

60+ years of chemical competence

Delivering unrivaled value through industry-leading partnerships



The chemical industry is a significant driving force for the economy

Meeting the complexities of a highly competitive and rapidly evolving market

The chemical industry is a significant driving force for the economy as a whole. In a variety of different processes, many new substances and innovative products emerge, most of which set trends for developments in many other industrial sectors.

Key factors operating in the chemical industry are:

- Increasing globalization of markets and companies
- Growing competition and therefore, increased significant cost pressure
- Increasing safety requirements due to the growing number of regulations and tightening of laws and directives

Industry 4.0 readiness At an industry wide level, there remains an increasing demand for automation and data exchange in manufacturing technologies. Are you working on IIoT (Industrial Internet of Things) concepts?

Efficiency, system availability and immediate local or remote access to data dominate the current mindset of the industry. At Endress+Hauser, we continue to innovate our approach and align it with the trends and technologies, by reshaping our offering to prepare our customers for integration.

60+ years

we've accompanied our customers addressing plant safety, productivity and maintenance challenges. Longterm partnerships with our customers has enabled us to provide you with the portfolio we have today.



13,000

employees serving worldwide as trusted experts by your side. Local presence of our project execution, service- and sales forces ensure comprehensive support along your plant's lifecycle.



Joint Targets



Process Safety,
Environmental Responsibility,
Plant Availability & Productivity

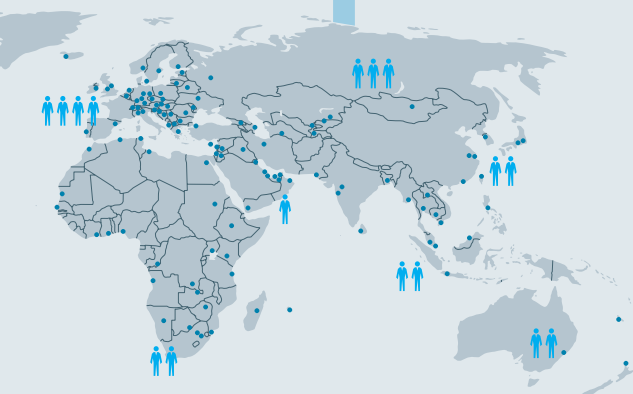


Find out more:

www.endress.com/chemical

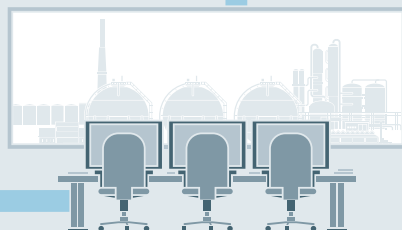
3 to 5 weeks

saved by using our engineering tools and standardized process for project management.



5 to 15%

is the estimated savings of energy consumption in your plant when using a targeted remote energy management.



Products Solutions Services

Safety



17+ years of functional safety standards IEC 61508 for quality, safety and reliability applied in applications. Most comprehensive certified product portfolio helps you to achieve safety in your process.

Technology



273 Patents filed - 700 employees work in our research and development departments, making sure your process is safe, efficient, optimized (including OPEX) and environmentally friendly. An industry optimized product portfolio that is developed according to international standards is critical to help you reach these targets.

Projects



As a main instrument vendor (MIV) with global presence, we have project management expertise locally available to

support you in meeting deadlines and managing costs. We handle your international projects based on PMI® (Project Management Institute) framework (PMBOK® Guide) and our PMP® certified project managers serve as your main point of contact.

Be competitive and increase safety in chemical processes

Get the extra project skills and the know-how needed to boost your plant's safety and performance



Your benefits in detail

- A solid, financial and independent family-owned company provides stable business
- A global partner with an international sales and service network who has production facilities worldwide
- 60+ years of experience in process automation
- Most comprehensive product portfolio based on innovations with more than 270 patents filed
- Product management expertise implemented locally with global standards (PMI)

It is a challenge to find the optimum balance between demands such as productivity, profitability, risk reduction and good environmental management. In addition you have to manage feedstock availability and maintain your technology leadership. We support you in attaining peak performance in your required areas.

A knowledge-based formula You gain concrete benefits from a partner who has first-hand knowledge of your sector's issues around the globe: on increased safety, on environmental protection, on over-supply leading to cost pressure on finding engineering support and service when required. You can rely on our help to become more competitive in your line of business.

With a long history of industry firsts we have grown with your sector by listening, acting and innovating to better serve you with:

Safety Handling flammable and toxic substances remains a critical challenge for the chemical industry and poses potential hazards for human safety and the environment.

Documented industry disasters illustrate the importance of proper safety management and the need for qualified expertise. We understand the safety essentials for optimal and safe plant operations.

We comply with the following internationally recognized safety standards/recommendations and internationally accepted hazardous area approvals: NAMUR, WHG, IP, ASME, NACE, API, IEC 17025, MID, OIMLATEX, IECEx, FM/CSA, NEPSI, TIIS, INMETRO.



Technology to lead Attaining peak performance in your process with reduced operational costs can be crucial for your daily business. Balancing production efficiencies while maintaining product quality, according to your customer's requirement, is not an easy task. However, reliable and accurate data can support you achieve this goal.

By providing you access to our range of innovative technologies and services, we help you to obtain the following:

- Accurate data and reduced maintenance efforts
- Safe in-process cleaning and calibration with Memosens technology
- Direct in the field mobile data availability
- Diagnostics and effortless proof testing with Heartbeat Technology



Best fit project management As a plant builder or EPC, a number of key challenges exist that increase the risk of projects running late and over budget.

As a main instrument vendor (MIV) with global presence, we have project management expertise locally available to support you in meeting deadlines and managing costs.

Adherence to global standards in project management provides a range of benefits:

- Maintaining costs and delivering milestones
- Accurate and responsive communication with single contact points
- Reduce costs of project delivery by providing productivity tools and embedded resources during basic and detailed engineering



Attaining peak performance in petrochemical processes

Boost your plant's productivity with up-to-date technologies



Key challenges The global output of e.g. ethylene is an estimated 150 million metric tons annually and growing substantially.

More than half of the total production of ethylene is used for the production of polyethylene. This means it is used for production under extreme conditions such as high temperatures or with usage of corrosive and hazardous substances.

