



Figure 1: Directly in the bath the LiquiSonic® analyzer of SensoTech measures quickly and accurately the cleaner concentration and degree of contamination.

Efficient cleaning of industrial parts and treatment of surfaces by inline analytical technology

Concentration fluctuations in cleaning and treatment baths affect the bath quality and resource efficiency if meeting desired nominal values is not monitored continuously or only imprecisely. Since the initial cleaner concentration decreases during the process, without proper bath monitoring the replenishment will be either too much or too little. Underdosing of the cleaner results in not meeting the cleanliness requirements; overdosing results in wasting valuable resources.

Further, the degree of bath contamination is subject to fluctuations that influence the cleaning performance and resource efficiency. During the cleaning process, the degree of contamination increases steadily. Having the information about reaching the contamination limit, bath changes can be done efficiently. Consequently, costs caused by frequent bath changes, which are reflected in the energy and raw material consumption, can be reduced.

Cleaners are aqueous, anhydrous, basic or acidic agents, for example. To measure the concentration of the cleaner and the degree of contamination in the bath continuously, accurately and quickly, the LiquiSonic® analyzer of SensoTech will be directly integrated into the process. Figure 1 shows an immersion sensor and the controller of the analyzer. The technology measures inline and properly in various bath liquids, because the measuring method is independent of the turbidity, colour and conductivity of the liquid and has a high tolerance of soiling as well. The automatic real-time measurements every second show immediately how much cleaner must be replenished to keep the cleaning result constant. This eliminates time-consuming manual measurements, which provide delayed laboratory results.

For example, the analyzer is used in cleaning and degreasing baths, in rinsing baths, pickling and etching baths and coating and plating baths as well. Numerous industries like metal, automotive, semiconductor or plastics industries, include such surface and

cleaning processes. In metal production, the LiquiSonic® technology is applied particularly in pickling baths. In this application, the analyzer monitors the concentration of acid or alkali, so that the replenishment can be done immediately and automatically. Moreover, in pickling baths LiquiSonic® also analyzes the content of the iron salt, which arises as a by-product in the bath due to the consumption of acid or alkali. In addition to monitoring pickling baths, the inline analytical technology optimises further process stages in metal production. For example, these include acid regeneration processes, rolling emulsion controls or electrolyte analyses in continuous galvanizing and roller chrome plating.

The pickling process

Pickling baths are used downstream of the hot rolling process to clean, modify or passivate metal surfaces and to remove tinder or rust for the further treatment in the following production steps. Finally, the metal can be reformed in the cold rolling process, for example, or electrolytically galvanized within the surface refinement.

