

# Flow Measurement in Hazardous Areas

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Head of Market Management  
Chemical Industry



## About FLEXIM

### Headquarters in Berlin

- 312 employees
- Manufacturing, calibration, research & development
- All shareholders are company founders
- Technology driven development



### Global Company

- Branches worldwide
- Final production, service support points and calibration stands in important target markets
- Around 500 direct FLEXIM employees worldwide
- Additional regional sales and service partners



# Advantages of Clamp-On Ultrasonic Flow Measurement



For high temperature applications or cryogenic media

Increased security for operators and systems!



For abrasive or dangerous media

for media with very high pressures

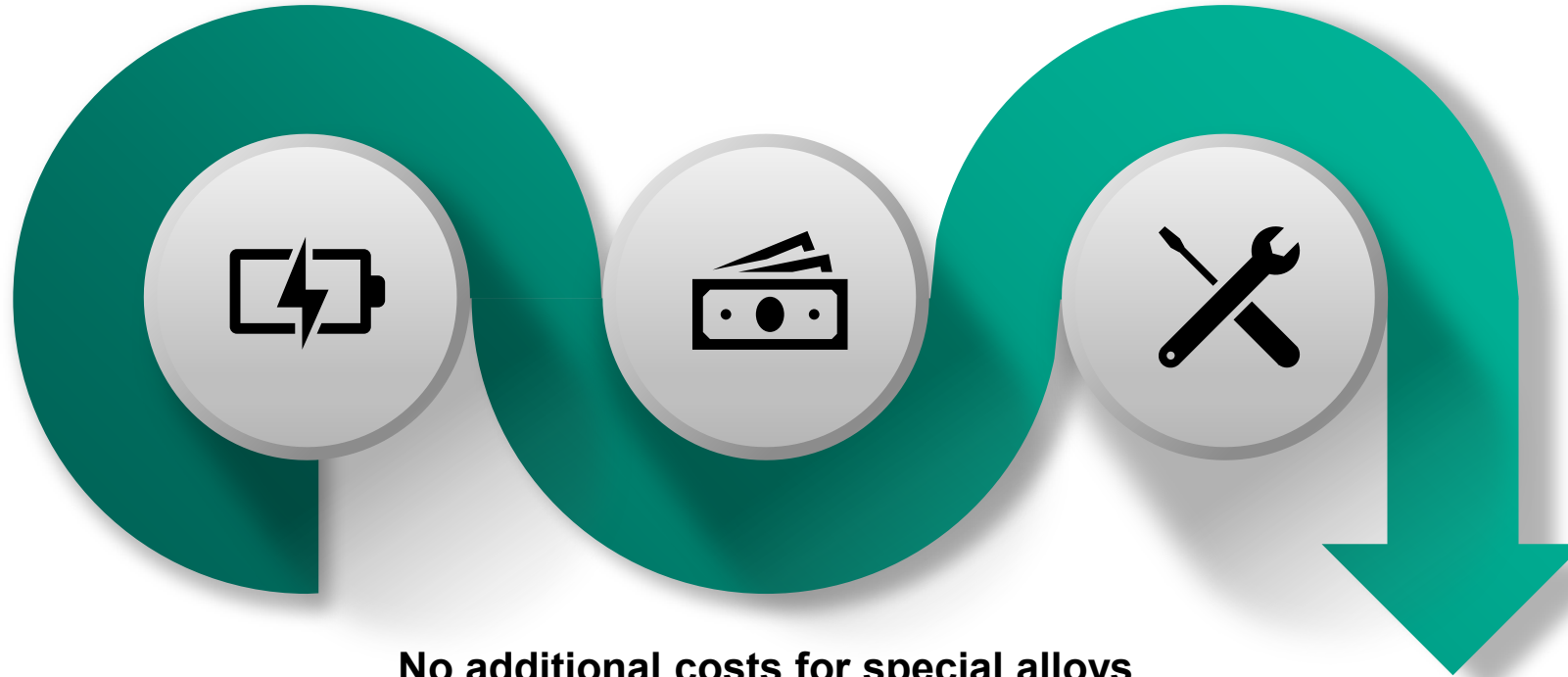