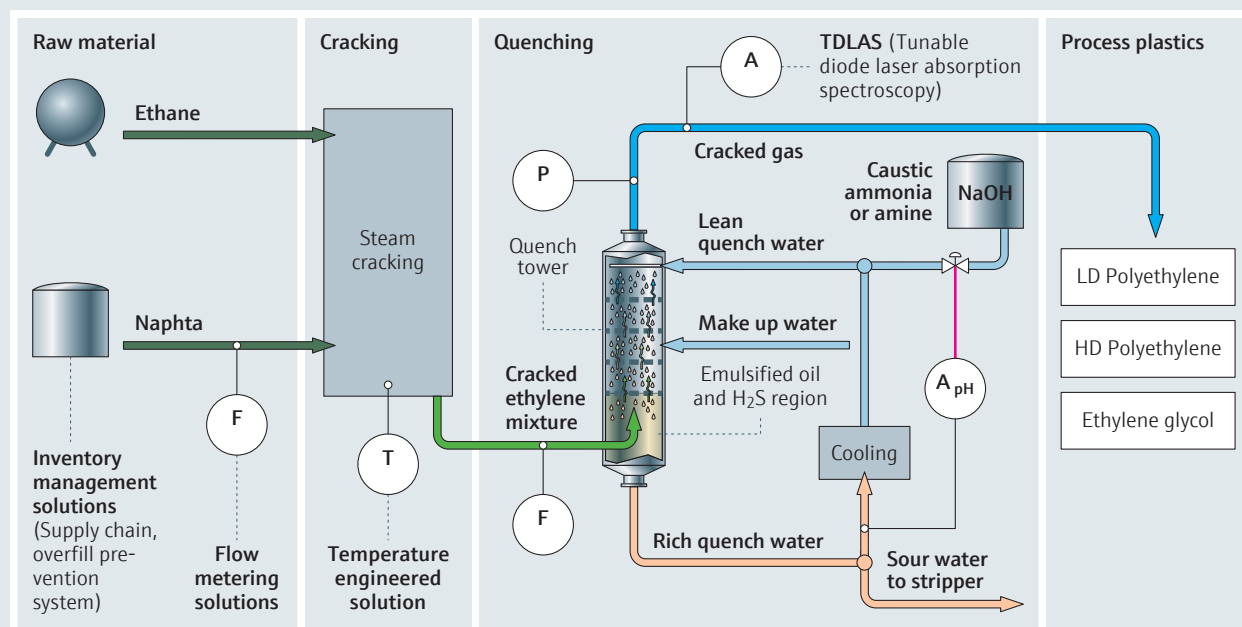
The challenges associated with maintaining maximum process safety are therefore ever present.

- Maintaining safety standards under extreme process conditions
- Reducing operational expenditure
- Enhancing productivity
- Preventing unplanned shutdowns

250,000
US dollars lost

stopping your olefin process, when using outdated mechanical measurement technology, according to industry experts.

Ethylene production *



* Some examples of measurements

“With Memosens, the sensor can be calibrated in the laboratory and replaced very easily.”

Hassan Maati B AlHarbi, Analyzer Specialist, SABIC Saudi Arabia

Solutions at a glance

Flow - Coriolis Proline Promass F 300

- Highest process safety – immune to fluctuating and harsh environments
- Space-saving installation – no in/outlet run needs
- Integrated verification – Heartbeat Technology
- Nominal diameter: DN 8 to 250 (3/8 to 10")



Pressure - Absolute & gauge Cerabar S PMP75

- Large variety process connections and membrane materials
- Highest safety due to gas tight feed through with capabilities up to SIL2/3, certified to IEC 61508
- Process temperature: -70 to +400°C (-94 to +752°F)



Temperature - iTHERM TMS01/02

- Reduced lifecycle costs
- Maximum of process safety and optimized process cycle
- Can be used from -270 C to +1.100 C



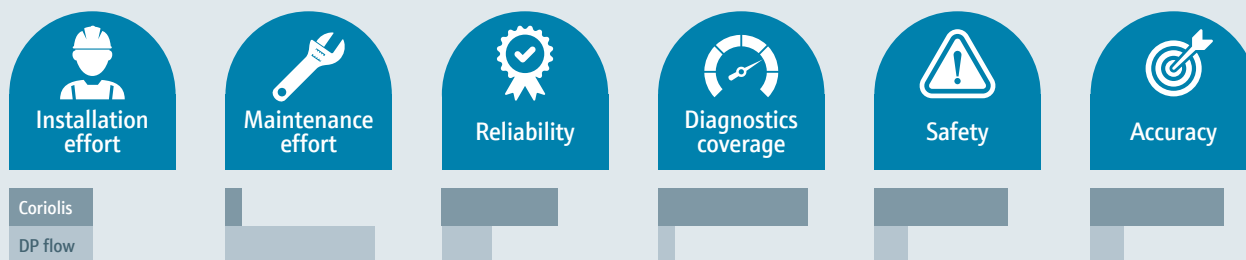
Analytics - Memosens CPS71D Cleanfit CPA871 Liquiline CM42

- ATEX, FM and CSA approval
- Wide range of process connections and materials
- Predictive maintenance concept for reduced OPEX



Increase safety in hydrocarbon transfer with modern technology:

Coriolis vs. DP flow



In this hydrocarbon transfer application from ship into storage tank (8" pipe) our customer rated the technical comparison between Coriolis and DP flow as visualized in the graphic.

We help obtain your targets, such as attaining peak performance with reduced operational costs no matter which process or application. With our technologies we provide you accurate data and reduced maintenance efforts, resulting in reduced downtime during calibration and proof testing.

Our global service and sales forces are located in your region and ensure you get the complete support needed, from choosing the right sensor through to maintenance concepts.

- Safe in-process cleaning and calibration as well as self-diagnostics and effortless proof testing with integrated Heartbeat Technology
- Unplanned shutdown prevention with advanced diagnostics
- Unified platforms in transmitters which support your reliable centered maintenance approach
- Best-fit instruments with intrinsic safety and high accuracy that provide reliable data and safety to the process



A closer look:

Monitoring a tank safely with an intelligent system – Automated overfill prevention system (AOPS)

A faulty level gauge can fail to alert operators at a storage depot when a storage tank is being filled to a dangerously high level. Using an independent (SIL2/SIL3-certified) automated overfill prevention system helps to reliably detect, indicate and prevent hazardous overflow of your chemical or petrochemical storage. This results in:

- Significant time savings thanks to performing the filling operation of multiple tanks simultaneously without administering
- Increased tank capacity thanks to reduced reaction times to shutdown
- The **remote automated proof test** saves time and reduces effort – **16 tanks in less than 5 minutes**



Achieve pure quality product of your specialty chemicals

Reliable measurement helps assure the quality needed to meet your customer demands and safety goals

