

exchange

Endress+Hauser International News - 2008/2



**Operational Analysis:
Modernization of
the acid storage
facility**

Page 9



**Interview: Water
under safeguard**

Page 6

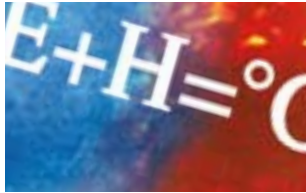


**Electromagnetic
flowmeters:
Topping the
million mark**

Page 22

How to draw the line

The intricacies of interface measurement



contents

Cover Story

How to draw the line:
The intricacies of interface measurement 14

Feature

Anywhere along the pipeline and the terminal system: Oil and gas storage facilities answer to new demands 2

Product Focus

Topping the million mark: Endress+Hauser is world market leader for electromagnetic flowmeters 22

Product News: Temperature measurement 12

Product News: Process solutions 5

Application Reports

An operational analysis: Modernization of the acid storage facility 9

News Update

Think global, act regional, go local:
Endress+Hauser has opened a Support Center for Central Asia in Kazakhstan 11

Interview

Water under safeguard:
An Endress+Hauser measuring station ensures the quality of Bucharest drinking water 6

Inside out

Product, Price, Place, Promotion, + P ... 24

Anywhere along

Oil and gas storage facilities answer to new demands

Tankvision makes tank walls truly transparent – for the user and all others authorized, without increased cost per access point due to web-browser technology: All necessary information about the tank farm inventory is now available in the control room. The user suddenly finds himself independent of Windows updates; and can install multiple user-logins without additional software licenses.



By Hai-Thuy Ngo, Business Driver Tank Gauging

Feature

the pipeline and the terminal system

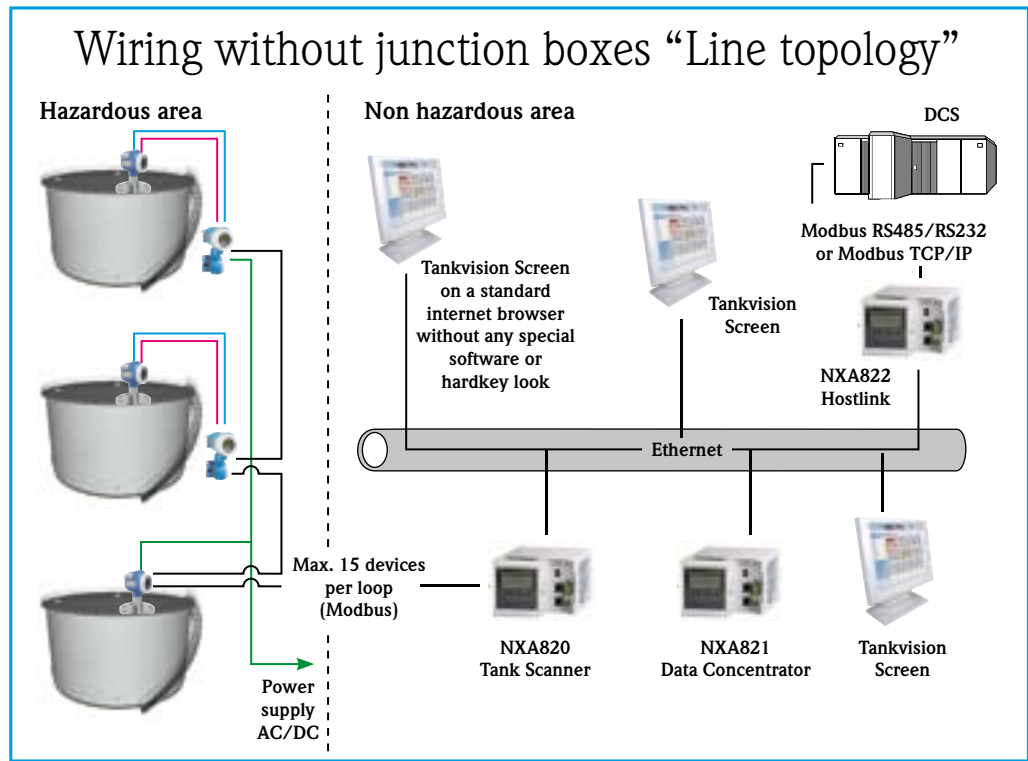
The dynamic nature of the oil & gas market is an omnipresent topic. Rising prices are discussed, as are their consequences and scenarios for future development. And the storage market is booming right along with the oil & gas industry. All the big players are reporting huge profit gains and increasing share prices.

In recent years there seems to be a trend for the major oil companies to sell off their storage facilities in order to concentrate on the core refining competences and optimize the refineries' productivity. The storage operating companies, on the other hand, are buying up distribution chains of bulk oil, gas & chemical products to specialize in storage and distributing. This hype leads to huge investments for new refineries and storage facilities, new exploring and production technologies as well as upgrades of existing tank farms.

Although with tank farms there is nothing like a standard size, style or organization, operators require basically the same skills to store and distribute bulk liquids safely and effectively 24 hours a day, 365 days a year. But now, with shifting market demands, efficiency is becoming increasingly essential. Logistics and management are the challenges of the day. As adding new tanks is costly, sometimes even not possible due to area restrictions, the maximum allowed capacity of existing tanks is fully utilized. Storage companies turnover tanks more and more quickly. Adequate inventory control needs to keep up with the increased pace. However, many tank gauging systems still use proprietary protocols – with all the restrictions that come with it...



All electrical and mechanical installation drawings for the project were supplied by Endress+Hauser.



Non-proprietary solution for inventory control at EAPC, Israel

Founded in 1968, the Eilat Ashkelon Pipeline Co. Ltd. (EAPC) serves as a land bridge for transporting crude oil from the Red Sea to the Mediterranean and vice versa. The transport system consists of 3 separate pipelines: A 42" diam. line of 254 km length links the Red Sea port of Eilat with the Mediterranean port of Ashkelon. The two other lines feed the oil refineries in Haifa and Ashdod. The company operates two oil ports and two oil depot terminals.

In addition to pipeline transit of crude oil, the company offers long-term terminal storage and crude oil blending according to customer requirements. EAPC also provides infrastructure services for liquefied petroleum gas, fuel oil, distillates and coal.

EAPC has decided in favour of Tankvision

Tankvision is a dedicated tank inventory system which is operated by a standard web browser and does not require proprietary software. It is based on a distributed architecture on a Local Area Network (LAN). Due to its modular structure, it can be adjusted to any application. Tankvision is a robust industrial operating system (QNX) with embedded software ensuring high stability and availability.

The concept of a system that can be accessed by a standard web browser from anywhere without requiring proprietary software and additional licenses won over EAPC engineers.

EAPC instrumented 9 tank areas with a total of 28 tanks. Each of the 25 crude oil tanks is equipped with a Proservo level instrument and a Prothermo multi-spot temperature probe. Six extra Proservo instruments have been fitted to the three LPG tanks. All tanks are connected to the central control room via intranet (fiber-optic cables). 12 Tankvision units provide and organise the inventory information. They are seamlessly integrated into the existing SCADA system.

But technology alone did not win the day. The stamina and proactive commitment of the supplier were equally convincing arguments. The Tankvision solution temptingly included reliable sales and service by Instrumetrics Industrial Control Ltd., the local Endress+Hauser representative office in Israel, combined with international engineering expertise. A 24/7 availability during the project, support in design and installation, project management that thought of everything and focused on the individual conditions helped to exploit the full potential of the solution for EAPC – making it strong in the face of changing market requirements.



On-site training and commissioning:
Mr. Shinichi Yamazoe

(Head of Service, Endress+Hauser Production Center Yamanashi, Japan),

Meir Nakash

(Instrument Maintenance Manager, EAPC Ashkelon, Israel),

Jan Strohmeier

(System Engineer, Endress+Hauser Instruments International, Switzerland)



Project control at EAPC Ashkelon from left to right:

Meir Nakash

(Instrument Maintenance Manager),

Itzhak Solomonovich

(Instrumentation & Control Dept. Manager),

Izick Levi

(Operation Manager)

Product News:

Process solutions



Track record of an open system

Endress+Hauser celebrates the 100th ControlCare project

Since 2002 customers have been benefitting from the advantages of Endress+Hauser's system platform ControlCare. Scalability, flexibility and true openness are the key features that contribute to this success. But technology tells only part of the story: It's the "People for Process Automation" who focus on the user and his specific application to bring out the best in the technology. The 100th ControlCare project was an important milestone. But we're not resting on our laurels – challenge us to enhance your process, too.