# Advantages of Clamp-On Ultrasonic Flow Measurement



**Reduction of energy consumption**  
no pressure loss

**No maintenance required**



**No additional costs for special alloys**  
compared to inline devices

Cost reduction





# Advantages of Clamp-On Ultrasonic Flow Measurement



## Reliability

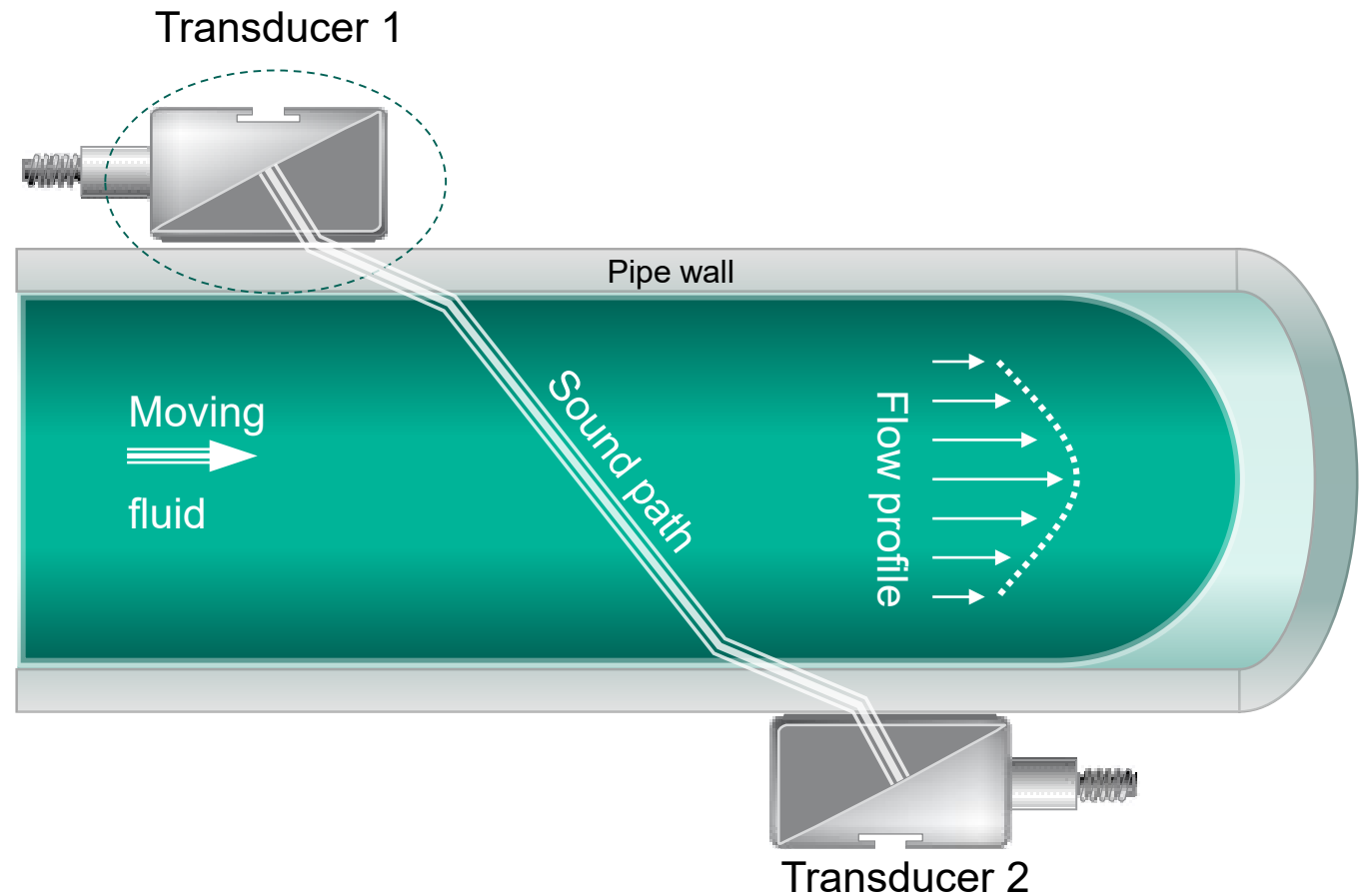
- No components with direct media contact > no deposits on the sensors!
- No clogged capillaries
- Measurement even with very low flow rates
- The measuring system is drift-free

## Plant availability

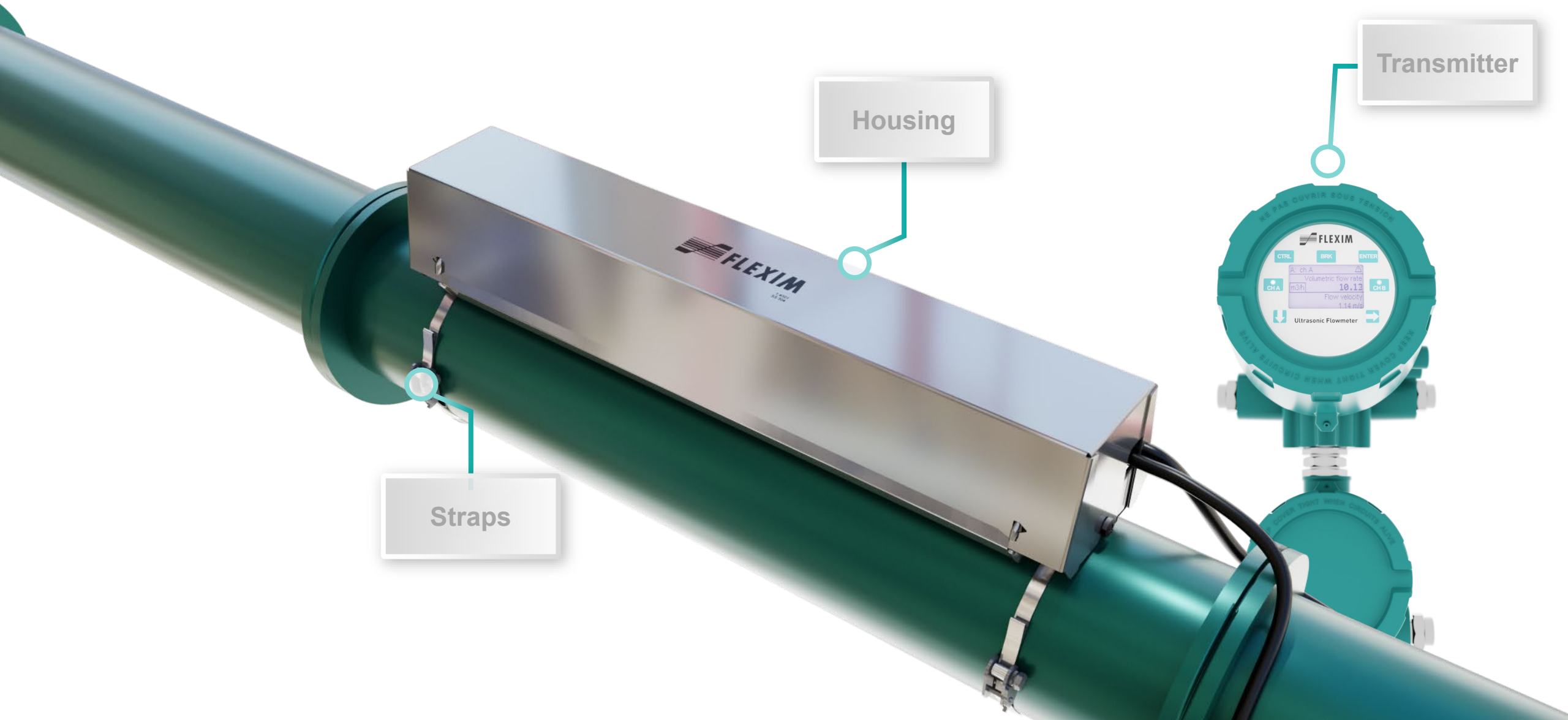
- No process interruption during installation
- Portable flow measurements during “start-up” of the plant or to check the media flows in operation
- Easy exchange of measuring systems in existing systems