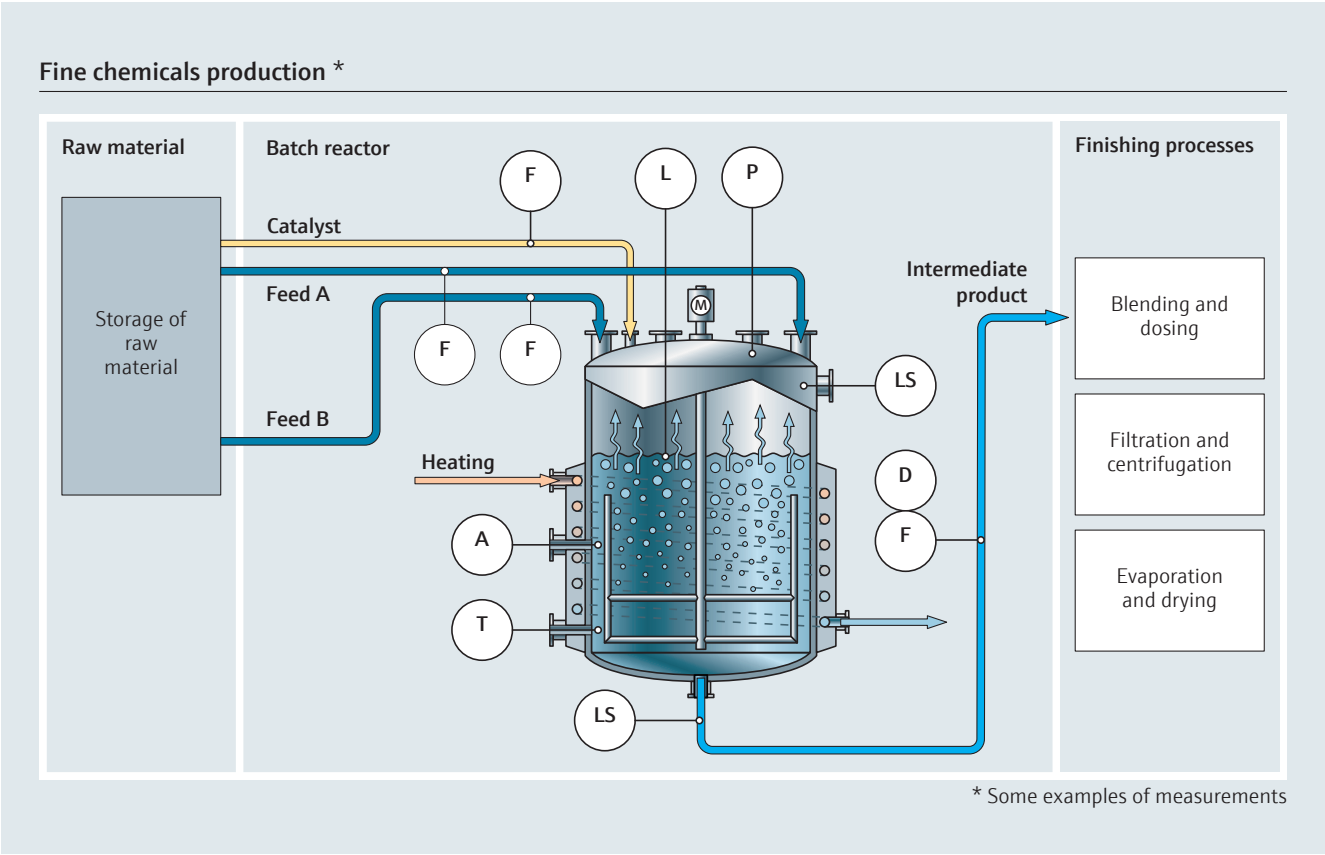


Key challenges A chemical plant's process presents many challenges while processing flammable and toxic substances. While managing those challenges, chemical plants aim to achieve pure product quality according to customers' specifications. This is done with high process efficiency, low energy consumption and overall safety for people and the environment.

- Fast reacting on market demands
- Controlling and operating complex processes such as reaction, extraction, separation or filtration
- Following regulation and standards with regards to safety

1,500
hazardous transport
operations/year

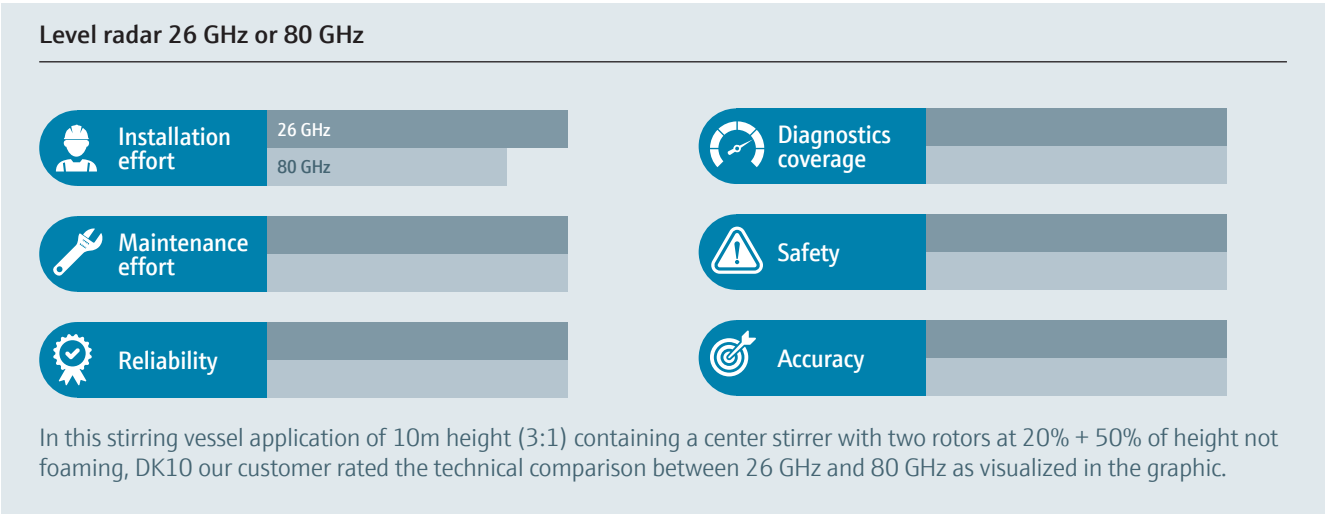
avoided by using our expertise and portfolio
reduces risk significantly and creates a major
contribution to safety.



“We have been impressed by the outstanding repeatability of this equipment. The measuring and metering equipment is also extremely reliable so we are completely satisfied.”