Take full advantage of intelligent fieldbus devices ControlCare:

- Offers best-for-purpose instruments for the application, not the system
- Supports open standards like High Speed Ethernet, PROFIBUS, Fieldbus Foundation, HART, Modbus, OPC
- Modular and decentralized approach allows cost-effective solutions



New device configurator: Field Xpert

Field Xpert is a high performance device configurator that perfectly meets the requirements of the process industry:

- Handheld for device configuration
- Wireless communication via Bluetooth™ or WLAN based on an industrial PDA
- Device commissioning, diagnosis and maintenance with the sophisticated software package Device Xpert (supports echo curve for Endress+Hauser time-of-flight devices)
- Supports all registered HART devices (DD update via Internet possible)
- Ex and NON-Ex Version available

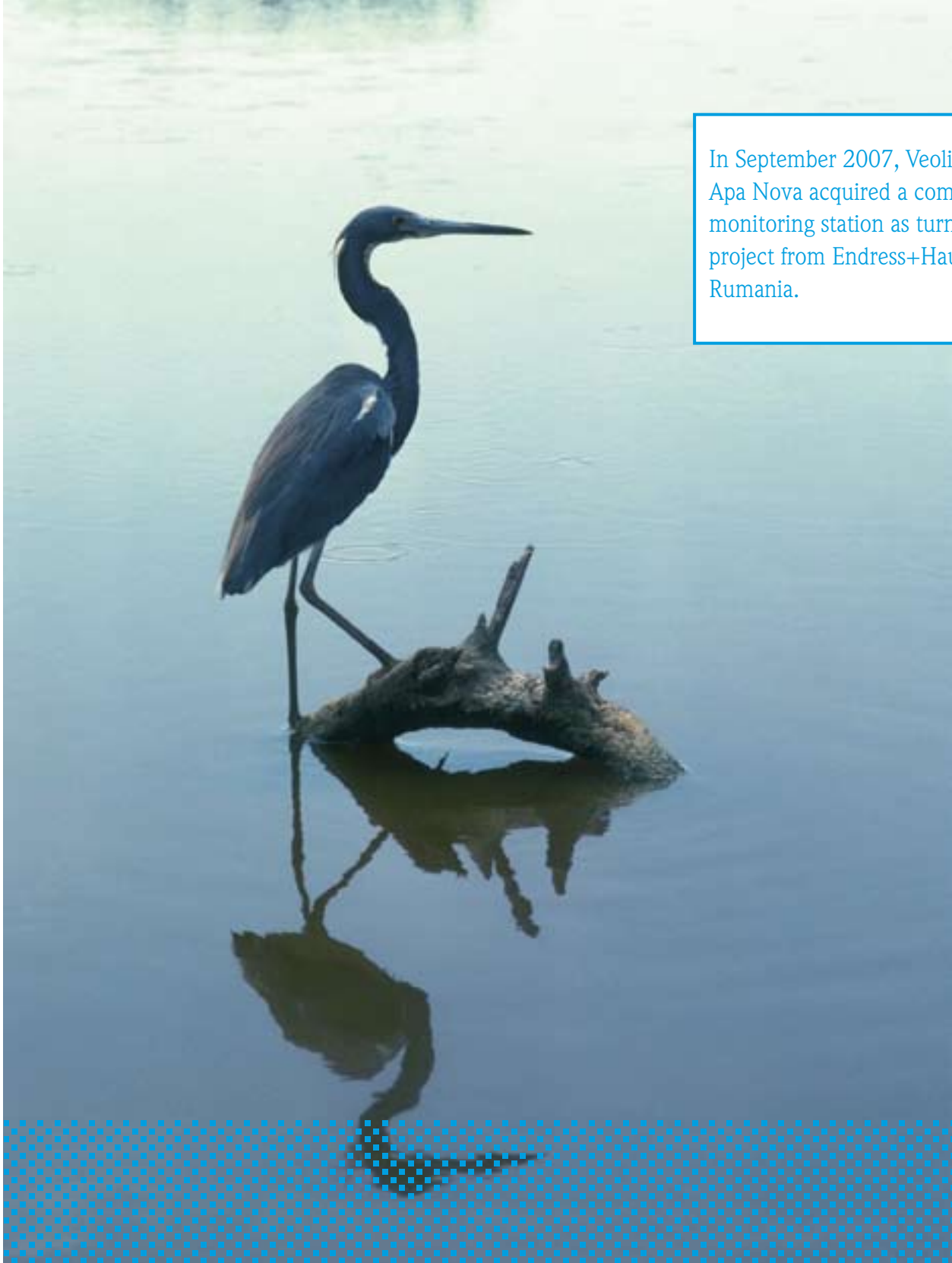


iDTM™ integrates EDD into FieldCare



The agonie of choice between EDDL (Electronic device Description language) and FDT (Field

Device Tool) is over. Until FDI, which will combine both technologies with full backward compatibility, becomes available, Endress+Hauser has developed an operational solution with the iDTM. The iDTM gives access to all registered HART instruments, which do not have a dedicated DTM by using the original standard HART interpreter SDC625 from the HART Communication Foundation (HCF). The iDTM comes free of charge with the FDT Frame application FieldCare Standard and Professional.



In September 2007, Veolia Apa Nova acquired a complete monitoring station as turnkey project from Endress+Hauser in Rumania.

Interview

Water under safeguard

An Endress+Hauser measuring station ensures the quality of Bucharest drinking water

Extended Endress+Hauser presence in Romania

Inauguration of the Endress+Hauser Sales Center in Bucharest

Mr René Matillon from Veolia Apa Nova talking to Mr Eric Sifferlen, Endress+Hauser Marketing Manager Analysis, Crivina, September 2, 2008

Eric Sifferlen:

Would you please acquaint us with the assignment of Veolia Apa Nova in Romania and your role in that assignment?

René Matillon:

The Veolia group comprises the companies OTV, the Compagnie Generale des Eaux, the APA Nova and many more. Being native French, I now work within the group for 26 years. The past seven years I have spent here in Romania. My current position is Vice Director of the operational division of Veolia called Apa Nova in Bucharest (1800 people).

Since 2001 (and for the next 18 years) the main task of Veolia Apa Nova is producing and operating Bucharest's drinking water supply. Additionally we are in charge of the city's wastewater network.

Veolia Apa Nova now runs three drinking water plants (Crivina, Rosu and Arcuda) which process 780 000 m³/day. It may be interesting to know that we processed 1 650 000 m³/day in 2001 and that this amount was reduced after we improved the network (repair of leakages for example) and the consumption decreased.

Eric Sifferlen:

Last year, Endress+Hauser supplied you with a container that included measurement devices for the following parameters: pH and conductivity, turbidity, oil film on water, phenol, chloride, cyanide, phosphate, iron, manganese and total organic carbon. The container was also equipped with pumping facilities, data recording and sampling units. What's it all for?



Endress+Hauser is recognized as a leading supplier of industrial measurement and automation devices. Until this spring, services and solutions for industrial processes made

by Endress+Hauser were skilfully supplied in Romania by a representative office in Bucharest. Now, this representative office has officially become Endress+Hauser Romania SRL. The transformation shows the commitment of the whole group to the Romanian market and enables the provision of services to an even wider range of industries in the country.

The inauguration of the new Endress+Hauser Sales Center took place in Bucharest, on May 21st 2008. The staff was pleased to invite Mr. Klaus Endress, CEO of Endress+Hauser group, as well as a number of customers and internal as well as external partners to the inauguration ceremony. It was the perfect opportunity to present successful projects (such as the cooperation with Veolia-Apa Nova) and to lay out the concept for future development: The plans are to expand both business and staff in order to deliver even better support to customers throughout the country.

Endress+Hauser Romania SRL
319C, Splaiul Independentei
RO - 060044 Bucharest
Tel.:+40 21 315 90 67
Fax:+40 21 315 90 63
email:info@ro.endress.com



CEO Klaus Endress congratulates Serban Samoila, Managing Director of Endress+Hauser Rumania

René Matillon:

Two of our drinking water plants, Crivina and Rosu, take their raw water from the Arges River. The main reason for installing the container was to ensure functional security of these plants. In other words: The container is our "alarm station" and installed to detect any kind of pollution, before the raw water is pumped in to our process.

Eric Sifferlen:

What kinds of pollution may possibly occur?

René Matillon:

Upstream along the Arges river, the city of Pitesti is home to numerous industrial plants (automotive, petrochemicals ...). Hence, we face the risk of hydrocarbons, phenols or cyanide in the river. On the other hand, there is always the possibility of agricultural pollution, for example through pesticides or nitrogen.

Eric Sifferlen:

In case of pollution, what is your control strategy?

René Matillon:

Right now, the container is installed directly at the intake point of the Crivina plant. If any pollution is detected, we have to act instantly. If the raw water quality is outside its normal characteristics, we will, in extreme cases, stop the intake pumping. The Rosu plant is situated downstream and leaves us about 5 hours time to take adequate action.





Eric Sifferlen:

After the first 9 months of operation, what are your experiences and objectives?

René Matillon:

Now that we finally have comprehensive and reliable data on water quality, we want to increase our reaction time. Our current project is to relocate the container 15 kilometres upstream of Crivina. To this end we entered into negotiations with the Romanian water agency (ANAR) to find a suitable place. They will also be provided with all the data regarding the quality of the Arges River. Since Romania is part of the European Union, the country faces a lot of investments to comply with the European Water Frame directive...

Eric Sifferlen:

What were your main reasons to decide on a turnkey container from Endress+Hauser?

René Matillon:

Basically, I didn't want to buy just instruments; I wanted to buy a solution, where my supplier was in charge and responsible for the whole container. Another critical issue was maintenance. The fact that Endress+Hauser has a local organisation able to provide fast and professional service

support for all instruments was a decisive argument.

Eric Sifferlen:

What is your maintenance strategy for the container?

René Matillon:

I want the installation to work perfectly with a coherent cost/quality ratio. The first level of maintenance (cleaning) will, therefore, be done by our own staff. Additionally, we set up a yearly maintenance contract with the Endress+Hauser in Romania. Endress+Hauser staff will provide the other levels of maintenance like calibration, preventive and maintenance. The contract also includes a consignment stock of consumables and related spare parts.