# Transit Time Flow Measurement

- Two ultrasonic sensors act alternately as transmitters and receivers
- The sound signal is "accelerated" in the direction of flow and "braked" against the direction of flow
- The time difference between the signals is proportional to the mean flow velocity
- The volume flow is calculated from this using the pipe parameters



# Permanent Ultrasonic Measurement Technology



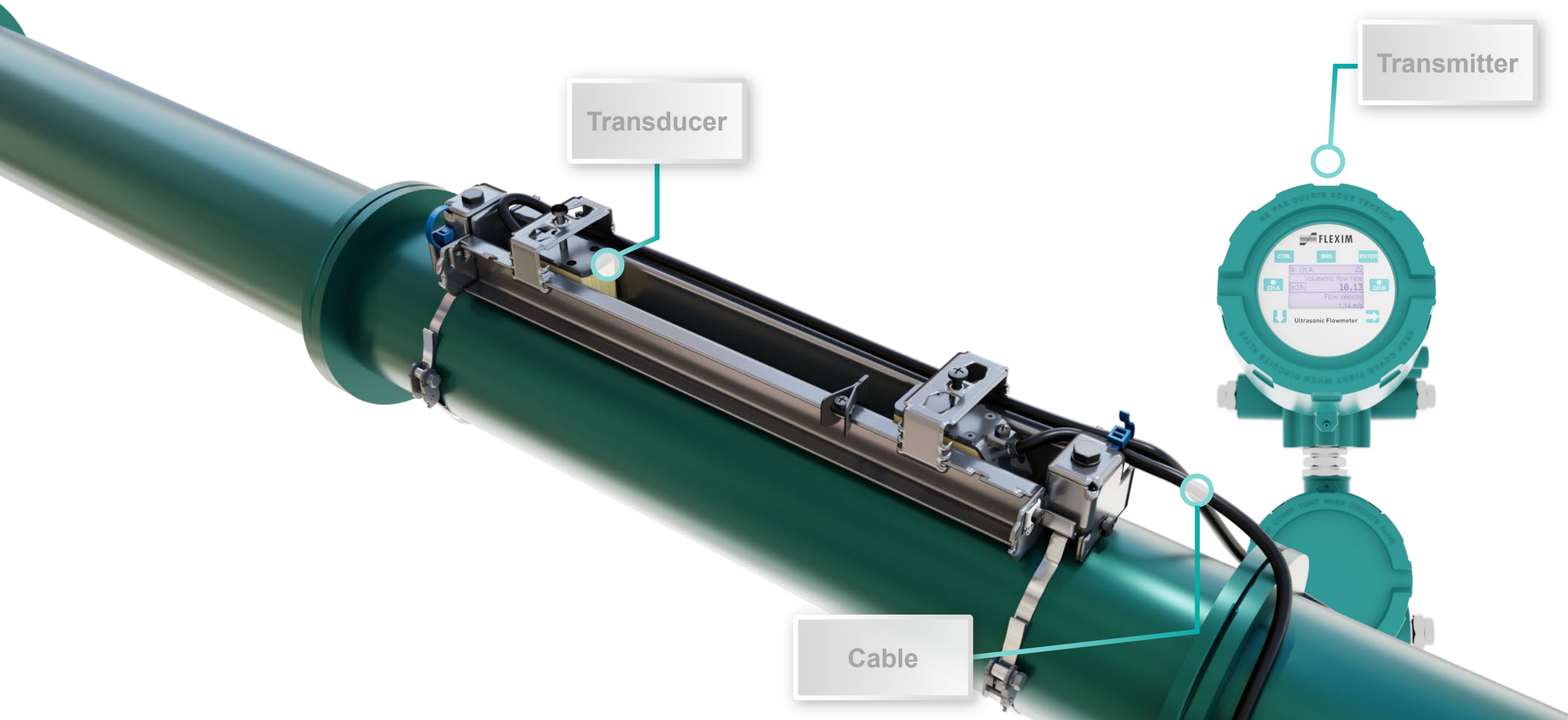
Housing

Transmitter

Straps



# Permanent Ultrasonic Measurement Technology



Transducer

Transmitter

Cable

# Typical Challenges in Chemical Plants

Chemical plants must handle a huge variety of different fluids. Depending of the production process and other supporting processes the fluids can vary with different properties.