Jean-Luc Richard, Maintenance Supervisor, Arkema

Increase safety in your reactor with modern technology:





Solution at a glance

Flow - Coriolis Proline Promass Q 300

- Optimized performance for liquids with entrained gas
- Space-saving installation – no in/outlet run needs
- Reduced complexity – freely configurable I/O
- High turndown due to low pressure loss/zero point



Level - Radar Micropilot FMR62

- Developed according to IEC 61508 up to SIL3 in homogeneous redundancy
- HistoROM data management for easy commissioning and maintenance
- Max. measuring range: 80m (262ft)



Level - Vibronic Liquiphant FTL81

- Safety systems requiring SIL3
- Proof testing interval up to 12 years
- Monitoring of fork for damage, corrosion, build-up and mechanical blocking
- Temperature: -60 to +280°C (-76 to +540°F)



Analytics - Color sensor OUSAF22

- Accurate color and purity monitoring for better product quality
- Values according to standard color scales (APHA/Hazen, etc.)
- Approved for use in hazardous areas



In order to ensure you remain protected, the entire safety loop system including measuring, controlling and correcting elements should come from one source. With our comprehensive portfolio, we help you overcome productivity, safety and environmental challenges. We provide you with appropriate solutions to handle hazardous processes safely.

- Certified safety engineers and management systems
- State-of-the-art technology with functional safety according to IEC 61508 (up to SIL 3)
- Uniform operating safety by design concepts for simple and safe operations
- International hazardous area approvals as well as standards and recommendations



A closer look: Accurate measurement for pure chemical product quality

Transparent metering of critical process parameters helps you achieve your goal of pure product to meet your customer needs. In addition, this ensures a safe chemical process and environment. Equipping your batch reactor with our level radar technology and flow Coriolis technology provides you with the accuracy and safety needed.

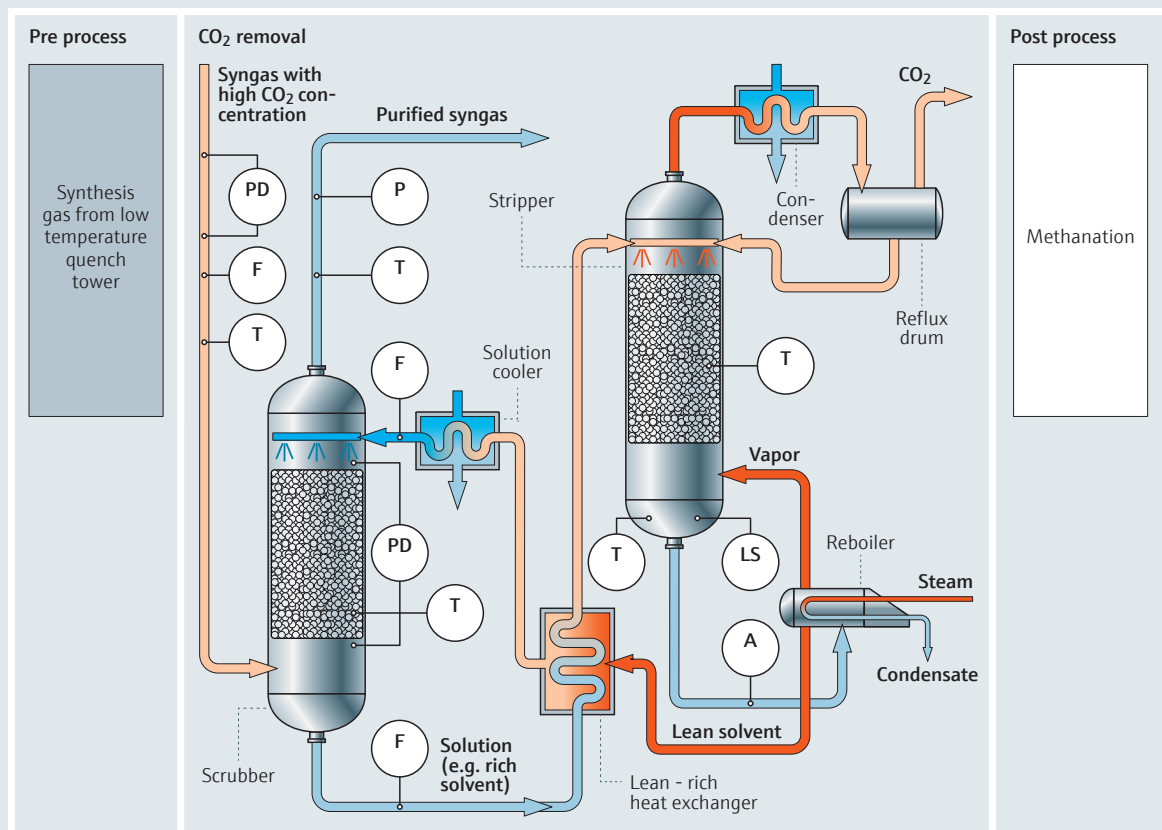
- Non-contact level measurement that is maintenance-free and unaffected by medium properties such as density and conductivity
- Flow measurement where fewer process measuring points are needed thanks to multivariable measurement of flow, density and temperature
- Integrated verification with Heartbeat Technology for easier and better control of your measuring points

Efficiency and safety for your agrochemical processes

Safe and reliable measurement even in demanding applications



Agro chemicals production *



* Some examples of measurements

Key challenges At Endress+Hauser we understand the inherent risk associated with many agrochemicals due to its explosive capabilities.

Agrochemicals in bulk storage pose significant environmental and health risks, particularly in the event of accidental overfill and or explosion. Of particular importance is the need for continuous and highly specific measurement with access to real-time data.

234 mil.
tons of ammonia

is the forecasted global demand for ammonia by 2021 according to the Fertilizer Outlook summary report of the Annual International Fertilizer Association (IFA) Conference 2017.

“Endress+Hauser provides safety instruments and has achieved SIL levels up to 2. This helps us a lot in achieving high safety standards.”