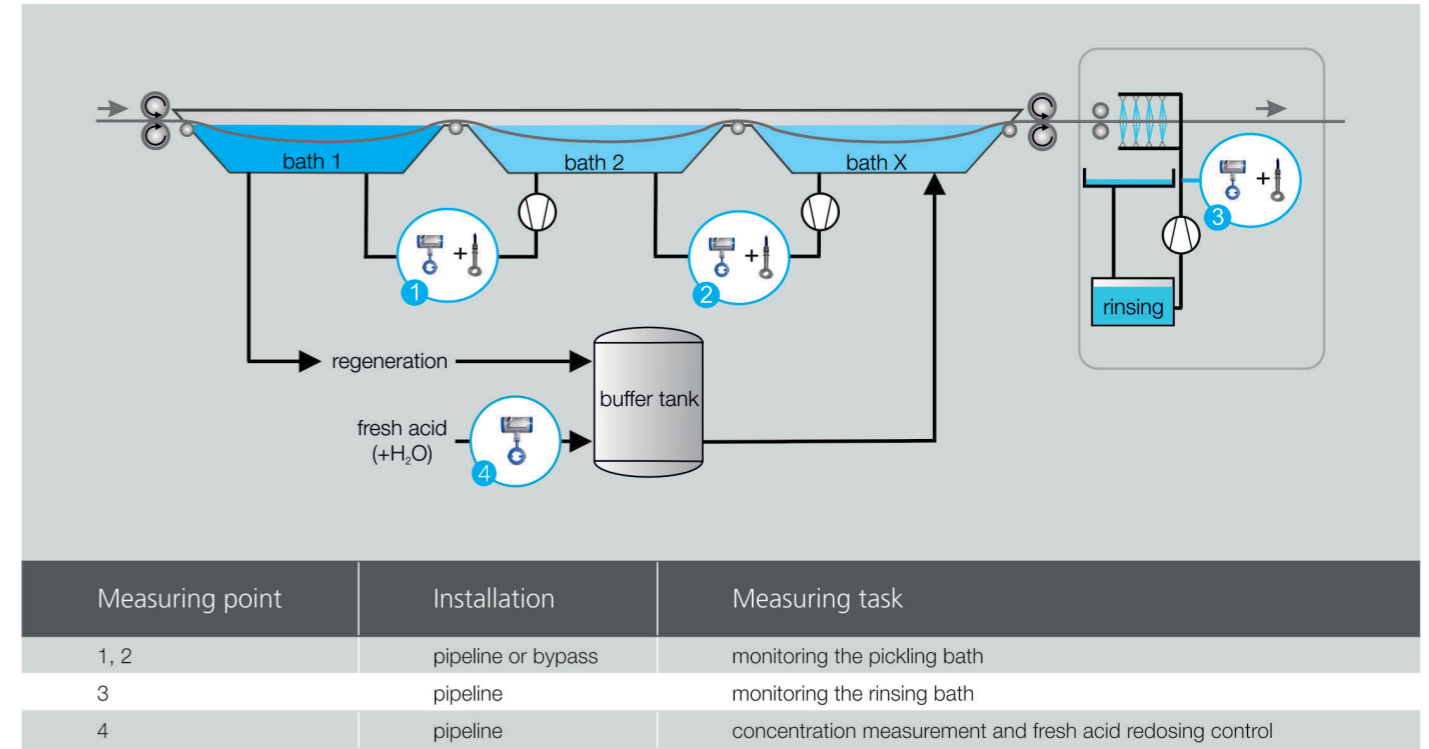


Figure 2: The pickling process can include several LiquiSonic® measuring points for optimal process monitoring.

Pickling baths primarily contain solutions or mixtures of different mordants. There are either diluted acids or bases used. For example, typical chemicals are sulfuric, hydrochloric, phosphoric or nitric acid as well as caustic soda. During the process, the concentration of the mordant decreases, whereas the portion of interfering components such as metal salts increases at the same time. In order to keep the pickling bath quality in an optimal range, it is necessary to redose with fresh acid or lye in a targeted manner. Moreover, the metal salts do not only arise by etching of contaminations, but also the mordant dissolves the metal surface.

In order to produce with an awareness of quality, economic factors and the environment, checking the concentration of the bath ingredients precisely and continuously is required. The permanent bath analysis reduces the frequency of bath changes and avoids overdoses. Thus, it leads to resource-efficient process control. In addition using online monitoring, an optimum pickling result is ensured.

For this purpose the LiquiSonic® analyzer of SensoTech is integrated directly into the pickling plant. Figure 2 represents a pickling process including different LiquiSonic® measuring points for optimum monitoring of each process step. The analyzer consists of one or more sensors and one controller. Installing the sensors into the bath pipeline is easy and suitable for every cleaning or surface processing plant. For an effective measurement neither a bypass nor smooth flow pipe sections are necessary. Due to the robust construction and corrosion-resistant material, the sensors are maintenance-free with a long lifetime. SensoTech offers immersion sensors with variable lengths or flange sensors.

Due to the option of a separated electronic housing, the sensors can be even installed in mini-plants with limited space. In case of low liquid flows, flow meter adapters having a minimum dead volume are used.