## Pressure

- Up to 3000 bar
- Ethylene
- Hydrogen

## Temperature

- -170 °C – 600 °C
- Steam
- Cryogenic media

## Corrosive media

- Toxic or corrosive
- HCl, H<sub>2</sub>SO<sub>4</sub>
- Phosgene



# High Pressure

“FLEXIM’s clamp-on ultrasonic measurements work independently of the conductivity of the medium, are not sensitive to pipe vibrations and never compromise security of supply.”

Günter Schellen  
(Planning and Documentation, **CURRENTA** Water Supply)





# Flow Measurement at Ultra-high Pressure

When critical, environmentally hazardous, toxic, or flammable fluids need to be reliably conveyed or metered in high-pressure processes, flow measurement can be a tricky task.

## Media

- Hydrogen (up to 100 bar)
- Ethylene (up to 3000bar)



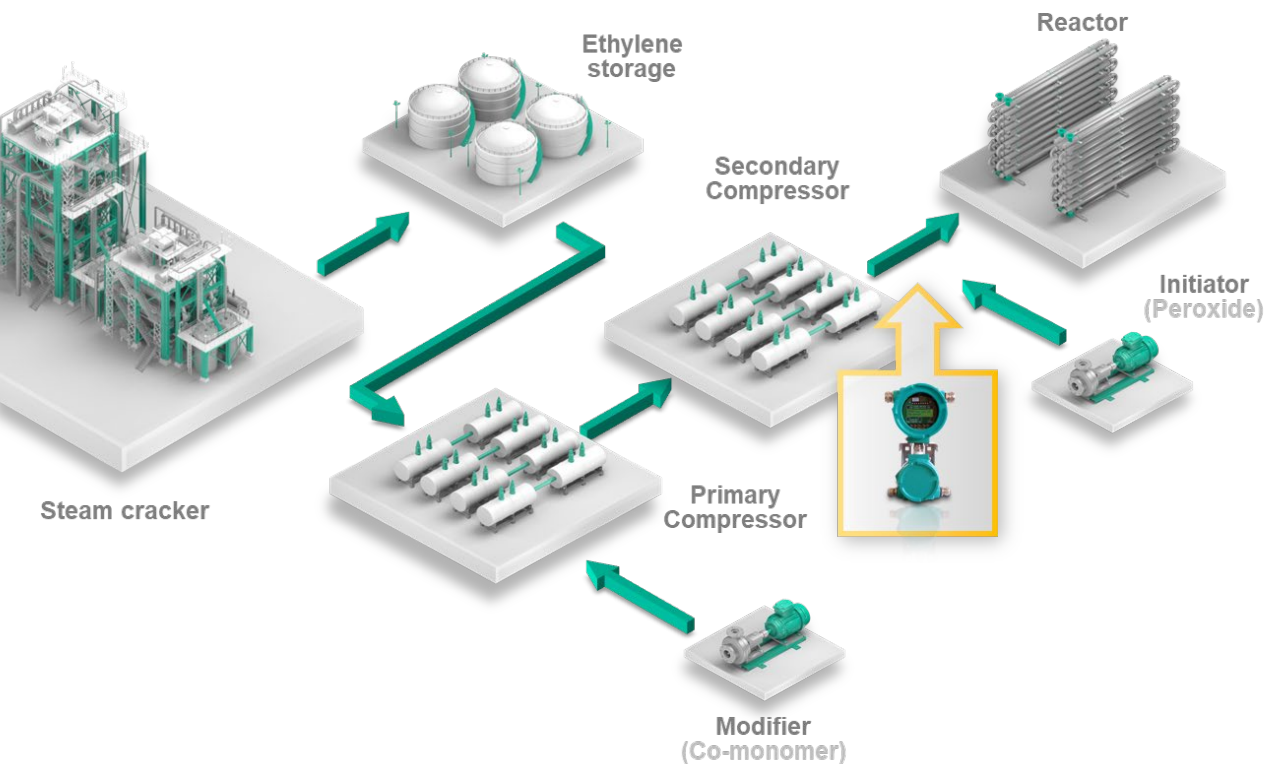
## Flow meters are required for:

- Monitoring of hydrogen volume flow to customers via pipeline
- Monitoring of hydrogen volume flow in refineries (e.g. de-sulfurization, hydrocracker)
- Monitoring of ethylene for LDPE production

# Flow Measurement at Ultra-high Pressure

With an annual overall production of over 100 million tonnes, polyethylene (PE) is the most common plastic in use today.

Due to the challenging process conditions with pressures up to 3,000 bars, operators of many LDPE plants worldwide have had identified FLEXIM's non-invasive ultrasonic technology as ideal solution for flow measurements in the production of LDPE. The clamp-on transducers are not exposed to the extreme pressure and therefore do not suffer from wear and tear. Furthermore, they do not cause any pressure loss.