Mansoor Alhammadi, Electronic Engineer, Ruwais Fertilizer Industries (FERTIL), United Arab Emirates



Solution at a glance

Level - Guided radar Levelflex FMP54 + Bypass

- Easy commissioning and maintenance with HistoROM data management
- Reliability thanks to Multi-Echo tracking evaluation
- Cost-effective & safe plant operation with Heartbeat Technology
- World's easiest proof test for SIL/WHG



Pressure - Absolute & gauge Cerabar S PMC71

- Best fit for vacuum, corrosive and abrasive media
- Process safety through membrane breakage detection
- Overload-resistant, high purity ceramic sensor (99.9% Al₂O₃)
- Safety thanks to gastight feed through up to SIL2/3, certified to IEC 61508



Temperature - iTEMP TMT82

- Approvals e.g. ATEX, NEPSI, Ex nA for intrinsically safe installation in zone 1
- Certified up to SIL 2/3 according to IEC 61508
- HART® 7 version
- Reliable operation with sensor monitoring and device hardware fault recognition



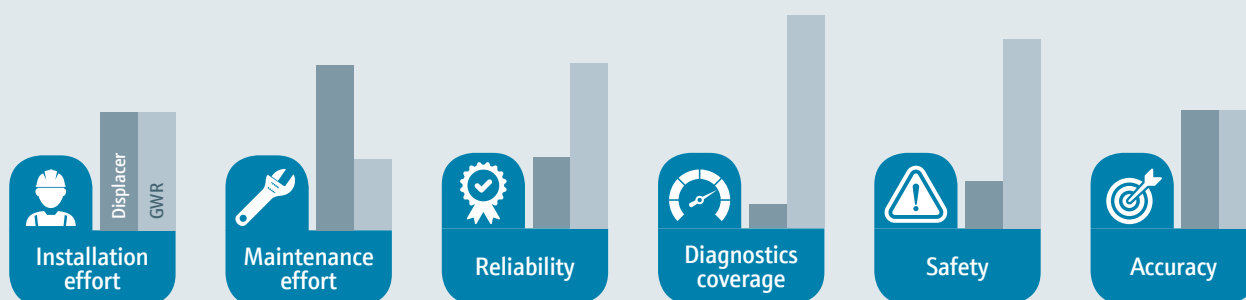
Gas analysis solutions Optograf™ / OptoAST™

- Analyzer provides unique laser-based Raman spectroscopic capability to measure the ratio of H₂ and N₂ diatomic gases
- Sampling system allows measurement directly at sample tap with no sample transport to the analyzer



Increase safety in your fertilizer production with modern technology:

Displacer vs. guided wave radar (GWR)



In this distillation application, with volatile surface, a bypass solution is a must for safety. Our customer rated the technical comparison between displacer and guided wave radar as visualized in the graphic.

Measurement devices and solutions which allow you to control and operate complex chemical processes such as extraction, reaction, separation or filtration, help you overcome daily challenges and meet your customer's demands.

With our complete offering you will be able to meet your goals of improving the plant's availability and safety.

- Broadest safety measurement portfolio developed according to safety by design and fulfilling hazardous area standards: e.g. ATEX, FM, TIIS
- Smart sensors with functional safety according to IEC61508, up to SIL 3 for documented proof testing procedures with Heartbeat Technology
- Safety and standards seminars and trainings to help educate your personnel



A closer look:

Real-time data provided without maintenance support for better control of your ammonia converter

Ammonia synthesis is a high pressure reaction. Maintaining a 3:1 stoichiometric ratio of H_2 to N_2 in the feed stream to an ammonia converter is critical for control and optimization of the synthesis process. Our unique analyzer/sampling interface arrangement helps you to monitor the feed stream composition.

- Optograf™ analyzer provides unique spectroscopic capability to measure the ratio of H_2 and N_2 diatomic gases in ammonia synthesis reactor feed streams
- OptoAST™ sampling system allows measurement directly at sample tap with no sample transport to the analyzer
- Laser-based Raman spectroscopy technique provides highly accurate, real-time measurements of the $H_2:N_2$ ratio for process control

Where there's steam, there's data!

Energy optimization in energy and utility management

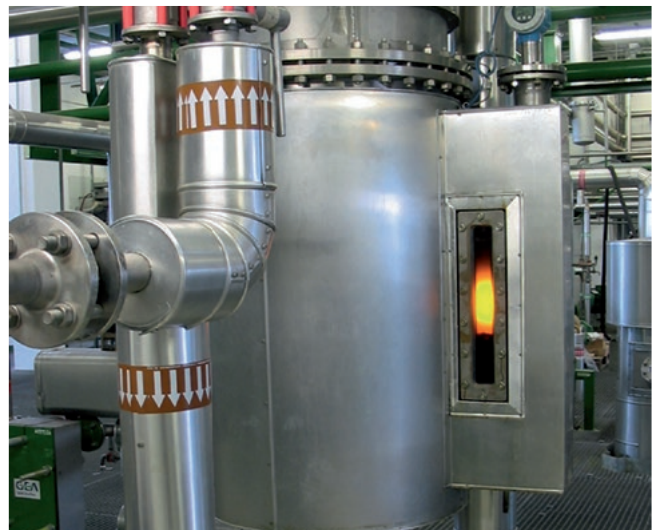
Differential pressure (DP) flow vs. Vortex



In this boiler application with outlet of saturated steam 10t / h and 10 bar of pressure our customer rated the technical comparison between DP flow and Vortex as visualized in the graphic.

Key challenges Water, converted into steam by heating, is the lifeblood of a plant. To ensure efficiency and safety, the integrity of the boiler equipment and the reliability of its control system are crucial. We support you by offering:

- A comprehensive portfolio of instrumentation, services and solutions that comply with environmental standards
- Maintenance optimization and local support in your daily challenges and demands



i A closer look: The Flow - Vortex Proline Prowirl F 200

- Integrated temperature measuring for mass/energy flow of saturated steam
- Highest process safety – dualsens version enables redundant measurement
- High availability – proven robustness, resistance to vibrations, temperature shocks and water hammer
- No maintenance – lifetime calibration
- Integrated verification – Heartbeat Technology



i A closer look: Loop powered indicators RIA14/16

- 5-digit measured value display with dimension, bar graph and backlight
- No external power supply required
- Versions: Die-cast aluminum housing or stainless steel housing
- International approvals
- Allows the HART® transmission protocol to pass unimpeded



Keep your inorganic processes safe

Depend on reliable data in aggressive media conditions to guarantee safety in your process