Eric Sifferlen:

How would you describe your attitude towards Endress+Hauser instruments and local services?

René Matillon:

Endress+Hauser has for a long time been our partner and has acquired a good reputation. We are sure to benefit from the company's high quality instruments and, at the same time, from latest innovative

technology. Concerning the local organisation: I'm really satisfied with their competence and availability around the clock. It is, as well, very comforting to meet the same people over the years. This proves that the organisation is durable and here to stay.

Eric Sifferlen:

Thank you very much for this interview, Mr Matillon.



Arges river



pH and conductivity measurement



View of the container from the river side including pumping and outlet facilities.



Mr René Matillon (right) and Mr Eric Sifferlen (left) standing inside the container





An operational analysis

Modernization of the acid storage facility in the cold rolling mill (CRM) at ArcelorMittal in Eisenhüttenstadt, Germany

Calculated cost reduction, guaranteed payback... application reports often focus on benefits as seen by controlling. For once, let's change the perspective: 6 months after the modernization of a Cold Rolling Mill (CRM) in Eisenhüttenstadt, Germany, what has changed in terms of process operation? Now that the modernization has paid off for the management, does the maintenance staff regard it as a success?

A key step in the process

The acid storage facility is an auxiliary plant of the cold rolling mill (CRM) regeneration plant. Essentially, it comprises several steel tanks for e.g. fresh acid, reclaimed acid, pickling and -sump water for neutralization as well as peripheral systems with e.g. process water and compressed air. The main purpose of this plant is to ensure 7-day-/24-h-Operation of uninterrupted pickling liquor flow to the steel mill. Problems in the acid storage tanks can lead to a stop in the pickling line process and subsequent loss of production for the entire CRM.

The main objectives in the modernization were therefore:

- Trouble-free operation around the clock
- Fast diagnosis and correction of any process problems

Defining the superstructure

The new system runs on PROFIBUS PA which is connected to a Siemens S7 PLC via a PROFIBUS DP card. A Wonderware InTouch® system serves as the Human Machine Interface (HMI). Endress+Hauser FieldCare is used both for commissioning and as a service tool.

W@M (= Web Enabled Asset Management by Endress+Hauser) provides the information platform to seamlessly integrate measurement technology from all suppliers of instrumentation involved in the project. The W@M-portal displays all data via a standard internet browser and needs no additional software. W@M serves as a basis for an optimized maintenance strategy.

Choosing Instrumentation

Only "intelligent" field instrumentation delivers the information demanded for optimum process control. The following devices were chosen for the project: radar measuring devices (type FMR245) and vibration limit switches (type Liquiphant FTL51) for level measurement,

electromagnetic flow measuring devices (type Promag 50 P+W), vortex meters (type Prowirl 72) for volumetric compressed-air measurement, pressure measuring devices (type Cerabar M PMC41) and Pt 100 resistance thermometers (type TR13).

"Previously, diagnosis was done in the field, while today it's done in the control room."

This is possible only because of the more accurate information provided by the field devices and transmitted to the HMI.

Operational payback

With the modernization of the acid storage facility, routines of the operational staff changed significantly. The control room has now become their main working area. Centralized visualization in the regeneration control room now enables better tracking and monitoring of volumes and levels, including trend tracking.

With regard to maintenance, MTBF (Mean Time Between Failures) and MTTR (Mean Time To Repair) higher qualities of the new instrumentation have improved system availability. However, the essential benefit of the new instrumentation: It reduces



Plant view



Vibration limit switch:
Liquiphant FTL51



Electromagnetic
flow meter:
Promag 50



Level transmitter:
Micropilot FMR245



response times in the event of an alarm condition, by using suitable diagnostic data. When carrying out the indicated error diagnosis, several defined error messages appear on the display. Due to the differentiation of operational requirements relating to maintenance, the diagnostic information provided can be used to determine if there is a problem with a measurement and control device or if there is a real process-related failure.

With the introduction of W@M, all process operators have up-to-date and complete data from engineering, procurement and commissioning to operation, maintenance and replacement of individual components right at hand. They now access this information from any internet-enabled PC. For Endress+Hauser devices, technical data, documentation, product status, spare parts lists and events from the life cycle are automatically provided.

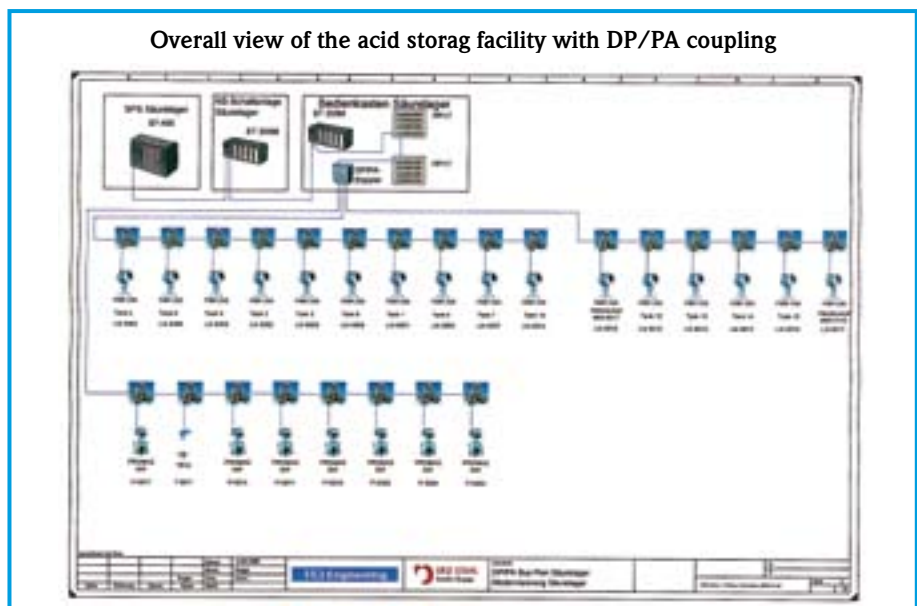
Up to the completion of the project, a lot of time has been wasted in trying to find the order numbers for spare parts. In conjunction with the classification of critical measuring points and maintenance risk, W@M now supports spare parts management: On the one hand it offers recommendations with regard to the provisioning of spare parts; on the other hand it greatly simplifies and accelerates the ordering process.

In a nutshell: Operational staff has profited greatly from the modernization – both in the quality and the quantity of their work. And, by the way, the payback was seen within one year right from the decision to start the modernization project.

Trend assumptions derived from this successful project:

Modern network structures will use intelligent and open fieldbus sensor technologies. A manufacturer-independent open configuration and diagnostic tool, such as FieldCare can be used for measurement and control technology, both for commissioning and as a service tool. With the W@M-portal, all data is displayed via a standard web browser, and information relevant to the system can be accessed at anytime.

We would like to express our special thanks to Mr. Pollack and Mr. Hunger, who gave an on-site interview about the project objective and their experience after 6 months in operation.





The CASC's core team (left to right): Yerbol Aubakirov (Sales Manager), Konstantin Khmelev (Service Manager), Erich Martsch (General Manager and Sales Manager), Yerkin Omarov (Sales Manager)

Think global, act regional, go local

Endress+Hauser has opened a Support Center for Central Asia in Kazakhstan

Currently, many globally represented companies still regard Moscow as the door to the Central Asian markets. However, this assumption does not live up to the present situation in the region. Politically, culturally and economically the countries have found their way into autonomy.

With a GNP that has recently grown about 9% per year, Kazakhstan stands out in the region as the most dynamic country concerning its economic development. Prominent factors in this development are the rich natural resources such as oil, gas and minerals. The country also is an active promoter of political stabilization within Central Asia.

Historical, cultural and political considerations strongly advocate a clear commitment to the area. Endress+Hauser takes these considerations seriously: The new Central Asia Support Center situated in Almaty, Kazakhstan, will actively develop and support the growing sales and service network in the region.

Up to now this network consists of 9 representative offices working in Kazakhstan, Azerbaijan, Uzbekistan, Georgia, Mongolia, Turkmenistan and Kyrgyzstan. Now all of them profit from experienced support - above all in project handling and service.

The CASC reflects an important maxim of the Endress+Hauser strategy: Being a close and reliable partner to customers in every corner of the world is part of the company credo. Similar Support Centers have been installed in the Middle East and Latin America.

- Facts and Figures**
- Registration of the „Central Asia Support Center“(CASC) in December 2007 as branch office of Endress+Hauser Instruments International.
 - Opening in Almaty, Furmanova Street 149, in January 2008
 - March 12, 2008: „Open Day“ and official presentation to customers and representatives
 - The CASC covers 9 countries with a total area of 6.2 mio km²: Kazakhstan, Uzbekistan, Kirgistan, Tadjikistan, Turkmenistan, Mongolia, Armenia, Azerbaijan and Georgia.

Product News:

Temperature measurement

Innovation from micro to macro

The evolution of temperature measurement goes on with a new generation of head transmitters, connection heads and displays.

New two-channel temperature head transmitters with digital communication

Endress+Hauser has developed two head transmitters with PROFIBUS and Foundation Fieldbus abilities. Both devices offer a second sensor input which allows additional functionalities such as automatic sensor-backup function, drift detection and advanced diagnostics – features that provide the greatest amount of safety and availability even in critical applications. A full set of the common international approvals allows easy integration into the dedicated bus systems.

