Issue 10

The Probe

KK&S INSTRUMENTS - April / June 2013

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Front Page – Sigmascope

High-Precision Conductivity Measurement with SIGMASCOPE® SMP10

For many non-ferrous metals, knowing the electrical conductivity enables decisions to be made concerning alloy composition, heat treatment, or material microstructure.

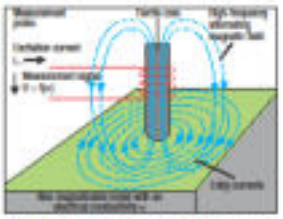
The Sigmascope SMP10 provides excellent features for measuring these characteristics. Signal evaluation based on established physical knowledge, the latest Helmut Fischer instrument technology and software for simple handling provide the ideal basis for such measurements.

Applications

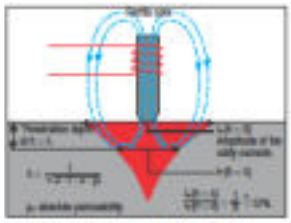
- **Measurement of the electrical conductivity of all non- magnetic metals, even stainless steel, coins, etc.**
- **Measurement of the hardness and strength of heat treated materials, e.g. aluminium alloys; inspection for heat damage.**
- **Measurement of the phosphor content in copper.**
- **Monitoring of deposition processes, e.g. for Cu-Cr-alloys.**
- **Determination of the degree of purity.**
- **Verifying the homogeneity of alloys.**
- **Scrap metal sorting.**

Outstanding features

- **Rapid and simple on-the-spot conductivity measurement of non-ferromagnetic metals**
- **Automatic temperature compensation of the conductivity (integrated or external sensor)**
- **Automatic curvature compensation for a known curvature diameter (down to 6 mm)**
- **Certified traceable calibration standards (MS/m, % IACS). Our probes were calibrated with these standards.**
- **Evaluation capabilities to the platform FISCHER DataCenter Software**



The eddy currents generated by the magnetic field of the probe and utilized as the measurement effect are influenced by the electrical conductivity.



The penetration depth δ of the eddy currents is established by the measurement frequency f, which determines the minimum permissible thickness of the specimen.

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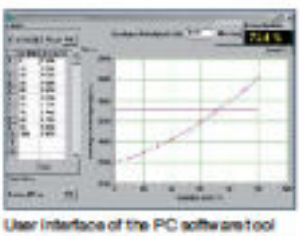
News – What's NEW!

Echometer 1077 Data – Precession A-Scan Thickness Gauge

The benefits of the A-Scan ECHOMETER 1077 Data at a glance

- High resolution display for optimal observation of the signal response
- High precision, selection of gate parameters, measurement at zero signal crossing
- Through coating measurement by evaluation of backwall echo sequences
- In readings screen mode three function keys for freely programmable menu items
- Square wave transmitter with pulse width individually adapted to the probe
- During calibration automatically detects probe properties including meas. range
- Selectable: Automatic gain and unique compensation of material attenuation
- Very high measuring rate
- Storage of readings with easy data administration with alphanumerical designation
- Configuration manager for fast opening of default set-ups of standard probes
- Customized set-ups may be stored with alphanumerical naming
- Statistical data evaluation: »» Min & max »» Mean »» Standard deviation
- Limit monitoring
- Individual storage of calibration in the respective files
- Output of readings via the data interface
- Robust Shock Absorbing rubber protective holster with stand
- Splash-proof housing compliant to IP 54



User interface of the PC software tool **KonzBest**: Example of a support curve for easy determination of the concentration of a liquid by means of a measured sound velocity

Echometer 1077K – Liquid Concentrations with Ultrasonics

Simply submerge the special probe into the liquid, measure the sound velocity and read the assigned concentration of the calibration curve.

The sound velocity of the material is a constant which differs in its magnitude with each chemical compound. With compounds made from two substances the sound velocity of the system changes characteristically dependant upon the composition.

If the concentration dependency is known (for instance, prior determined as a curve of measured values by means of calibration measurements) the given composition of the binary blend can be determined by means of a measurement of sound velocity.

