FLEXIM

Refinery Solutions

Non-intrusive Flow Measurement - Safety shut-down - Mass Balance - Up to 1120 °F

- FCC feed and residue
- Coker feed
- Atmospheric and Vacuum tower residue
- Cooling tower balance
- Overflash
- Heavy Coker Gasoil (HCGO)
- Alkylation (including acid concentration)
- Tank Storage
- Temporary flow measurement
- Fuel gas

FLEXIM
when measuring matters

The superior metering solution at extreme process temperatures

Non-intrusive ultrasonic flow measurement with WaveInjector®

Reliable - Safe - Cost Effective

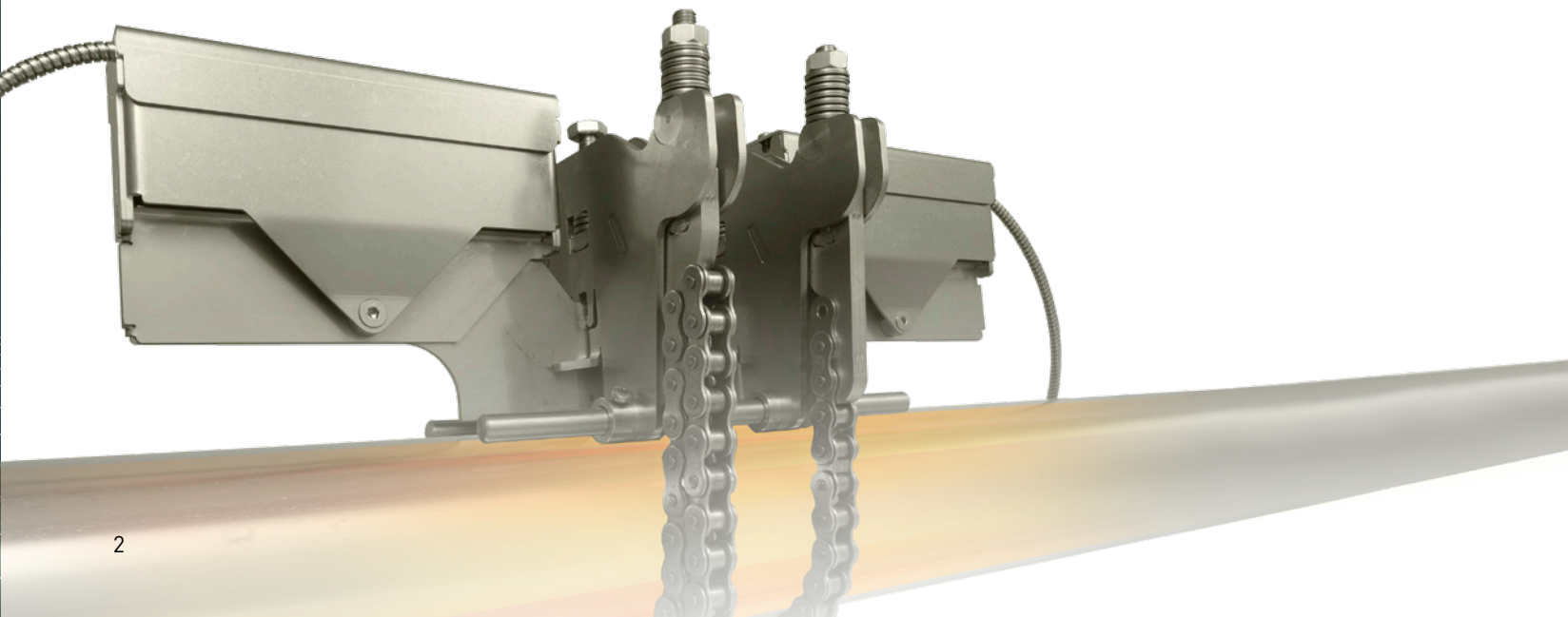
The WaveInjector® has been specifically engineered for high-temperature applications. Using patented technology, the WaveInjector® thermally isolates the ultrasonic transducers from the hot pipe, allowing operation at process temperatures up to 1100 °F.