The plug-on display TID10, a window into your process

The new transmitter platform also comes with a new display: Plug it onto the head transmitter at any time (even during operation) and get information on the current measured value and the measuring point identification. The display also indicates errors in the measuring chain.

New versatile terminal connection head family

A new set of connection heads complete the components: The heads are available with various forms of lids which are optionally equipped with a display window and hence offer, in conjunction with the plug-on display TID10, an on-site indication. Approvals for the explosion-proof versions are obtainable at any time.



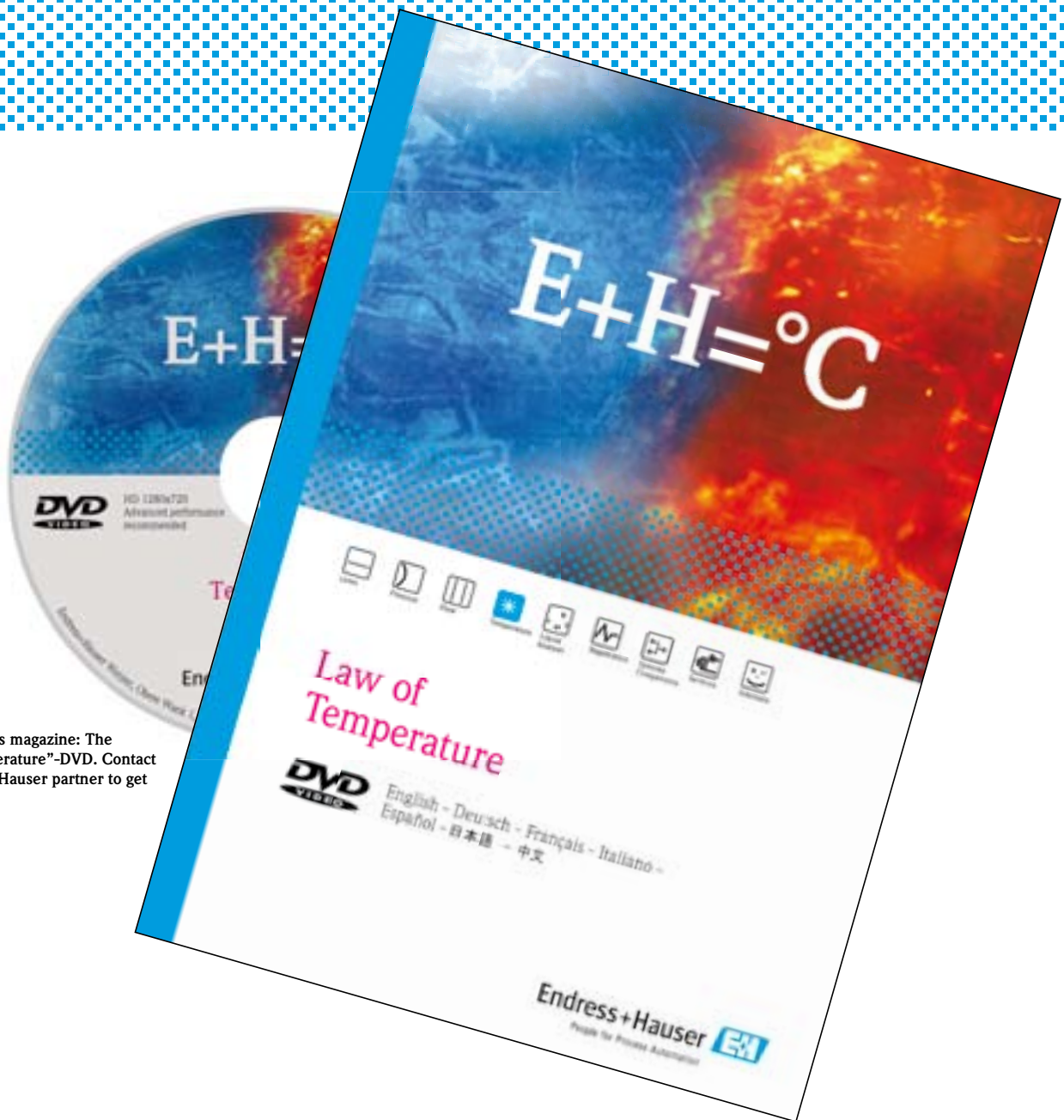
TA30A temperature head + TID10 plug-on display + TMT85/TMT84 temperature head transmitter



TMT85 temperature head transmitter with different connection types: screw terminal (left) and spring terminal (right)



TID10 plug-on display



Included in this magazine: The "Law of Temperature"-DVD. Contact your Endress+Hauser partner to get extra copies.

Full of smart details

The three new components, head transmitter, connection head and the plug-on display are the basis for a new generation of thermometers. Great value is attached to comfortable installation and commissioning and process safety. A number of smart detail solutions simplify handling routines. All new terminal heads, for example, have a spiral cable guide through which the wires are automatically fed towards the transmitter terminals. The low body base allows optimal accessibility to the transmitter making the wiring mere child's play.

Commanding the "Law of temperature" – from micro to macro

The unique qualities of Endress+Hauser solutions in temperature measurement range from the primary sensor up to the engineered solutions – from micro to macro. Take a look at our manufacturing technologies and our testing and calibration expertise. Learn about the added value offered by Endress+Hauser during the entire lifecycle of all measuring points. Get yourself a quick tool to define the best temperature sensor for your needs... All this information is entertainingly given in

our "Law of temperature"-DVD which is available in this magazine – and from your Endress+Hauser partner.



How to draw the line

The intricacies of interface measurement

Two liquids in one tank? In numerous processes - particularly those working with oil - the tank acts as a separator. All of a sudden, a simple level problem becomes complex measuring technology - for how do we know where one liquid stops and the other starts?

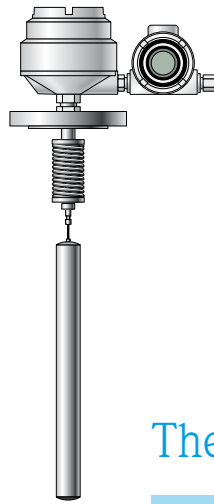
Interface measurement is thus a complicated task since we need to know the exact properties of the two liquids in terms of how they are normally, and how they change during a (dynamic) process. This article examines what we need to know, and looks at where interface measurement works best and how we can achieve optimum results.

If a tank contains two liquids that are not mixed, the transition from one liquid to the other is known as the interface.

Most interface measurement situations involve measuring the interface between water and something else. General speaking, this "something else" is a product of oil processing. The procedure for processing crude oil itself begins with the separation of oil, water and sand. As easy as this may sound, diverse requirements apply in the various processes. Why?



Guided radar: guided radar device mounted in a bypass - the Levelflex interface



The classic dispenser element is at least in line with the measuring range.

The classic “full length” displacer

The principle of the displacer transmitter for level or interface measurement is based on the buoyancy force exerted on a body immersed in a liquid. This force is equal to the weight of the liquid displaced. A cylindrical displacer element, whose length corresponds to the range of the level measurement required, is immersed in the liquid. The change in the effective weight of the displacer element is equivalent to the weight of the liquid displaced.

Interface measurement with a displacer is based on the difference between the specific weight of the two liquids. If the displacer is completely submerged in the liquid with the higher specific weight, then the effective weight of the displacer element is equivalent to the displaced volume of the liquid with the higher specific weight. If the displacer is completely submerged in the liquid with the lower specific weight, then the effective weight of the displacer element is equivalent to the displaced volume of the liquid with the lower specific weight.

The difference between the effective weight of the displacer element in the 2 liquids is the span for interface measurement. The displacer element for interface measurement must be completely submerged. A protruding displacer element results in a major error.

The accuracy of the measurement is directly related to the variation of the specific weight of the liquids. Any buildup on the displacer element will influence the displaced volume of the liquid and impact the accuracy.

Because the physical properties of the liquids vary greatly, as do the requirements in terms of accuracy in the application in question and the design of the tank.

What measuring technology is best for my application? The answer is primarily based on the properties of the two liquids and on whether these properties remain constant or change in the course of the process. This mainly affects the density and the relative permittivity (dielectric constant). Other criteria include contamination, buildup on the sensor, accuracy requirements and the condition of the interface - is it a clear separation line or a mixed transition zone (emulsion)?

Over the next few pages, we will use these criteria to take a closer look at the most common measuring principles, including the guided radar principle which has become the modern solution over the past number of years. But first, let's start with the good old displacer.

Arguments in favor of the displacer

- A displacer only senses the specific weight of the liquids. It is not sensitive to other liquid properties like permittivity ϵ_r (dielectric constant) or conductivity.
- A displacer is not affected by emulsion layers.

Arguments against the displacer

- The displacer element has to be fully submerged - all the time!
- Information is given on the interface OR level, not on the level AND interface.
- Any buildup affects the accuracy.
- A change in the specific weight of the liquids has a direct impact on the accuracy.