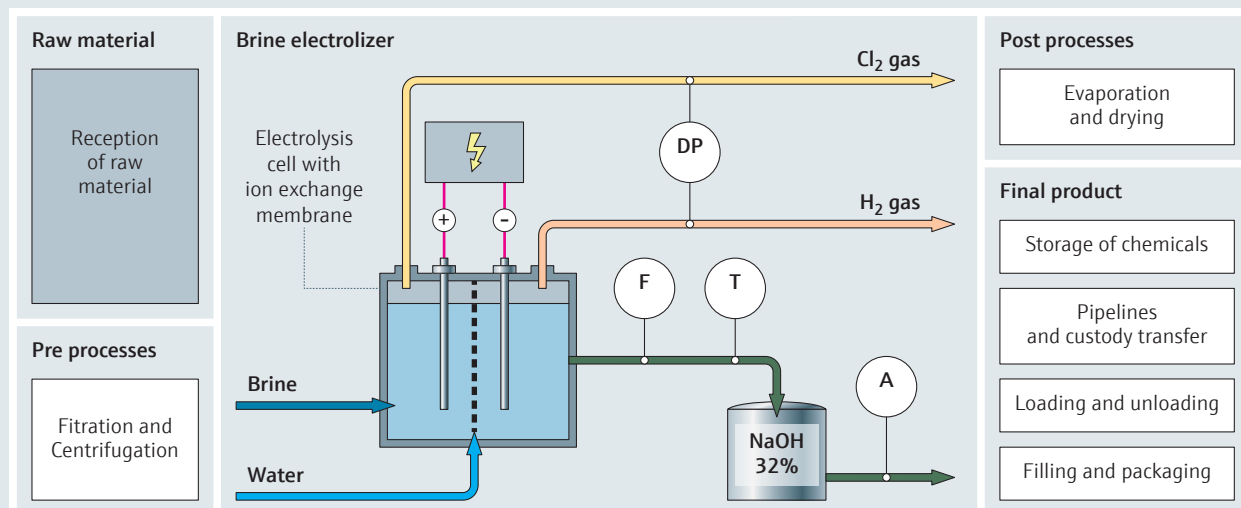


Key challenges The handling of highly toxic chemicals reinforces the demand for measuring devices that can offer accurate, reliable and reproducible readings. Practical equipment for everyday use is required, considering operators' working conditions, the solutions available are limited.

Our solutions support you with:

- Dealing with very aggressive chemicals
- Preventing unexpected shutdowns
- Reaching cost-effective production

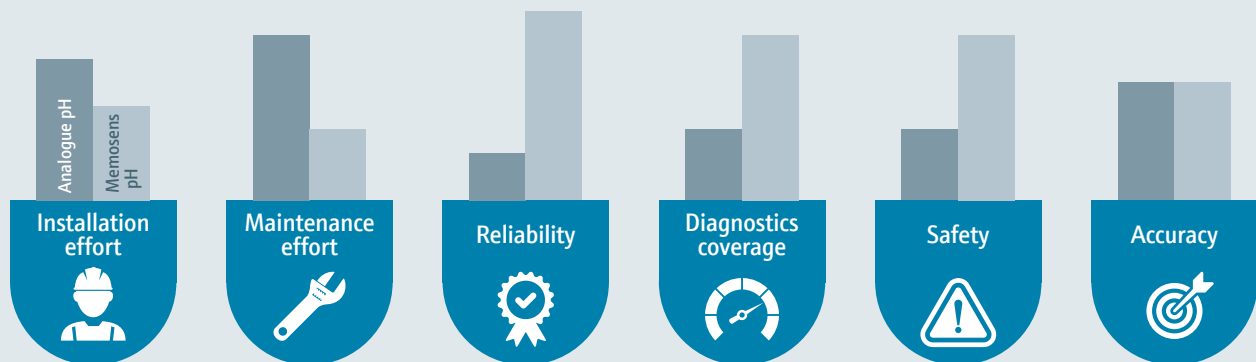
Chlorine production *



* Some examples of measurements

Assure quality of your chlorine outlet with modern technology:

Analogue pH vs. Memosens pH



In this batch process with 10-100 °C, 1-12 pH our customer rated the technical comparison between analogue pH and Memosens pH as visualized in the graphic.

“Efficient automation technology is a must in order to deliver chemical raw materials just in time.”

Wolfram Heymann, CEO Brenntag Schweizerhall AG, Swiss subsidiary of Brenntag AG



Solution at a glance

Flow - Electromagnetic Proline Promag P 300

- Versatile applications (wetted materials)
- Maintenance-free (no moving parts)
- Reduced complexity (freely configurable I/O functionality)
- Integrated verification with Heartbeat Technology



Pressure - Differential pressure Deltabar PMD75

- Best accuracy, longterm stability
- Highest safety thanks to gas tight feedthrough with capabilities up to SIL2/3, certified to IEC 61508
- Overload-resistant up to 420bar / 42MPa / 6300psi (function-monitored)



Temperature - Omnigrad S TMT142R

- HART protocol for operating via handheld or remotely via PC
- Single Pt100 with 3 or 4 wires connection
- Undervoltage detection responds immediately (output of falsified measured values is prevented)



Analytics - pH sensor CPS11D

- Low maintenance thanks to long poison diffusion path and PTFE ring diaphragm
- Process glass for highly alkaline media and pressure-stable up to 16 bar (232 psi)
- Safe and quick exchange in hazardous areas with Memosens



Precise mixing of your dyes and varnish

Reliable measurement and monitoring of your process ensures accuracy and increases efficiency

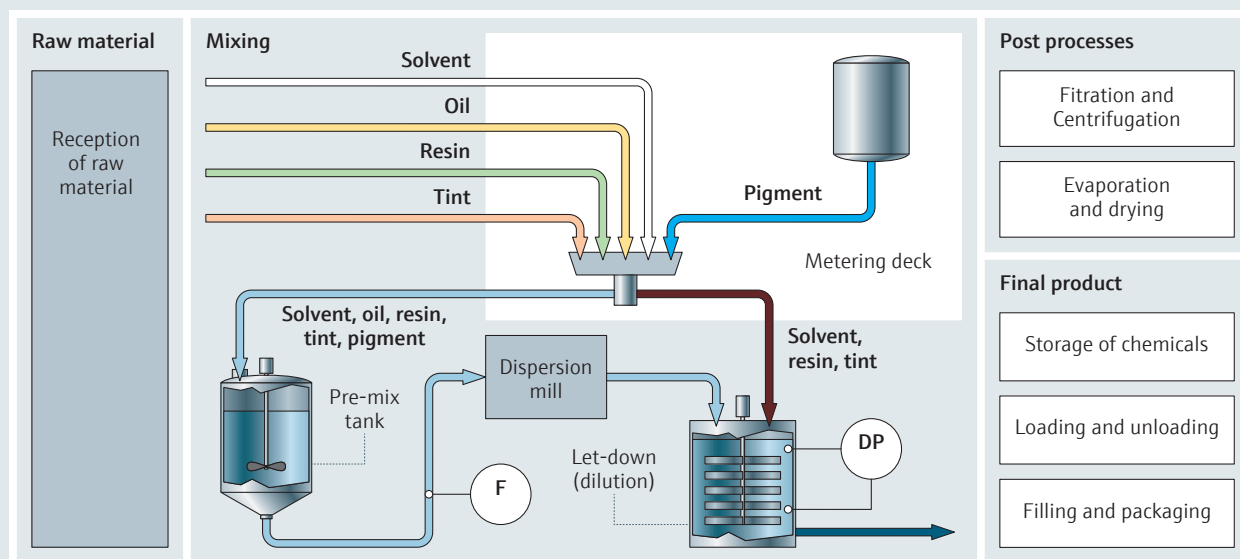


Key challenges The global growth of the pigment market is an estimated \$34.2 billion over the next few years and will continue to grow substantially. Having the right instrumentation and solutions to heighten the efficiency of your process will help address this market demand.