The measuring results are updated every second and are available immediately and at any time. The controller

visualizes and manages the data that can be transmitted to control systems via fieldbus, analog outputs, serial port or Ethernet. Thus an automatic, targeted cleaner dosage is guaranteed. For process transparency and traceability, the measuring data are permanently recorded and stored in the controller. Clear trend charts and custom data protocols provide a comprehensive overview of the process flow. In consequence of the reproducible process management, it is possible to always operate the pickling plant in optimum condition.

Sonic velocity combined with conductivity

The bath liquid consists of the following components: water, acid or lye and metal salts. The metal salts accumulate through the reaction of the mordant with the metal in the bath. The concentration monitoring of the pickling solution and of the salts is essential for optimal bath results. In such a 3-component mixture two physical values are necessary to determine the single concentrations of these both substances. The measuring principle is

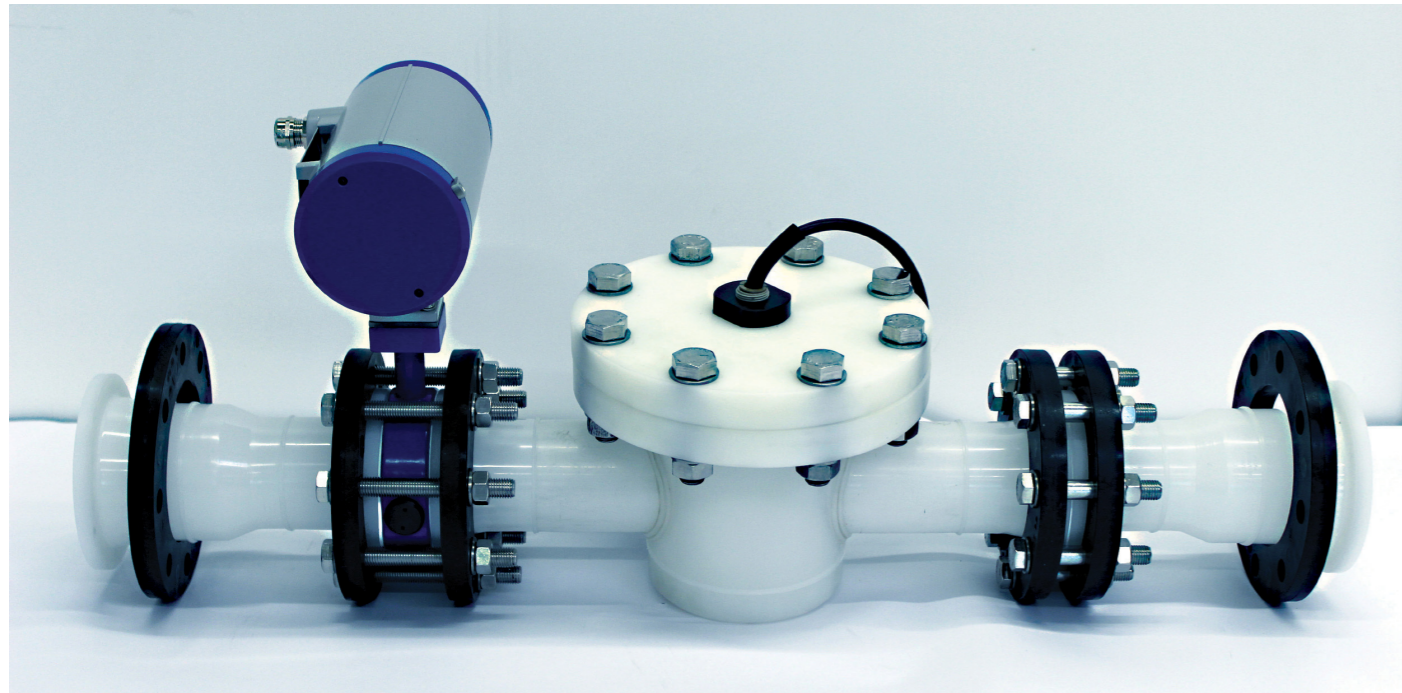


Figure 3: For concentration measurement in a 3-component mixture, a LiquiSonic® measuring point consists of a sonic velocity flange or immersion sensor and a conductivity probe.

based on the different effects exerted by concentration changes of a liquid's single components on physical values such as sonic velocity, conductivity or density. This characteristic is stored as a calculation model in the LiquiSonic® controller, so that the measuring results of the physical values can be converted into concentrations. So measuring two physical values concurrently, the simultaneous determination of two concentrations can be realized.