# Flow Measurement at Ultra-high Pressure

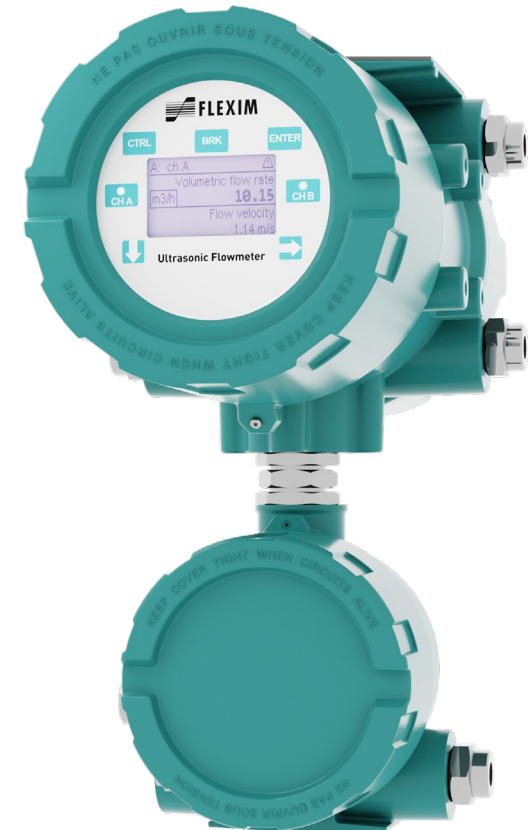
## Measuring Tasks

Non-invasive flow measurement of ethylene gas at ultra high pressure for LDPE production

- Medium: Ethylene
- Pipe: 1.5-inch inner diameter (1 inch wall thickness)
- Temperature: 60°C
- Pressure: 1500 to 3000 bar

## Advantages

- Precise non-invasive
- No extra costs to accommodate the high pressure
- Measurement is unaffected by vibrations or pressure surges
- Unaffected by wax particles
- No drift caused by variations in the static pressure
- Minimal installation effort





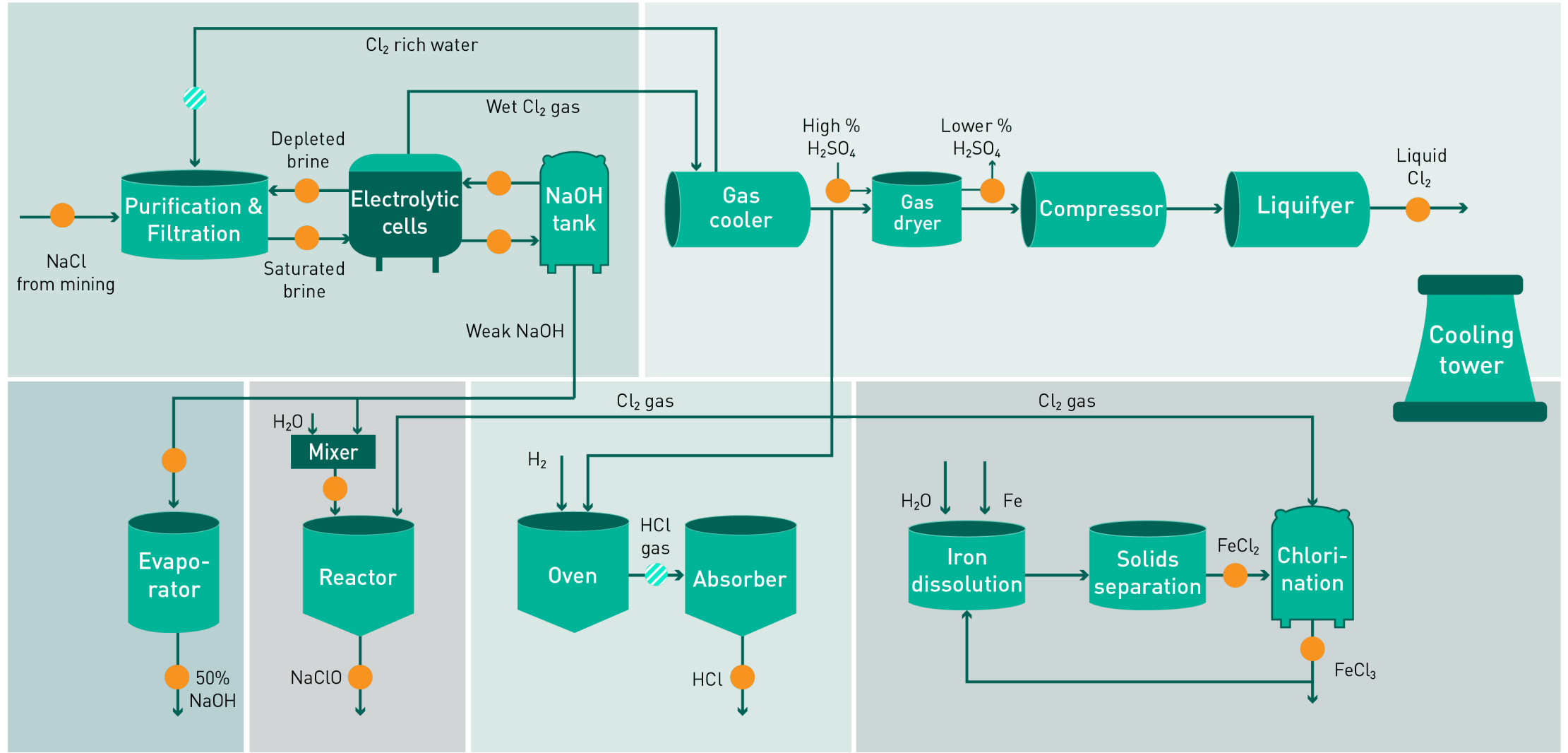
# Corrosive Media

“After we were able to quickly resume production of polyamide 12 by bridging the defective Coriolis flowmeters, non-invasive clamp-on ultrasonic technology also proved to be a superior measurement solution in the long term.”