Our solutions help you:

- Ensure the accuracy of your dosing
- Increase the efficiency of your process

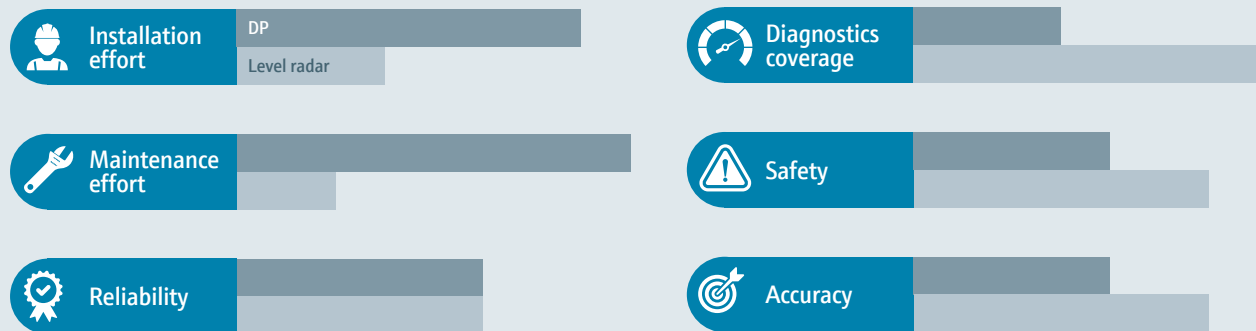
Dye mixing process *



* Some examples of measurements

Increase accuracy of your mixing outlet with modern technology:

Differential pressure (DP) or Level radar



In this mixing application in ambient conditions our customer rated the technical comparison between differential pressure and level radar as visualized in the graphic

“We had an issue with the stability of data. With the solution provided by Endress+Hauser we are successful.”

Carlos João, Instrumentation Engineer, Dow Chemical Company, Estarreja, Portugal

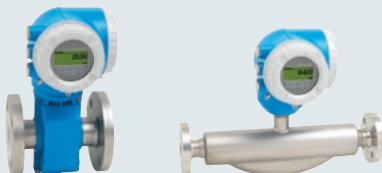
i A closer look: Flow – Proline Promag P/Promass F 300

Proline Promag P 300

- Wide variety of wetted materials applications
- Maintenance free thanks to no moving parts
- Reduced complexity (freely configurable I/O functionality)
- Integrated verification with Heartbeat Technology

Proline Promass F 300

- Highest process safety (immune to fluctuating and harsh environments)
- Less measuring points with multivariable measurement (flow, density, temperature)
- Space-saving installation (no in/outlet run needs)
- Integrated verification with Heartbeat Technology



i A closer look: Level – Electronic DP Deltabar FMD71

- Eliminates traditional mechanical issues resulting in greater process availability and reliability
- Overload-resistant high purity ceramic sensor (99.9% Al₂O₃)
- Safe operations in hazardous areas
- Lowest total cost of ownership due to reduced installation time, maintenance, downtime and spare requirements
- Multivariable level measurement: HART-based differential pressure, head pressure and sensor temperatures from one system



Taking the pulse of your measurement

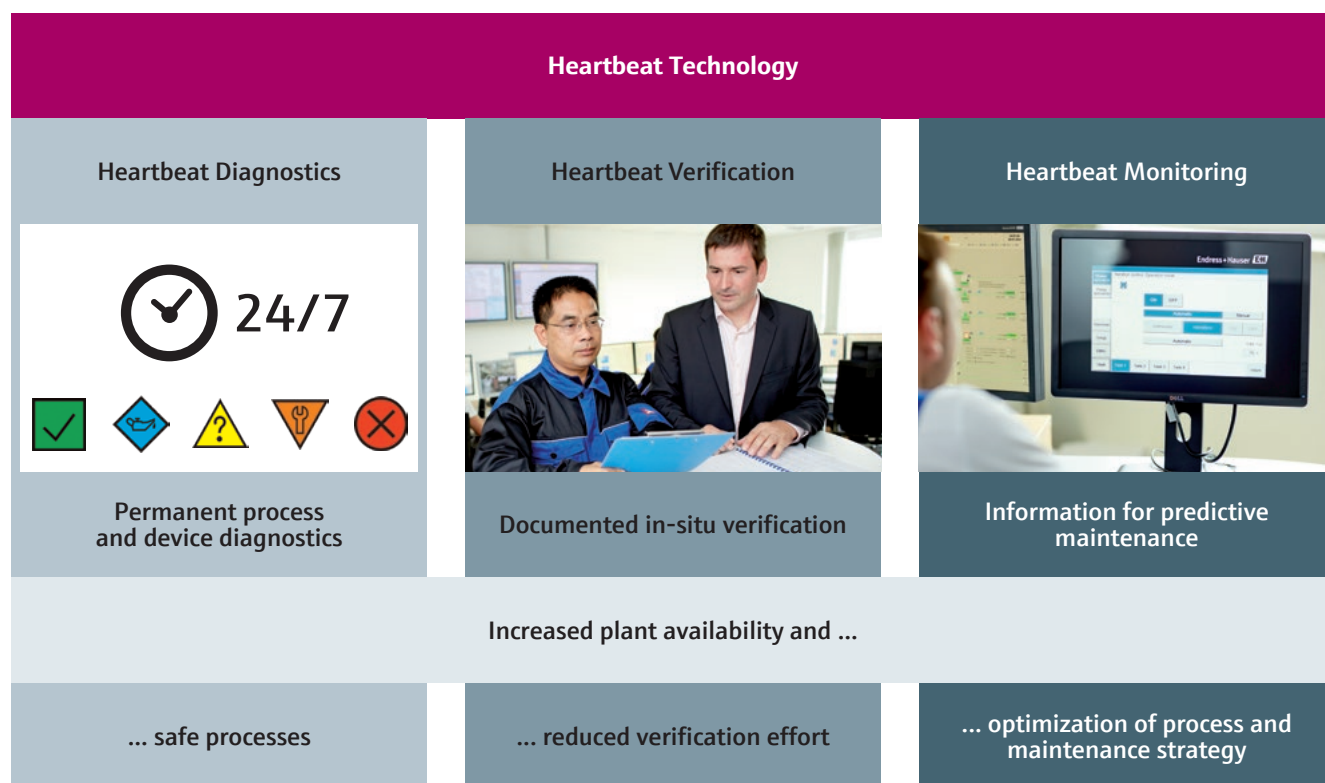
Would you like to increase your plant availability and reduce costs?