The correlation between sound velocity and concentration is influenced by the temperature. If the sound velocity is used to determined the concentration of various temperatures, and if the temperature coefficient of the mixture is unknown, you need to acquire a new calibration curve for each temperature. The temperature meter **Checktemp,** which is part of the delivery assists you in doing so.

The Windows tool **KonzBest** which is included in the delivery, simplified the acquisition of calibration curves; the readings become connected by means of curve fitting and then shown on the screen.

The gauge for example is ideally suited for use in the field of quality assurance of chemical products where the consistent concentration of liquid mixtures is essential

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Ultrasonic Plant Supervision in the Petrochemical Industry: A Wall-Thickness Measuring System for Fixed Installation on Endangered Piping Locations

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Summary

Depending on the chemical and physical properties of transported gaseous or fluid media, e.g. their velocity, piping in the petrochemical industry are often subject to a considerable and permanent wear, caused by corrosion and erosion at the inner surface. Locations, where increased wear is expected, must regularly be inspected within short intervals. However, the endangered locations are usually hard to reach for instrument and personnel. In this paper, a new wall thickness measuring system is described, which is permanently mounted to the outer surface of a pipe and thus, can permanently monitor the wall thickness at those locations. The system consists of a special ultrasonic transducer, permanently coupled to the outer pipe surface and an electronic circuit placed nearby. The latter works like a remote thickness gauge and transfers digital thickness values via a serial interface to any desirable location, which may be as far as 1200 meters away. With the current set-up, up to 256 of such systems can be connected to a network. Each wall thickness system of this network has its own identification code and can be addressed from the central host station, so that thickness readings of 256 different measuring locations can be transferred. The central host system collects the data for storage, evaluation and further processing.

Introduction

Piping in plants of the petrochemical industry, e.g. refineries, are often subject of more or less erosion or corrosion at the inside wall. This depends on operational conditions, pipeline materials, and also on the chemical aggressiveness of the transported gases or fluids. Both effects can mainly be seen where the flow rate is increased, a multiphase-flow occurs, or where a high concentration of corrosive ingredients is present within the medium. Therefore, especially endangered are pipe bends, locations of reduced cross-section, or connections of external piping into the system, where the additional inflow is redirected towards the main flow. Those endangered locations have to be inspected during regular plant supervision within very short intervals. However, in many cases they can hardly be reached by the testing personnel, especially in case of piping mounted several meters above the ground. Sometimes, the locations to be examined are accessible only during a shut-down of the plant or after partial removal of surrounding armatures. For a continuous supervision of those plants, there is a long-wanted desire for a simpler solution of this measuring task.

Description of the Measuring Task

For the measuring locations, which are defined as being endangered, the first task is to permanently install and connect ultrasonic sensors for the residual wall thickness measurement in such a manner that their measured values can be evaluated at an easily accessible place. Therefore, distances in the order of 100 metres between measurement and evaluation place have to be bridged by a fixed cable installation. The reliable operation is an crucial pre-requisite. Also, such an installation must reduce the cost by saving time for the testing personnel compared to the conventional manual measurement for each location.

Continued Page 2

Application – Echometer Measuring System for Fixed Installation on Aggressive Corrosion Endangered Piping

Concept of the New Wall Thickness Gauging System

The newly developed measuring system for wall thickness monitoring of endangered locations of piping uses the principle that for each location, an independent measuring electronics (see fig. 1, right) is mounted close to the ultrasonic probe. The electronics contain all functions of a conventional wall thickness gauge, i.e. the electrical transmitter, an amplifier with distance amplitude correction (DAC), counter functions for exact determination of ultrasonic travel time, a micro-processor for evaluation and data processing, and also an interface driver to transfer the wall thickness readings via the data cable.

Unlike a hand-held wall thickness gauge, a display to show the wall thickness value is not required for the new electronics. Instead, the wall thickness reading is given in millimetres and is digitally transferred via a standardised serial two-wire data line to a remote host station (see fig. 1 left, ***ECHOMETER***-host station), where all wall thickness values can be read and stored.

Fig. 2 shows the gauging system mounted to a pipe. The ultrasonic sensor is mounted into a prism-shaped holder, and it is permanently pressed to the outer pipe surface with high force by using a steel belt. For acoustic coupling, a special couplant is used, which does not evaporate even at higher temperatures due to its extremely low vapour pressure and allows a permanent coupling over several years.