Dr. Karsten Hoeland,  
(EMR System Engineer, Evonik)



# Flow Measurement in the Chlor-alkali process



# Flow Measurement of Corrosive Fluids

## Measuring Tasks

Non-invasive mass flow measurement of highly concentrated sulphuric acid

- Medium: Sulfuric acid 96%-100%
- Pipe: DN 300
- Temperature: 80...120°C

## Advantages

- Reliable and accurate flow measurement
- Non-invasive measurement from the outside of the pipe
- No wear and tear by the aggressive medium
- No risk of leakage

## Purchasing arguments

- Minimal installation effort compared to wetted measuring equipment
- No shutting off, emptying, rinsing and opening of the pipeline
- Unimpaired, complete plant availability





# High and Low Temperature

“For us, the main advantage of non-invasive measurement technology is the increased operational and plant safety“

Process Management  
Cluster Chloride, BASF

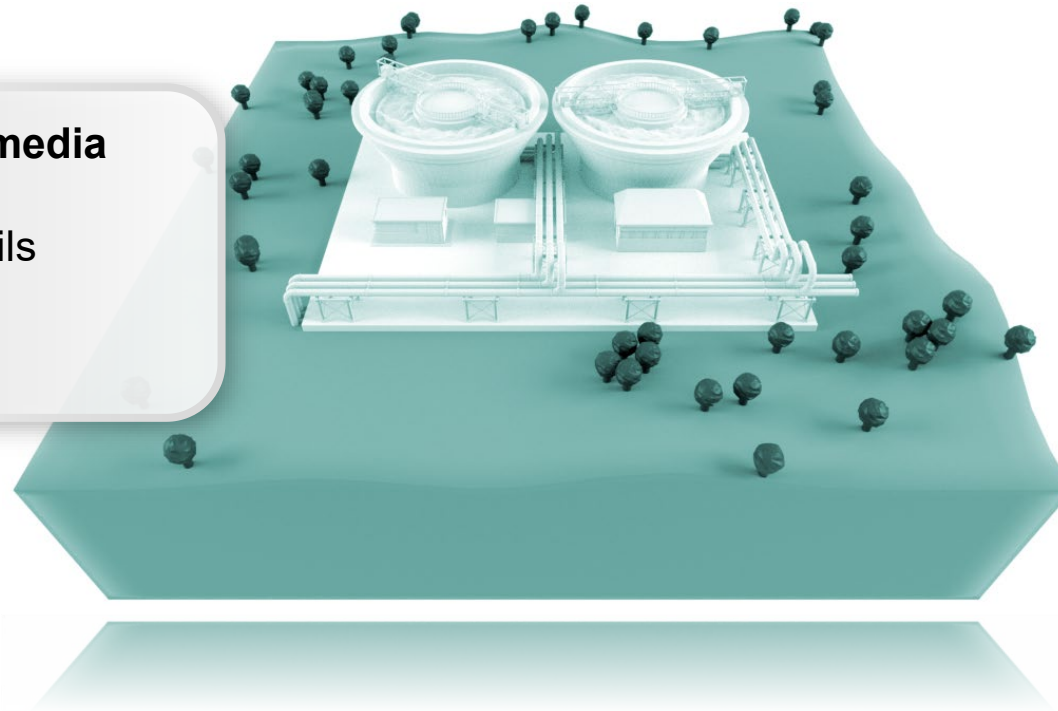


## Heating/Cooling

Heating and cooling play a big role in the chemical industry. Often, industrial heaters are used for their efficacy and dependability. Heat exchangers are the basic heat transfer equipment used in chemical process industries for wide range of applications. Varying temperature requirements of streams in a chemical process facilitates the use of heat exchanger.

### Heat transfer media

- Heat transfer oils
- Steam
- Cooling fluids



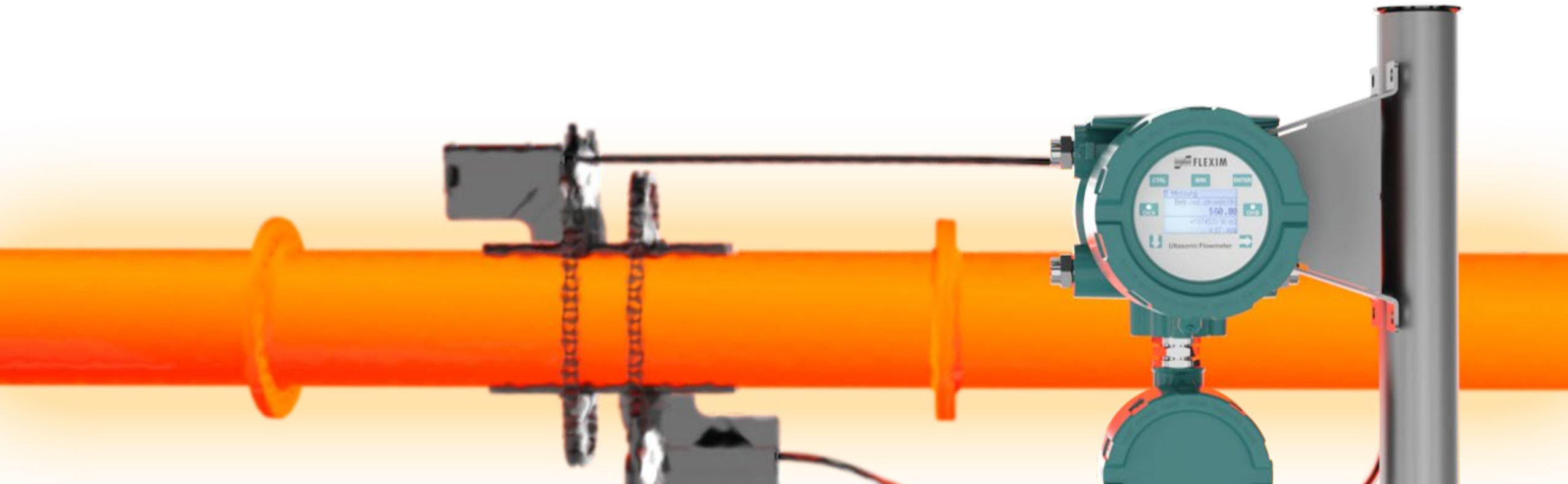
### Flow meters are required for:

- Monitoring of steam flow for steam generators
- Monitoring of cooling liquids
- Monitoring of heat transfer oil during the production

## WaveInjector

Intrusive flow measurement technologies require frequent servicing. As the sensors are in contact with either hot or the extremely cold fluids, they show high failure rates - and especially pressure taps for orifice plates tend to clog. Such high-maintenance measuring technologies reduce plant availability and critically undermine the profitability.

FLEXIM's non-invasive flow measurement technology, in combination with the patented WaveInjector, provides you with the competitive edge – in process control, process management, and environmental protection.





# Flow Measurement at Low Temperatures

## Measuring Tasks

Non-invasive flow measurement at a temperature of -40 °C for isocyanate production

- Medium: organic heat transfer fluid
- Pipe: DN350 carbon steel
- Temperature: -40 °C
- ATEX Zone 2



## Advantages

- Reliable and accurate measurement
- Effective process optimization

## Purchasing arguments

- Simple retrofitting during ongoing operation
- Cost effective solution for large nominal widths
- Impressive long-term experience using FLUXUS® and Wave



# Flow Measurement of Steam

## Measuring Tasks

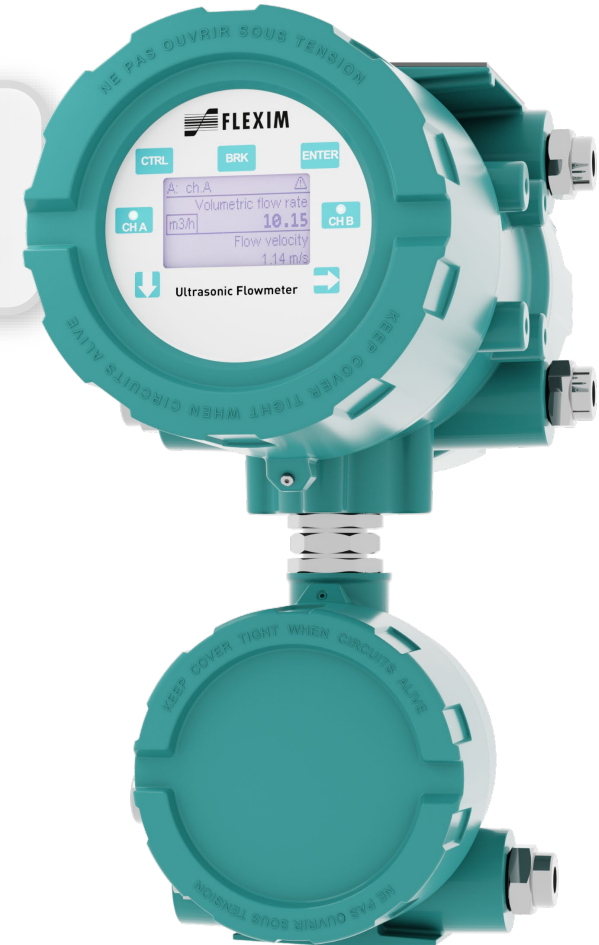
Non-invasive flow measurement of saturated steam in distribution lines

- Medium: saturated and superheated steam
- Pipe: DN 275 (carbon steel)
- Temperature: 330°C @ 51 bar

## Measuring point details

- In the SO<sub>2</sub>/SO<sub>3</sub> production plant, steam is generated as waste product
- Steam is provided into distribution network (40-60 bar pipelines)
- Internal billing

**G831 ST**  
The World's Only  
Clamp-On Steam  
Meter for hazardous  
areas



## FLUXUS G831 ST-LT (ST-HT) Steam Measurement

- Steam volume measurements from the lowest to very high flow rates with one and the same instrument.
- Measurement of volume and mass flow of saturated and superheated steam at temperatures up to 600 ° C.

Parameter	Transit Time	CFM
Flow Velocity	No limits	Re > 10.000 (turbulent)
Pressure	3-10 bar (45-145 psi)	Min. 1 bar (15 psi)
Temperature	Max. 180°C (356° F)	100-600°C (212-1112 °F)
Pipe sizes (ID)	45-400mm (1.8-16 inch)	15-800mm (0.6-31 inch)
Measurement uncertainty (volumetric flow rate)	±1..3%	±3%
Repeatability	±1%	±1%
Response time	1s	12-32s

# FLEXIM Solutions

“A single one-day measuring service has allowed us to permanently increase the cooling capacity of the cooling tower by almost half and, accordingly, increase the capacity of our production facilities.”

Andreas Drath (Reliability Engineer)





# FLEXIM Products for Chemical Industry



## F/G 721

The staple of FLEXIM's permanent solution. Available in FM Div. 1 Class 2, ATEX Zone 2 certification.



## F/G 831 SERIES

Permanent solution for ATEX Zone 1 or 2, FM Class 1 Div. 1 or 2 environments.



## WAVEINJECTOR®

Used in extreme temperature applications from cryogenic to super heated.