With Heartbeat Technology Endress+Hauser offers the broadest range of devices with a trend-setting diagnostic and verification concept for this purpose.

Heartbeat Technology permits cost-effective and safe plant operation during the entire lifecycle by combining diagnostics, verification and monitoring functions in an expedient manner.



Easier and better control of your measuring points



- Unambiguous and standardized **diagnosis messages** with clear **instructions for action** facilitate economically efficient and state-oriented maintenance.
- **Permanent self-diagnosis** of the instrument facilitates safe plant operation with extended verification cycles.

- The measuring point may be **verified and documented in-situ** at any time.
- An easy, guided verification procedure always achieves **unambiguously documented verification results**.
- The automatically generated **verification protocol** supports the evidence required for regulations, laws and standards.

- The provision of **instrument and process data** facilitates trend recognition for **predictive maintenance**.
- The combination of instrument and process parameters facilitates the analysis for **targeted process optimization**.

Value beyond measuring & monitoring devices

Whether you need support for an individual instrument or a managed service contract covering a combination

of products, software and solutions, you can rely on our support throughout the entire plant lifecycle.

Optimize directly in the field

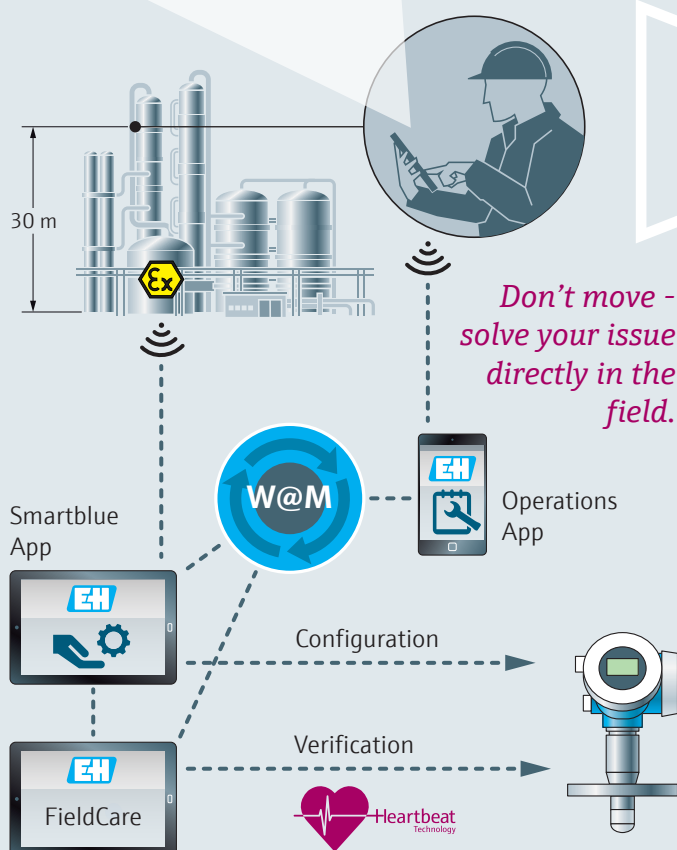


Data availability in the field:

- Remedy information
- Spare-part information
- Maintenance report
- Status information

Three ways to identify your device:

- QR
- Serial no.
- RFID Tag



We support you in optimization

- Engineering
- Commissioning
- Calibration
- Technical support
- Maintenance
- Optimization
- Diagnostic and repair
- Functional proof testing
- Training

Our global service team offers a portfolio of services to ensure optimal performance of your solutions and systems and its underlying components. More specifically Endress+Hauser can assist you by:

- Ensuring measurement components have been correctly commissioned and are operating optimally
- Checking existing measuring devices to ensure reliable results
- Routine maintenance to ensure performance and identify potential problems
- Centralizing all service records in an easy to access repository
- Developing in-house skills and know-how through on-site technical support and training
- Providing optimization advice



Minimize project management risks

Partner with us to minimize risks and optimize CAPEX



Key challenges As a plant builder or EPC, your main challenges in international projects are finalizing your project on time and within budget. In the chemical and petrochemical industry, the project lead and project execution team can be located together or separated sometimes by long distance.

We help provide solutions:

- Project teams spread around the world
- Maintain error-free database in the course of a chemical project
- Maintain the project timeline and stay within budget at the same time

16
working hours

spent solving just two issues via email,
when using the traditional way
of handling capital projects,
according to experts.

US\$ 25,000

saved on spare parts when partnering with us as a MIV considering an instruments project value of US\$ 700,000.

1 week

turnaround time saved by RFQ, considering 800 devices to engineer, compared to the traditional way.

90%

of all your project questions are answered directly when using our on-site embedded engineering program, compared to the traditional way.

Utilize us as the Main Instrument Vendor (MIV) in your process industry projects. Let us be your expert partner from FEED (Front End Engineering Design) to operation. Our scope embraces all necessary offerings to fulfill all your requirements:

- One partner who will ensure consistency and avoid ambiguities
- Experienced professionals who reduce changes for improved timeline accuracy
- Superior processes, methodologies and tools to support efficiency and repeatability for risk reduction

“Endress+Hauser was the ideal partner in instrumentation and engineering. The cooperation was perfect. These people know what they are talking about.”

Mike Giunti, Director of Operations, Remat Chemie B.V., Helmond, The Netherlands



A closer look: Engineering tools for consistent data quality from FEED to operations

With our state-of-the-art tools we guarantee a seamless data transfer through the whole engineering phase of your project.

- Central Engineering Platform, as a central information hub
- Applicator for selection and sizing as well as Configurator
- CAE documents (CAD drawings and electrical wiring diagram)
- Standardized documentation for faster instrument approval



A closer look: On-site engineering, a trusted partner you have access to any time you need

Experience is needed in complex and demanding projects. Embedding one of our subject matter experts into your engineering team is one solution to drive your project to success:

- Providing engineering expertise in the field of instrumentation
- Close collaboration with on-site engineering disciplines
- Resolving issues immediately keeping the project on time and budget
- Reducing repetitious external communications and delays caused by emails and phone calls

Eco-friendly produced and printed on paper from sustainable forestry.

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SC01006N/99/EN/02.18