◀ The motorized “moving” displacer

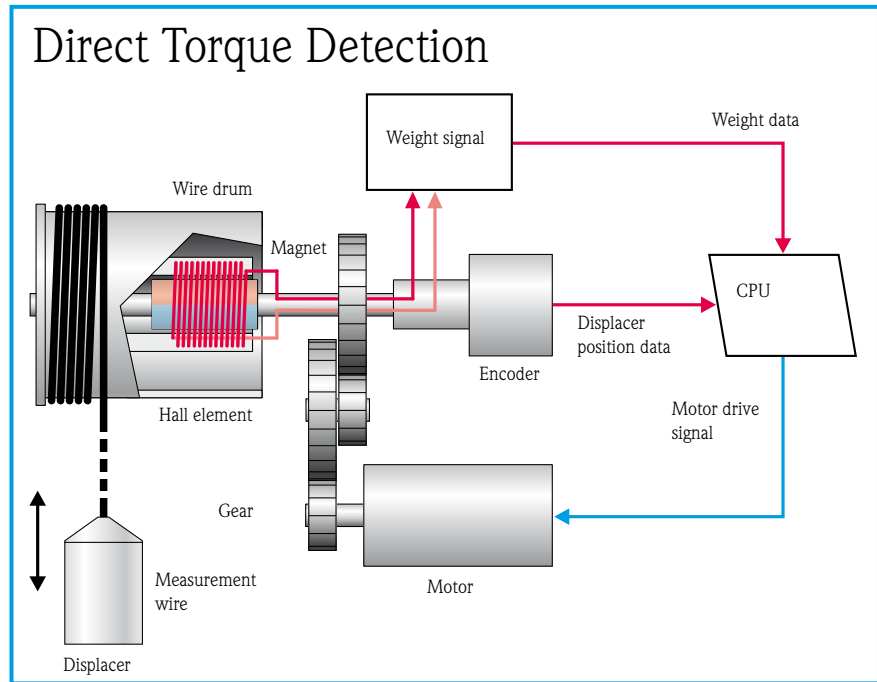
The length of the classic displacer element is at least in line with the measuring range. The static element delivers one value that has to be interpreted according to the liquids in the tank.

The neat little displacer element of the torque instrument driven by a servo motor (hence the Endress+Hauser “Proservo”) moves up and down measuring the level, specific weight and interface consecutively.

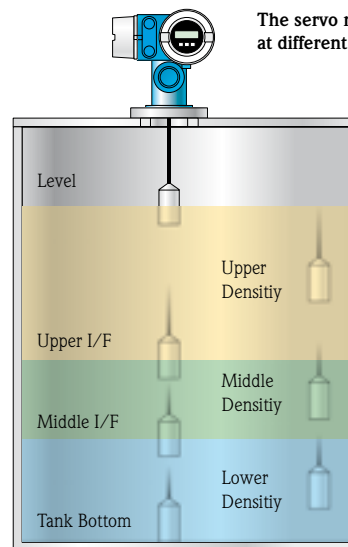
A small displacer is accurately positioned in the liquid medium using a servo motor. The displacer is suspended on a measuring wire which is wound around a finely grooved drum housing inside the instrument. The drum is driven by coupling magnets which are completely separated from the drum housing. Outer magnets are connected to the wire drum whilst the inner magnets are connected to the drive motor. As the inner magnets turn, magnetic attraction causes the outer magnets to turn as well, and also causes the entire drum assembly to turn as a result.

The weight of the displacer on the wire creates a torque on the outer magnets that generates a change in the magnetic flux. These changes generated between the drum assembly are detected by an individual electromagnetic transducer on the inner magnet. The drive motor is actuated to balance the voltage generated by the variations of magnetic flux to equal the reference voltage defined by the operating command.

When the displacer is lowered and touches the liquid, the weight of the displacer is reduced because of the buoyant force of the liquid. As a result, the torque in the magnetic coupling is changed and this change is measured by 5 sets of Hall sensors (patented chips) which are temperature compensated. The signal indicating the position of the displacer is sent to the motor control circuit. As the liquid level rises and falls, the position of the displacer is adjusted by the drive motor. The rotation of the wire drum is precisely evaluated to determine the level value which is accurate to within ± 0.7 mm



Construction of the servo motor-driven displacer



The servo motor-driven displacer measuring at different levels within the tank.

Arguments in favor of servo motor displacement

- Only one instrument is needed to measure the liquid level, interface level, spot density, density profile, tank bottom and water dip.
- The displacer is independent of electrical product properties such as conductivity or the dielectric constant.
- The instrument can be mounted on a ball valve at pressurized tanks.

Arguments against servo motor displacement

- The instrument only works in clean liquids. Any buildup distorts the results.
- Information on the level, specific weight and interface are only updated consecutively.

Typical applications

Servo motor displacement is used in inventory control and custody transfer measurement at tank farms.

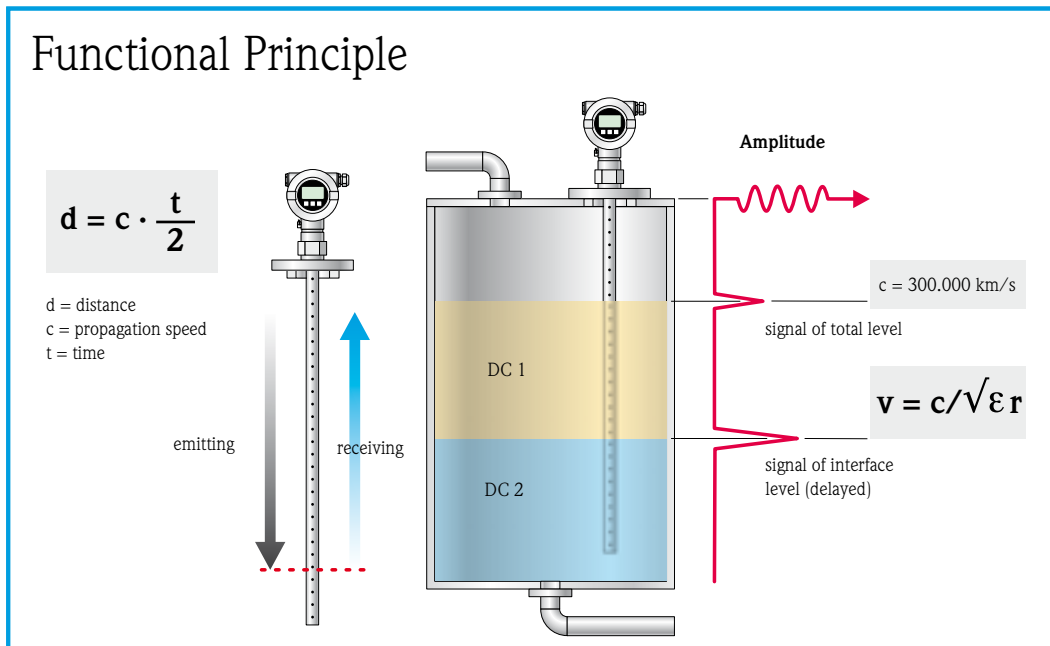
◀ TDR (time domain reflectometry) or guided radar

A very short radar pulse with a frequency range of 0.3 to 1.5 GHz is transmitted along a metal rod or a steel rope. The pulse travels from the point of transmission towards the end of the rod or rope. The resulting electromagnetic field comprises a radius of approx. 300 mm around the rod. In the case of a coax probe, or if mounting in a bypass, the electromagnetic field is concentrated between the rod pipe and the metal pipe.

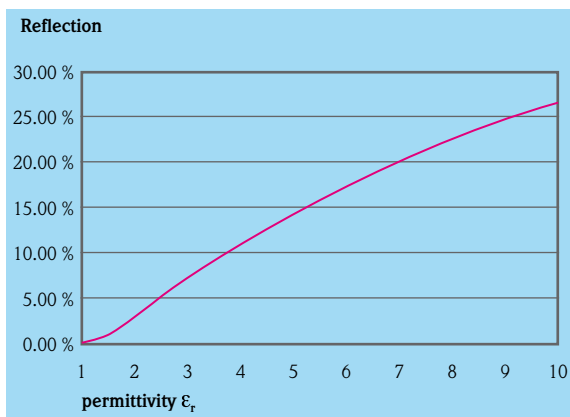
The radar pulse propagates at the speed of light in a vacuum. The speed of propagation in a nonconductive medium depends on the relative permittivity ϵ_r (also known as the dielectric constant). The ϵ_r of a vacuum = 1. At low pressure, the ϵ_r of air approaches 1 (the ϵ_r of air at 1013 hPa abs. = 1.000633). For this reason, we also presume a propagation velocity $C = 300000$ km/s here.



Measurement with guided radar: Levelflex interface in the bypass



The functional principle of guided radar.



In the case of nonconductive liquids, the degree of reflection depends on the jump in the ϵ_r : 2% of the energy is reflected in the case of kerosene whose $\epsilon_r = 1.8$; this figure is 2.9% for gasoline whose $\epsilon_r = 2$, and 9.2% for biodiesel whose $\epsilon_r = 3.5$.

Reflection at the gas/liquid phase

Every sudden change in electrical impedance along the rod causes a reflection in the radar pulse. Total reflection takes place for conductive liquids. In the case of nonconductive liquids, the degree of reflection depends on the ϵ_r . The unreflected part of the pulse penetrates the liquid and travels further along the rod. However it no longer travels at the speed of light. Instead it slows down and travels in accordance with the formula $v = c / \sqrt{\epsilon_r}$. For example, petroleum whose $\epsilon_r = 2$ reduces the propagation velocity from $c = 300000$ km/s to $v = 212000$ km/s. The total level is calculated using the reflection at the gas/liquid interface and the time-of-flight of the pulse.