According to studies, sonic velocity combined with conductivity has turned out as the best measuring method. Therefore, the LiquiSonic® analyzer consists of a sonic velocity sensor and a conductivity probe. The sonic velocity sensor measures the concentration of the mordant and is made of stainless steel or Hastelloy. In aggressive chemicals the stainless steel sensor is coated with a special material such as Halar or PFA. The conductivity probe is made of PEEK or coated with PFA. Thus, both type of sensors are corrosion-resistant in almost all chemicals and can be used at temperatures of up to 180 °C.

Furthermore, the LiquiSonic® sensors

feature a highly efficient ultrasonic ceramic that ensures a proper measurement even in the event of a high proportion of gas bubbles in the liquid. The conductivity probe measures the salt concentration and is connected, together with the sonic velocity sensor, to the controller. Figure 3 shows a LiquiSonic® measuring point, where a flange sensor and a conductivity probe is installed into a pipeline.

Use at AMAG

The company AMAG Austria Metall AG is the nation's leading manufacturer of aluminium semis and casthouse products for the processing industry. The group purchased the LiquiSonic® analytical technology of SensoTech that is used successfully to optimize the processes in the aluminium pickling plant. The bath operates with caustic soda at a temperature between 50 °C and 70 °C. Therefore, it consists of water, sodium hydroxide and sodium aluminate. Sodium aluminate results from the reaction of sodium hydroxide with aluminum. In the past AMAG worked in a batch process and used a titration analysis to control the pickling bath. However, this measuring method presents problems because of manual

sampling and time delays of the measuring results. Consequently, the goal was to control inline and in real time the quality of the pickling bath.

By the installation of the LiquiSonic® analyzer, this challenge has been satisfactorily resolved. The combination of sonic velocity and conductivity measurement makes it possible to analyze the pickling process continuously. The concentration of caustic soda is determined by an immersion sensor made of stainless steel and the concentration of sodium aluminate by a conductivity probe made of PEEK. Both sensors are mounted with flange fittings in a DN 50 pipeline close to each other. The rugged sensor design, non-corrosive materials and the resistant sensor and controller housing prepare the analyzer for best usage under tough production conditions. Figure 4 shows the installed LiquiSonic® immersion sensor in the pickling plant of AMAG.

Via Profibus the measuring data are passed to the process control system. The results are reproducible and logged in the LiquiSonic® controller. In case of exceeding or falling below a predefined threshold, or if process