## PIOX® R400

Transit light Refractometer Laboratory precision in the process



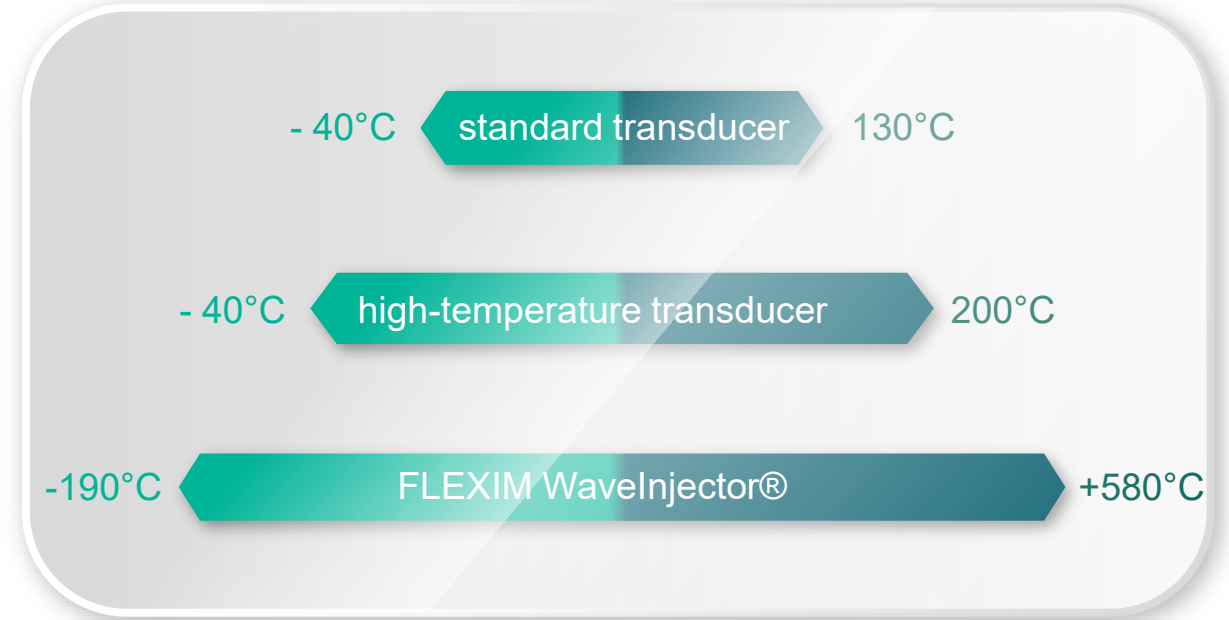
## PIOX® S

Concentration, Density and Mass Flow Measurement by Ultrasound



# Application Range

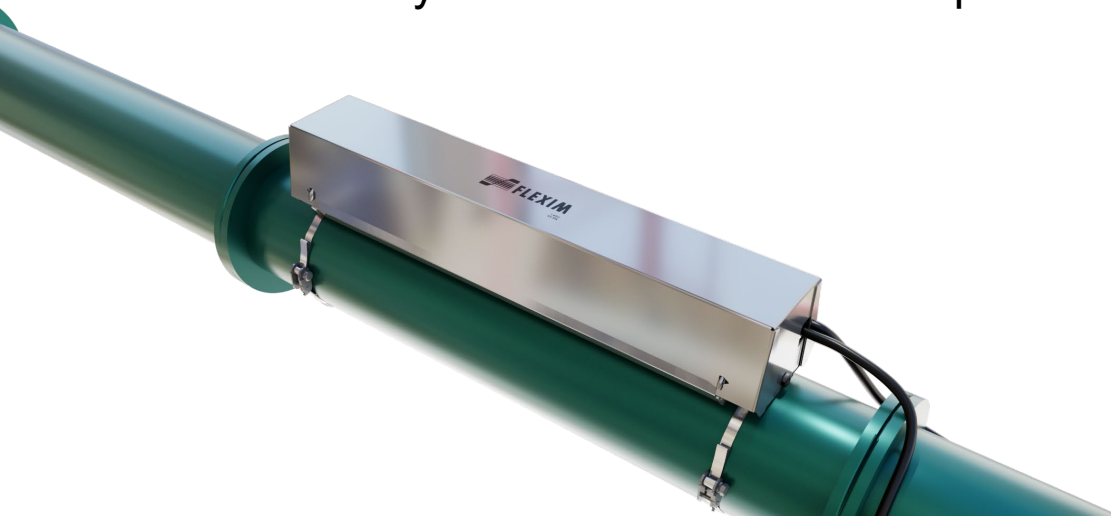
<b>Fluids</b>	Liquids, gases and steam	
<b>Pipe diameter</b>	liquids: 6mm to 6500 mm gases: 8mm to 1600 mm	
<b>Pipe material</b>	almost all pipe materials are suitable metal, alloys, plastics, glass, etc.	
	<b>Liquids</b>	<b>Gases</b>
<b>Flow velocity</b>	0.01 – 25 m/s	0.01 – 35 m/s
<b>Precision</b>	0.15%	0.15%
<b>Uncertainty</b>	±1-2%	±1-3%



## Obvious Advantages

### FLEXIM's range of non-invasive flow meters ensure:

- Non-invasive flow measurement solution for gases, liquids and steam
- No wear and tear by the aggressive media
- Perfect solution for high pressure
- Suitable for extreme low and high temperature measurements.
- Assembly without business interruption
- For safe or hazardous areas
- ATEX, IECEx, FM, EAC, Inmetro approvals
- Foundation Fieldbus, Profibus PA
- Bidirectional communication
- USB / TCP / IP interface





# Questions?

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