Reflection at the liquid/liquid interface

The same reflection conditions as those in the gas phase apply for the pulse continuing through the liquid. A sudden change (in the impedance, conductivity or ϵ_r) causes a reflection. If the lower liquid is conductive or is a liquid whose ϵ_r value is far higher than the upper liquid, then the pulse is reflected at this interface. The upper layer has to be thick enough to ensure a clear separation of the two pulses. Thanks to special deconvolution signal processing at the interface of the Endress+Hauser Levelflex device, the interface can be detected from layers as thin as 60 mm.

The reflection capacity is reduced if there is an unclear transition between the two layers, i.e. an emulsion layer. Emulsion layers thicker than 50 mm can absorb the pulse completely. The interface is usually not visible from above. The Levelflex interface indicates the signal intensity of interface reflection and thus makes it possible for the user to ascertain the reliability of the measurement.

Accuracy

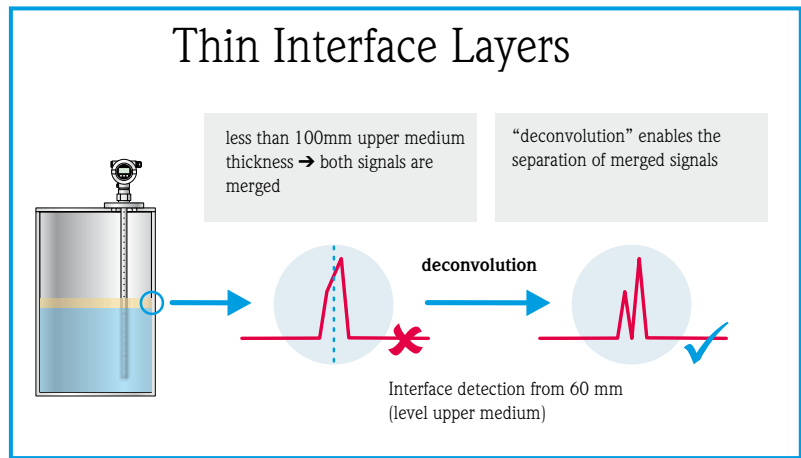
Reflection at the surface and the time-of-flight of the pulse are used to determine the overall level. The height of the upper liquid column results from the time-of-flight between the first and second pulse reflected (at the interface to the lower liquid) but only if the reduced velocity of propagation is taken into account.

However, steps to accelerate the separation of liquids – and thus to optimize the process – often result in a change in the ϵ_r . These fluctuations act directly as measuring errors when calculating the upper liquid column. Changing the ϵ_r from $\epsilon_r = 2$ to $\epsilon_r = 3$ reduces the propagation velocity by 18% from 212000 km/s to 173000 km/s. This error refers to the height of the upper liquid column. The level of the interface calculated is then incorrect by this amount.

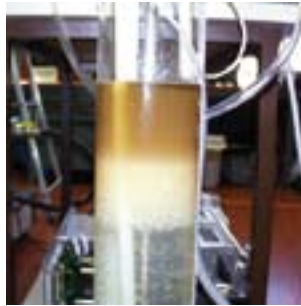
Bottom water detection

In this special type of interface measurement, the level of the water collected in large storage tanks for hydrocarbons has to be determined precisely. Access is usually only possible from above. The radar pulse would have to penetrate the entire upper liquid. However, the pulse is totally absorbed with levels of 20 m and more. This method also fails in terms of accuracy. With the long path in the upper liquid, minor fluctuations in the ϵ_r result in major errors in the level of the water interface layer displayed. A minor change in the ϵ_r from $\epsilon_r = 2$ to $\epsilon_r = 2.05$ causes an error of 254 mm in the value displayed for the water level at the base when the height of the upper liquid is 20 m.

Thin Interface Layers

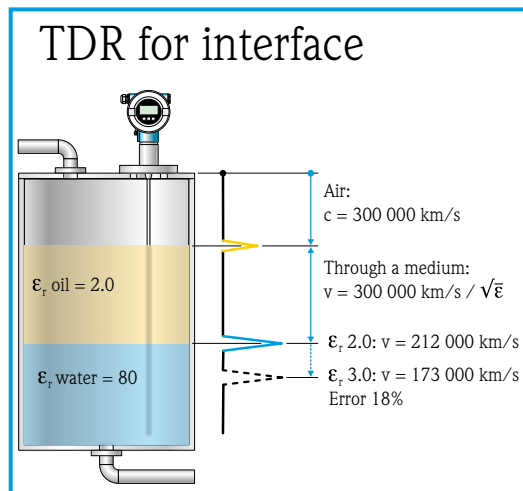


Signals merge if the thickness of the upper liquid is less than 100mm. "Deconvolution" separates the signals. The Endress+Hauser Levelflex measures reliably from upper liquid layer thickness levels of 60 mm.



If the layer of emulsion between the two liquids is too thick, it can absorb the pulse completely. The emulsion usually cannot be detected from above.

TDR for interface



Fluctuations in the ϵ_r act directly as a measuring error in calculating the upper liquid column. Changing the $\epsilon_r = 2$ to $\epsilon_r = 3$ reduces the propagation velocity by 18% from 212000 km/s to 173000 km/s. This error refers to the height of the upper liquid column.

Arguments in favor of the guided radar

- One probe measures the level and interface simultaneously.
- Buildup has practically no effect on the accuracy.
- The accuracy is also not affected by fluctuations in the overall level.
- The accuracy is not affected by changes in the specific weight of the liquids.

Arguments against guided radar

- The ϵ_r value of the upper liquid should be <10 and should not fluctuate.
- Measurement does not work properly if thick emulsion layers greater than 50mm are present.

Typical applications

This measurement method is used in many petrochemical processes, e.g. in the separation of hydrocarbon/water and hydrocarbon/hydrofluoric acid. The guided radar is also used for measuring the interface between stearin and water or hexane and water.

Capacitance measurement (also known as impedance or admittance measurement)

A metal rod or rope (fully insulated) and the neighboring tank wall form a capacitor. The distance between the probe and the tank wall, as well as the area of the probe (diameter and length) are given. Only the space between the probe and the tank wall is variable. This space is known as the dielectric in the case of classic capacitors. When the tank is empty, there is air between the probe and tank wall. This air is nonconductive and has a permittivity $\epsilon_r = 1$. When the tank is filled, the air is displaced by the product with a higher ϵ_r , i.e. the capacitance increases. The values of the capacitor formed also change when the tank is filled with 2 different media.

For capacitance interface measurement, the media have to exhibit clear differences in their electrical behavior however. Ideally, the upper medium should have a ϵ_r value <10 and the lower medium should exhibit good conductive qualities ($>100 \mu\text{S}$). In the case of interface measurement, in particular, the possible fluctuation of the ϵ_r value of the upper liquid is often seen as a problem, for example in the case of an oil/water separator. A simple examination of the measured variables shows the effect on the accuracy.

Accuracy: air, oil and water

The following sample values refer to a fully insulated capacitance probe with a probe rod, 16 mm in diameter, mounted in a metal tank at a distance of 500 mm to the wall: 1000 mm probe length in air ($\epsilon_r = 1$) forms a capacitance of 12 pF. If the air is displaced by oil with a ϵ_r of 2, the capacitor is doubled and has 24 pF. In the case of the nonconductive liquid - oil - the classic examination of the change in the dielectric between the 2 capacitor plates applies. In the case of a liquid with good conductive qualities, the ϵ_r value of the liquid is irrelevant. From an electrical perspective, the conductive liquid now forms the second capacitor plate as if the tank had been filled with liquid metal e.g. mercury. The capacitance is now 360 pF.



Error analysis

With a measuring range of 1000 mm for measuring the oil/water interface, calibration for the 0% interface would take place when 1000 mm of the probe is covered with oil, i.e. at 24 pF. The calibration for the 100% interface takes place when 1000 mm of the probe is covered with water, i.e. at 360 pF. The actual span for displaying the 0 – 100% interface range is 336 pF. If the ϵ_r value of the oil increased from 2 to ϵ_r 3, the capacitance would increase by a maximum of 12 pF. It follows that the largest possible error would be if 1000mm of the probe were covered with oil and the ϵ_r were increased from $\epsilon_r = 2$ to $\epsilon_r = 3$. The resulting additional 12 pF would be incorrectly displayed as +3.6% for the level of the water/oil interface. A change in the overall level (change in the level of the oil layer) has the same degree of impact as changing the ϵ_r value from 2 to 3. Since the oil level drops in this case, the ϵ_r changes from 2 to 1 and the error works in the opposite direction, i.e. if the layer level of the upper liquid drops, the value displayed for the water level also drops.

Bypass, probe with ground tube

Errors caused by ϵ_r fluctuations or fluctuations in the overall level have a significantly greater impact in the bypass. The capacitance is also 360 pF here if 1000 mm of the probe is covered with a conductive liquid. The value of 55pF at air $\epsilon_r = 1$ is, however, far higher than when free in the tank. Oil with $\epsilon_r = 2$ doubles the value to 110 pF. As a result, the span for displaying the interface would only be 250 pF and the error if the ϵ_r value were changed from 2 to $\epsilon_r = 3$ would be 22%.