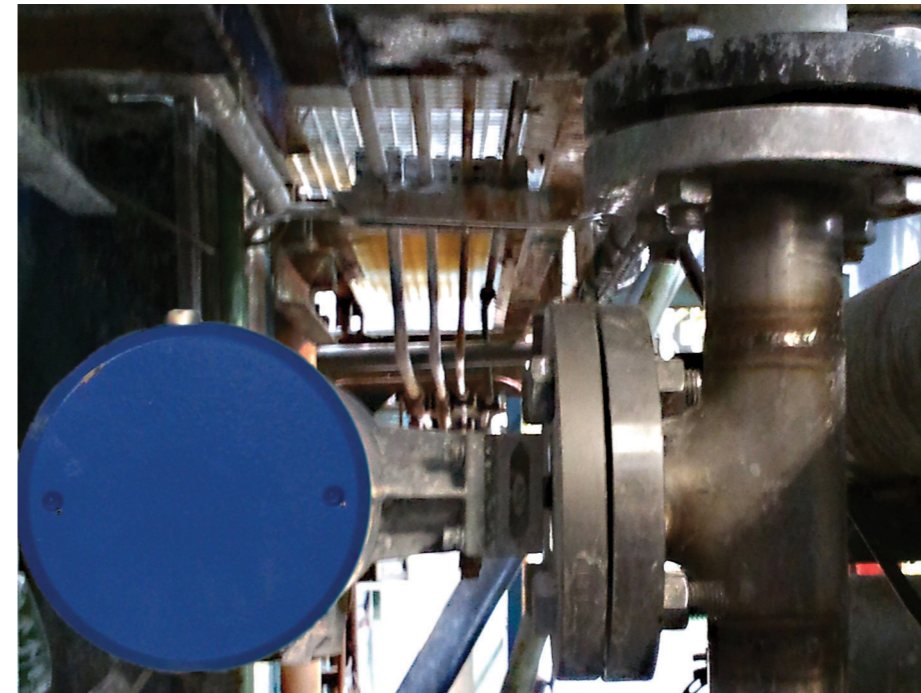


Figure 4: In the pipe of the aluminium pickling plant of AMAG Austria Metall AG the LiquiSonic® immersion sensor is installed to monitor inline the concentration of caustic soda.

problems occur, the analyzer immediately signals an alarm. Therefore, it is possible to react quickly on deviations and take countermeasures. "In our case, changing to the continuous process was very important, because in the past we had to stop the pickling process once a week to exchange the bath. Using the inline analyzer of SensoTech, we are now able to control our pickling process continuously and in a targeted way. So we have gained in yield significantly and can save production costs", explains Christian Pointner, Process Engineer at AMAG.

Conclusion

The inline analytical technology LiquiSonic® measures precisely, continuously and directly in the process the cleaner concentration as well as the degree of contamination in various bath liquids. This enables an accurate and automatic replenishment of cleaner and an efficient control of bath changes. An application focus is pickling baths in the metal industry, for example. In these kinds of baths, the analyzer monitors the concentration of the pickling solution and of the metal salt. Via common interfaces, the analyzer can be integrated into existing control systems.

The online monitoring leads to an efficient, safe and eco-friendly run of the pickling process. On the one hand significant results are quality assurance and increasing the yield. On the other hand costs are reduced by saving energy and material.

Author:

Ms. Rebecca Dettloff
Marketing Manager
SensoTech GmbH
Steinfeldstr. 1
D-39179 Magdeburg-Barleben
GERMANY

SensoTech:

For over 20 years SensoTech has been focused on the development, manufacturing and sales of inline analysis systems for process liquids. With worldwide installed, highly precise and innovative measuring systems for monitoring of concentrations, compositions and changes of chemicals as well as properties directly in the process, SensoTech has significantly contributed to the enhancement of the state-of-the-art. In addition to the measurement of concentration and density, the phase interface detection as well as the monitoring of chemical reactions like polymerization and crystallization are typical applications. SensoTech inline analyzers set standards in the technological and qualitative valence, user friendliness and reproducibility of process values. Special calculation methods and sophisticated sensor technologies enable reliable and precise measuring results even under the most difficult process conditions. The knowledge and the experiences of the highly motivated and committed SensoTech staff are the result of many different applications supported by well-known customers from the chemical and pharmaceutical industry, food technology, semiconductor technology, automobile and metal industry as well as many other industries. In addition, these experiences also open up unimagined solution possibilities for new measuring challenges.

Contact:	
Headquarters	
SensoTech GmbH Steinfeldstr. 1 D-39179 Magdeburg-Barleben Germany	T + 49 39203 514100 F + 49 39203 514109 info@sensotech.com www.sensotech.com
U.S. Office	
SensoTech, Inc. 1341 Hamburg Tpk., Suite 2-3 Wayne, NJ 07470 USA	T +1 973 832 4575 F +1 973 832 4576 sales-usa@sensotech.com www.sensotech.com