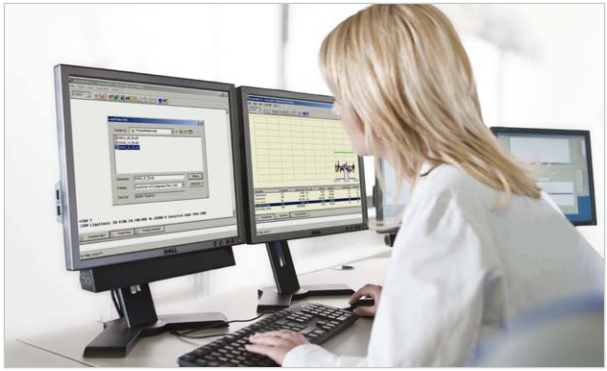
Creative research is another pillar of our company. The specialists in our research and development team provide valuable new ways to optimize product attributes, such as testing new types of sensor designs and materials or the sophisticated functionality of electronics, hardware and software components.

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

ndards **for process analysis.**

n, that **creates new solutions.**

psolute **spirit of development.**

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 the concentration and density of liquids. Our analytical systems set benchmarks that are used globally.

Manufactured in Germany, the main principle of our innovative systems is to measure ultrasonic velocity and density in continuous processes. We have perfected this method into an extremely precise and remarkably user-friendly sensor technology. As well as 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® measurement and analysis systems ensure optimal product quality and maximum plant safety. Thanks to their 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 reproducible measuring results even under difficult process conditions. Inline analysis eliminates safety-critical manual sampling and is immediately available for your automation system. All parameters can also be adjusted with high-performance configuration tools, so that you can 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

In liquids, we set the measure.

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