Buildup on the probe

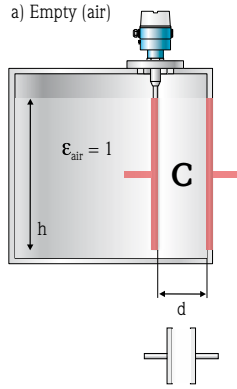
Nonconductive buildup, caused by the upper liquid, acts like thicker probe insulation. This has a serious impact on the measured value of the conductive liquid. A film of oil, 0.5mm thick, on the probe insulation causes an error of -10%.

Emulsion layers

A capacitance probe also works in the event of a mixed transition zone between the two liquids. In the event of an emulsion layer (e.g. water and oil), the high proportion of water in the lower zone of the emulsion layer causes a large change in the capacitance. The increasingly smaller proportion of water in the upper zone does not play a major part in the overall result. As a rule of thumb, we say that the level displayed for the interface is around the level of the lower 1/3 of the emulsion layer.

Capacitance probes

a) Empty (air)



$$C = \frac{\epsilon_0 \cdot \epsilon_r \cdot A}{d}$$

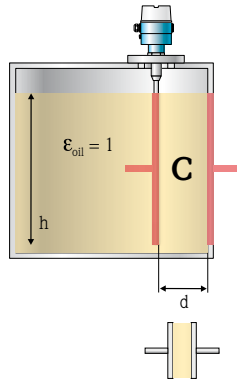
$$\epsilon_{\text{air}} = 1$$

$$h = 1 \text{ m}$$

$$d = > 0,5 \text{ m}$$

$$c = 12 \text{ pF}$$

a) Non conductive medium (oil)



$$C = \frac{\epsilon_0 \cdot \epsilon_r \cdot A}{d}$$

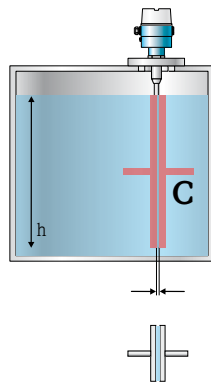
$$\epsilon_{\text{oil}} = 2$$

$$h = 1 \text{ m}$$

$$d = > 0,5 \text{ m}$$

$$c = 24 \text{ pF}$$

b) Conductive medium (water)



$$C = \frac{\epsilon_0 \cdot \epsilon_r \cdot A}{d}$$

$$\epsilon_{\text{PTFE}} = 2$$

$$h = 1 \text{ m}$$

$$d = 1 \text{ mm (PTFE Thickness)}$$

$$c = 360 \text{ pF}$$

1000 mm probe length in air ($\epsilon_r=1$) forms a capacitance of 12 pF. If the air is displaced by oil with a ϵ_r of 2, the capacitor is doubled and has 24 pF. In the case of media exhibiting good conductivity, the ϵ_r value of the liquid is irrelevant. From an electrical perspective, the conductive liquid now forms the second capacitor plate as if the tank had been filled with liquid metal e.g. mercury. The capacitance is now 360 pF.

Bottom water detection

A minor change in the ϵ_r value causes an error with such a high layer of oil over the amount of water at the bottom. This error is too large for measuring the water interface level with millimeter precision. Special probe versions therefore have the active capacitance probe at the end of a carrier cable or combine it at the end with temperature measurement. The length of the active (probe) length corresponds to the measuring range needed for the water/oil interface. The oil above this does not affect the measurement. This makes it possible to display the water level with extreme precision. The same would be achieved by installing a probe laterally at an angle in the water zone at the bottom. However, this is often not possible since lateral installation sockets are often not available.

Arguments in favor of capacitance

- Emulsion layers are not a problem for capacitance measurement.
- The principle makes reliable water-bottom detection possible.
- The reaction time is extremely fast.

Arguments against capacitance

- The interface is displayed – the level is not.
- Measurement does not work properly if both liquids are conductive.

Typical applications

Capacitance probes are used in oil production (e.g. oil/water separator), in the production of biodiesel (e.g. methylester/glycerine, biofuel/water), and in water bottom detection in tank farms.

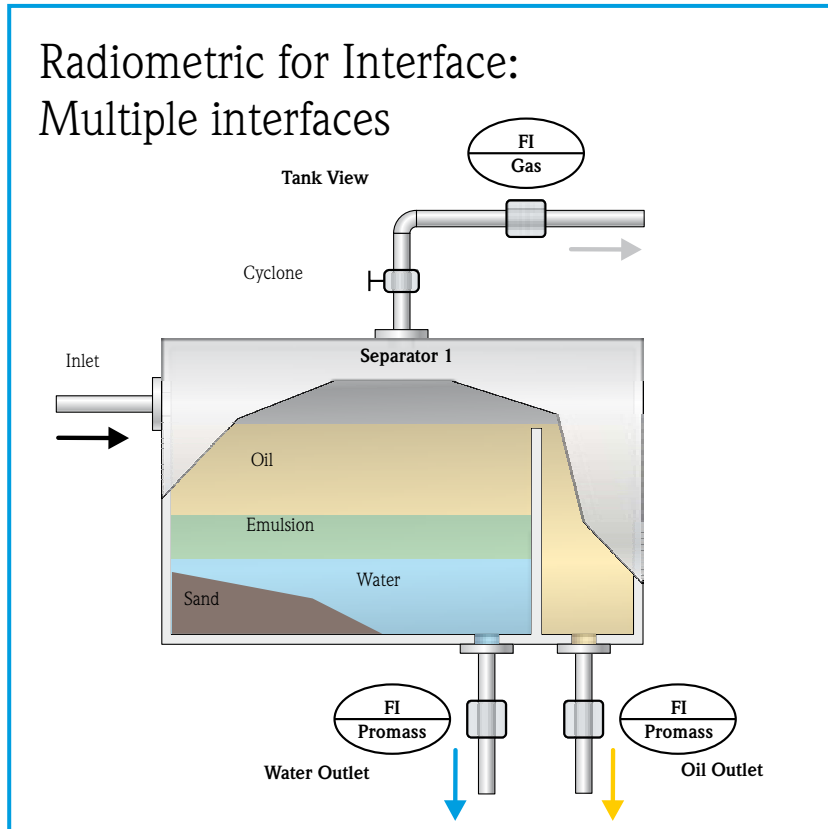
◀ Radiometrics

Operating principle

The radiometric source emits radiation. The intensity of the gamma radiation is attenuated as it passes through the tank wall and the medium. A detector is mounted outside on the opposite side of the tank and converts the radiation into an electric signal. The measuring effect results from the product to be measured absorbing the radiation.

For interface measurement, the radiation of media with different specific weights is also attenuated differently. If the transmitter is calibrated to the medium with the lower density using wet calibration and then to the medium with the higher density, a correlation for the measurement of the interface layer automatically results. This interface measurement can also be realized between solids and liquids.

The accuracy of the measurement is directly related to the variation of the specific weight of the liquids.



Separation of oil, water and sand in crude oil production

Arguments in favor of the radiometric method

- The measurement only accounts for the specific weight of the liquids. It is not sensitive to other liquid properties like permittivity or conductivity.
- Radiometry measures hard and soft interfaces.
- The devices are nonintrusive, and are thus not affected by buildup.
- Instruments handle liquid/liquid as well as solid/liquid interfaces.

Arguments against the radiometric method

- Wet calibration is necessary.

Typical applications

Radiometric measurement is used to separate oil, water and sand in crude oil production.

Summary

The guided radar has opened up new possibilities in interface measurement: ONE instrument TWO measured values (level AND interface). Buildup and changes to the specific weight of the liquids only have a minor influence, or no influence at all, on the accuracy, and the degree of maintenance required is reduced. These are the most important features of this measuring principle.

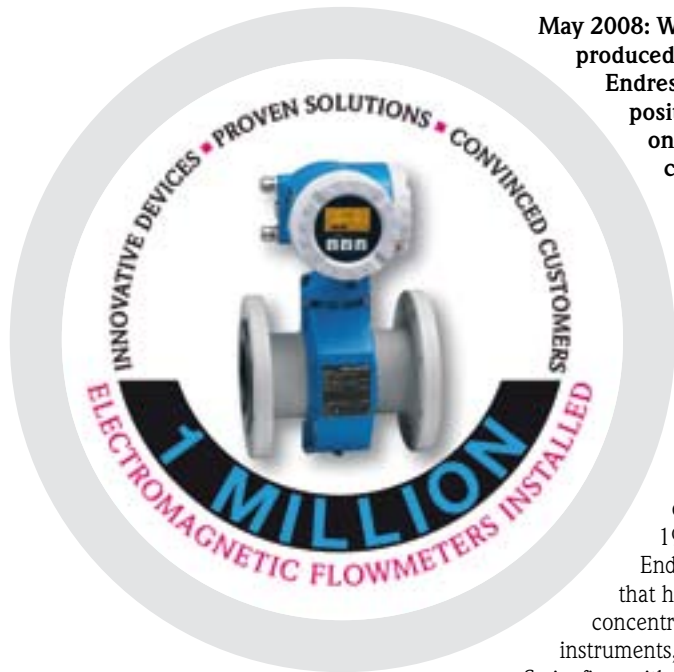
Providing an optimum solution for the application, and optimizing quality and production with minimum maintenance – such are the requirements and demands the guided radar also has to meet. The measuring conditions and the application-specific setup decide the measuring principle: “Separating the best from the rest” not only applies to interface measurement but also to choosing a suitable measuring principle. Displacers,

capacitance, radar or radiometric: The technical and economic pros and cons of each measuring option have to be weighed up, taking the dynamics of the process and the liquid properties into account.