The probe is connected to the wall thickness electronics via a short weather-proof cable and with pressure and water-tight screw-able connectors. The electronic circuitry is mounted within a robust aluminium housing of approximately 120 by 65 by 40 mm^3, which is splash-protected according to IP 65. The small size of the electronic circuitry would allow for a further reduction of the housing size, if required for the measuring location.

The weather-proof cable connection between the wall thickness electronics and the host station contains four wires. Two of the wires are responsible for the power supply. Only low voltage (+5 V) is required which can be of importance in petrochemical plants (intrinsic safety). The voltage is generated by the host station. If the host station is active, also the wall thickness electronics is working and wall thickness data is continuously transferred from the measurement location towards the host station.

Fig. 2 shows the entire set-up including the probe, the measuring electronics and the simplest version for a host station only containing a data display (see also fig. 1). The wall thickness value is produced with a resolution of 0.1 mm. A serial data interface (either RS232 or RS485) allows for large distances between measurement location and the host station.

Conclusions and Outlook

This newly presented wall thickness gauging system for fixed installation at endangered locations of piping has two main advantages: It can reduce the required time and therefore the cost of non-destructive testing in the petrochemical industry. Secondly, it can increase the operating safety of the plant, because due to the minimised cost of the procedure, the testing intervals can become shorter. Also, a continuous supervision is now possible.
The probe shown in fig. 2 is resistant to long-time temperatures up to 80° C. The wall thickness electronic circuitry can withstand temperatures up to 50° C. Thus, the set-up enables also a supervision of hot piping. When higher temperatures are expected, special designs are possible. For the construction of the probe, the wall thickness electronics, and the low-voltage power supply, aspects of intrinsic safety were already considered. Therefore, an approval for hazardous areas, e.g. refinery areas, would require only little effort.

The design of the wall thickness electronics for fixed installation is based on a field-proven modern wall thickness gauge manufactured in large quantities under cost-efficient conditions. Therefore, the expense for this newly presented system is much lower compared to the conventional procedure by saving cost for the inspection personnel.

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Application – Echometer Measuring System for Fixed Installation on Aggressive Corrosion Endangered Piping

Fig. 1: ECHOMETER-host station with data display (left) and on-site wall thickness electronics (right).

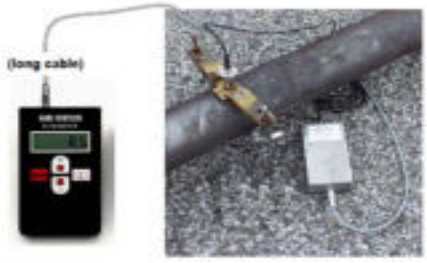

Fig. 2: Measuring location on pipe with permanently installed wall thickness probe (middle), on-site wall thickness electronics (right bottom) and remote **ECHOMETER** unit as host station and/or data output (left). The cable length can range from 100 m (RS 232 serial interface) up to 1200 m (RS 485 serial interface).

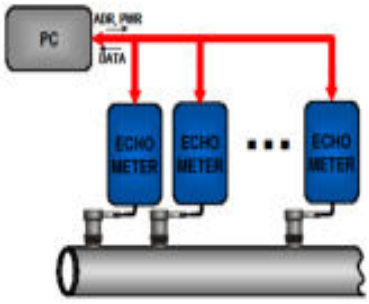

Fig. 3: Principle of set-up for wall thickness measurement system. The remote host station (PC) is addressing the individual on-site units (max. 256 units for RS 485 serial interface) and is supplying them with power. The wall thickness data is then transferred back to the host station and further processed.

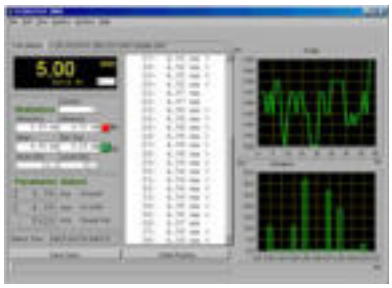

Fig. 4: Sample screen for software to process wall thickness data. Current value, statistical functions, batch data and graphical representations are provided.

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