Topping the million mark

Endress+Hauser is world market leader for electromagnetic flowmeters

Product Focus



May 2008: With a million magmeters produced and safely delivered, Endress+Hauser confirms its position as world's number one producer. The company sees this as a reward for 31 years of unremitting research and investment in the quality of every instrument. And an end to the "Promag" success story is not in sight...

The foundation stone of the story was laid in 1977 when a growing Endress+Hauser company, that had hitherto been largely concentrated on level and pressure instruments, bought up Flowtec, a small Swiss firm with only three employees. From this core - and from a small, former military barrack - developed the Endress+Hauser Flowtec AG, the group's centre of competence for flow measurement technology. It now employs more than 1,000 people and runs production sites in Switzerland, France, India, China and the USA. The factory in Cernay, France, stretches to a floor space of roughly 16,500 square meters, and is the world's biggest production facility for electromagnetic flow meters.

Through innovative products and future-oriented services, Endress+Hauser flow measurement devices gained the trust of users world-wide - so the sales figures continually increased. 500,000 electromagnetic flowmeters have been sold in the past seven years alone.

Versatile by nature

In the industrial environment electromagnetic flowmeters are today used primarily in water management, in the process, pharmaceutical and food industries. The robust construction permits their use under the most demanding conditions: electromagnetic flowmeters are even frequently used in the notoriously harsh mining processes.

Typical measuring tasks include recording and monitoring continual flow rates, filling and dosing applications as well as use in custody transfer. A large number of aqueous-based fluids can be measured with electromagnetic flowmeters: water, wastewater, sludges, pulps, pastes, acids, alkali, juices, fruit mashes etc.

A celebrated cause: Endress+Hauser commemorates the millionth success by supporting a water project in Mozambique.

Today, there are more than a billion people in the world who still have no access to clean drinking water. The Swiss development organization Helvetas describes the fair distribution of ever dwindling water reserves without endangering the Earth's ecological balance as "one of the biggest challenges facing the 21st century". On the occasion of the millionth electromagnetic flowmeter, and as a sign of solidarity with countries in which clean drinking water can by no means be taken for granted, Endress+Hauser Flowtec AG supports the Helvetas project "Water and sanitation in rural Cabo Delgado Province in Mozambique" to the tune of CHF 50,000.

Cabo Delgado Province lies in North Mozambique, about 2,000 kilometres from the capital city of Maputo. Water provision in many places is inadequate. In the countryside fewer than half the population has access to clean drinking water.

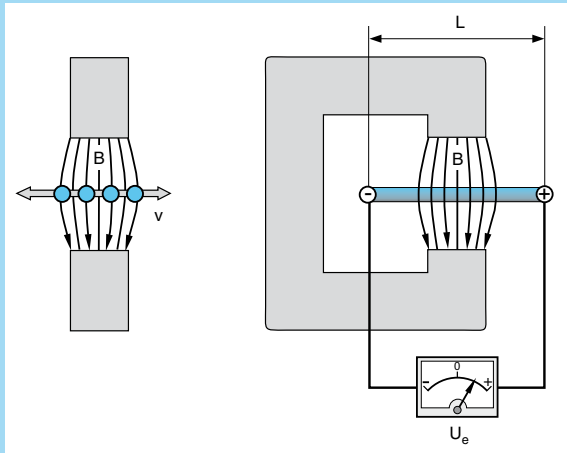
The beginnings of Endress+Hauser Flowtec AG in a former military barrack



Villagers in Mozambique pumping out water at a newly built drinking water system (photograph: Sandra Künzle)

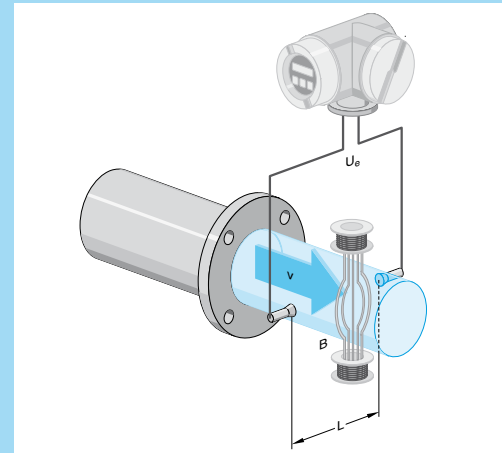


How magmeters work



Left: Principle of electromagnetic induction as formulated by Michael Faraday

Right: Principle of electromagnetic flow measurement



Electromagnetic flowmeters have been around since 1939. Swiss cleric and inventor Father Bonaventura Thürlemann (1909–1997) pioneered the industrial utilization of this measuring principle. The physical phenomenon on which the technique is based, however, has been known for a great deal longer. The English physicist Michael Faraday (1791–1867) realized that electric charges are induced in a conductive metal rod of length (L) moved at velocity (v) through a magnetic field (B) and, consequently, a voltage (Ue) of a few millivolts is generated between the ends of the rod. Faraday also discovered that the magnitude of the voltage induced in this way is directly proportional to the velocity (v) of movement and the strength (B) of the magnetic field.

- $U_e = B \cdot L \cdot v$
- Ue Induced voltage
 - B Strength of magnetic field
 - L Length of the electric conductor (corresponds to the electrode spacing in the measuring tube)
 - v Velocity of conductor movement (corresponds to the fluid velocity in the measuring tube)

In a magmeter, the conductive fluid flowing inside the measuring tube corresponds to the metal rod in Faraday's experiment. The magnetic field of constant strength is generated by two field coils, one on each side of the measuring tube. Two electrodes on the inside wall of the pipe detect the voltage generated as the fluid flows through this field. The measuring tube is electrically insulated from the fluid and the electrode with a non-conductive lining (e.g. rubber, Teflon, etc.). Given a magnetic field of constant strength (B), the equation on Page 4 shows that the induced measuring voltage (Ue) is directly proportional to the flow velocity (v). Pipe cross-section (A) is known, so volumetric flow (QV) is easily calculated:
 $QV = v \cdot A = (U_e / B \cdot L) \cdot A$

The primary aim of the supported project is the lasting improvement of the rural drinking water supply and sanitation in an area with about 300,000 inhabitants. The activities tie in with Helvetas' 25 years of experience in Mozambique. Working together with villagers and the authorities, disintegrated wells are rebuilt, silted-up

boreholes cleared and faulty pumps replaced. To ensure the provision of drinking water in the long-term, the population has been involved from the outset. Endress+Hauser couldn't have found a more worthwhile investment into the future.



Endress+Hauser Flowtec displays the millionth device at the production plant in Cernay



Product, Price, Place, Promotion, + P...

About the fifth P in Marketing

Inside out

During all my years in sales I have had many opportunities to test the application of the four Ps in Marketing. Sales experience and marketing know-how? How does that fit together? Very easily, let me say. In the end, sales are nothing but marketing put to the test. And this test reveals the forgotten P. Strangely enough; it has been forgotten in spite of the customers freely telling you about it: A plant engineer once very kindly informed me that his process did not feature a single one of our instruments. "And that's not because of your products, or the price", he told me. "It's because the salesman from your competition visits us periodically."

"Wouldn't you prefer buying your instrumentation in a supermarket, sparing you the tedious entertaining of salesmen?", I once jokingly asked a customer. He smiled patiently. "We are a serious company.", he finally said. "And we take the responsibility to our shareholders and customers very seriously. We require sales care that shares and support our goals. You don't get this kind of support in a shop around the corner. I evaluate not only your products but also your commitment to my business."

I picked up his idea: "But would you invite a salesman that had come to sell vacuum cleaners to sit on your living room sofa?" "Probably not." He conceded. "And I could not even tell you why... Maybe because it is an issue related with trust. - I would never leave a good 'sales' neighborhood, where people would help each other with painting a house or cutting a hedge." he added with a laugh.

"That is a wise thought", I agreed before entering into a discussion on our offer to instrument his new production line. "... and, of course, I will be present for the commissioning" I said as I came to a close. "I certainly hope so!" he said without looking at me and signed the order with a smile.

Going on a customer visit, you need a strategic goal in mind. Otherwise, you will not even start to sell. Beyond that goal, however, it is the person that counts. It is my job to give a reliable face to our products and at the same time to relate to the person behind the nameplate, too.

That's why Personal relation is the fifth P in marketing – as it is the first P in sales.

Presunto Sagaz

Exchange 2008/2

For further information on all articles please contact your local Endress+Hauser partner or send an email to: exchange@ii.endress.com

Published by:
Endress+Hauser
Instruments International AG
Kaegenstrasse 2
4153 Reinach
Switzerland
E-mail contact: exchange@ii.endress.com

Email: exchange@ii.endress.com

Editorial Team (all Endress+Hauser):
Isabel Hötger, Jürgen Lau, Eric Sifferlen,
Andrew Reese, Ralph Knall, Hai-Thuy
Ngo, Holger Knau, Erich Martsch, Juan
Ehrenhaus

Printing:
Straub Druck, 78713 Schramberg,
Germany

Date of Publication:
November 2008

CM08-2/27/en/11.08

Circulation: 21,000