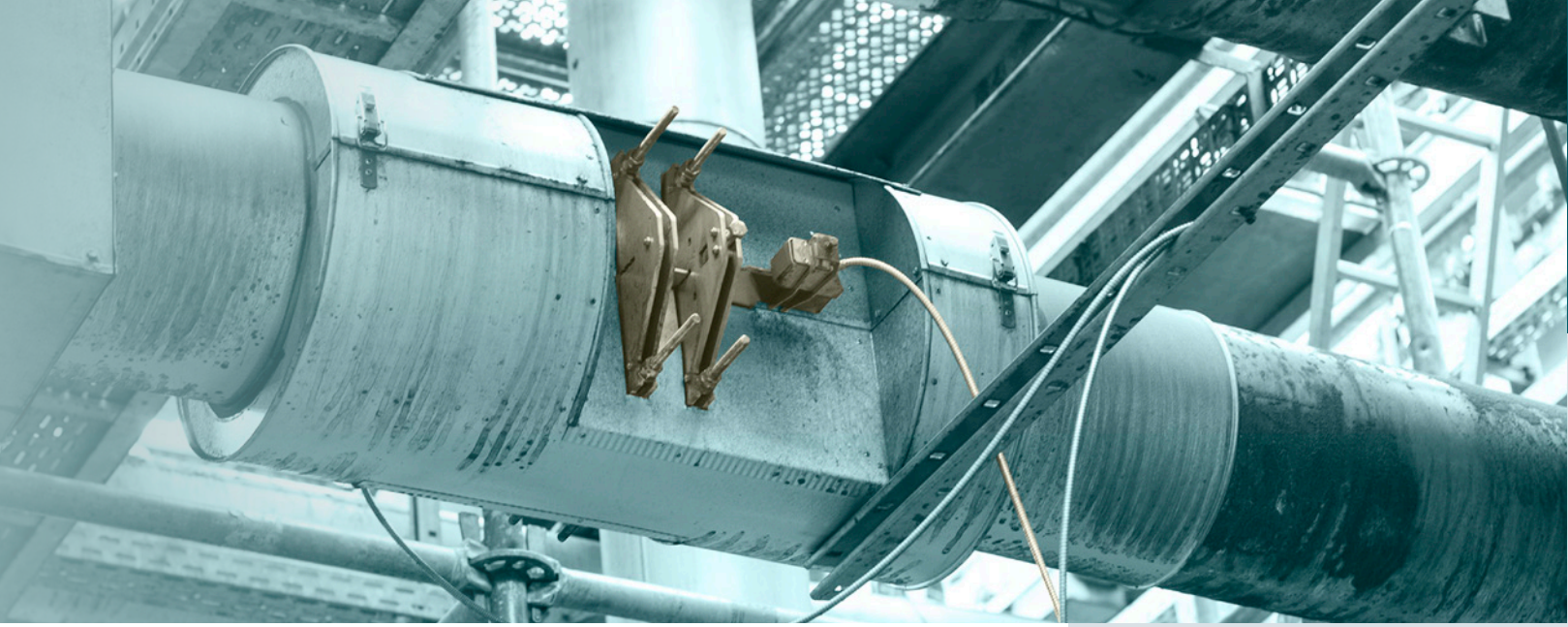
The operational conditions in refineries are very demanding: extreme temperatures, abrasive media and high viscosity. Conventional orifice / differential pressure, coriolis and vortex meters, which are used to measure refinery flows, face well-known shortcomings - often being maintenance intensive, requiring process stops for installation and causing pressure losses within the pipe, reducing the plant's availability and profitability.

Patented measuring technology

With the WaveInjector® FLEXIM provides a metrological alternative, which offers fundamental advantages and has proven itself in numerous refinery applications worldwide. Without the need for pipe work or process shut-downs, the WaveInjector® is mounted to the outer surface of the pipe. Rugged mounting fixtures provide long-term stable measurement even on pipes with extreme vibration.

A wide range of ultrasonic transducers and transmitters guarantee the ideal adaptation to the individual measurement task, independent of pipe material, wall thickness and measurement range - even within hazardous areas (FM Class I, Div. 1 and 2).





Unrivalled advantages of the non-intrusive flow measurement with FLEXIM in Refineries:

- No process shut-downs for installation - **maintenance free** (no need for frequent work in hazardous areas)
- No impulse lines to clog
- No moving parts therefore no wear and tear
- Certified for operation within hazardous areas (ATEX, IECEx, FM)
- No leak points
- No pressure drop
- Independent of pipe material, diameter, wall thickness and internal pressure
- Accurate and repeatable measurement readings - even at the lowest flow rates (high turndown ratio)

Technical facts

Temperature ranges:	
with WaveInjector®:	-310 °F to +750 °F (up to +1100 °F are applicable)
without WaveInjector®:	-40 °F to +390 °F (for gases up to +210 °F)
Flow rates:	
Liquids:	0.03 to 80 ft/s
Gases:	0.03 to 115 ft/s
Repeatability:	0.15% of reading ± 0.03 ft/s
Calibrated accuracy:	
Liquids:	± 1.0% of reading ± 0.03 ft/s
Gases:	± 1% ... 3% of reading ± 0.03 ft/s
(if field calibrated):	± 0.5% of reading ± 0.03 ft/s (liquids and gases)
Pipe sizes (outer diameter):	
Transducer directly at pipe:	1/4 inch to 225 inches (liquids), 0.4 to 83 inches (gases)
with WaveInjector®:	1.6 to 40 inches
Protection degree:	up to NEMA 6P
Ex approvals:	FM Class I, Div. 1/2
Pressurisation:	no limitations for liquids > 70 psi for gases in steel pipes

Unique features of the FLEXIM flow meters:

- Engineered for measurement of liquid AND gas flow
- Every measurement system is calibrated on a wet flow lab, to a N.I.S.T. traceable standard and delivered with a calibration certificate
- Integrated temperature compensation according to ANSI/ASME MFC-5.1-2011 regulations and digital signal processing guarantee a high zero point and flow measurement stability
- Ultra low frequency transducers available for applications with high solids content

Field-Proven Clamp-On Flow Measurement

Case Study: Clamp-On Flow Measurement of Bitumen at Suncor Energy

Today, oil sands may represent two thirds of the world's total petroleum resource. The Athabasca oil sands in Canada are by far the world's largest bitumen deposits and the only one suitable for surface mining.

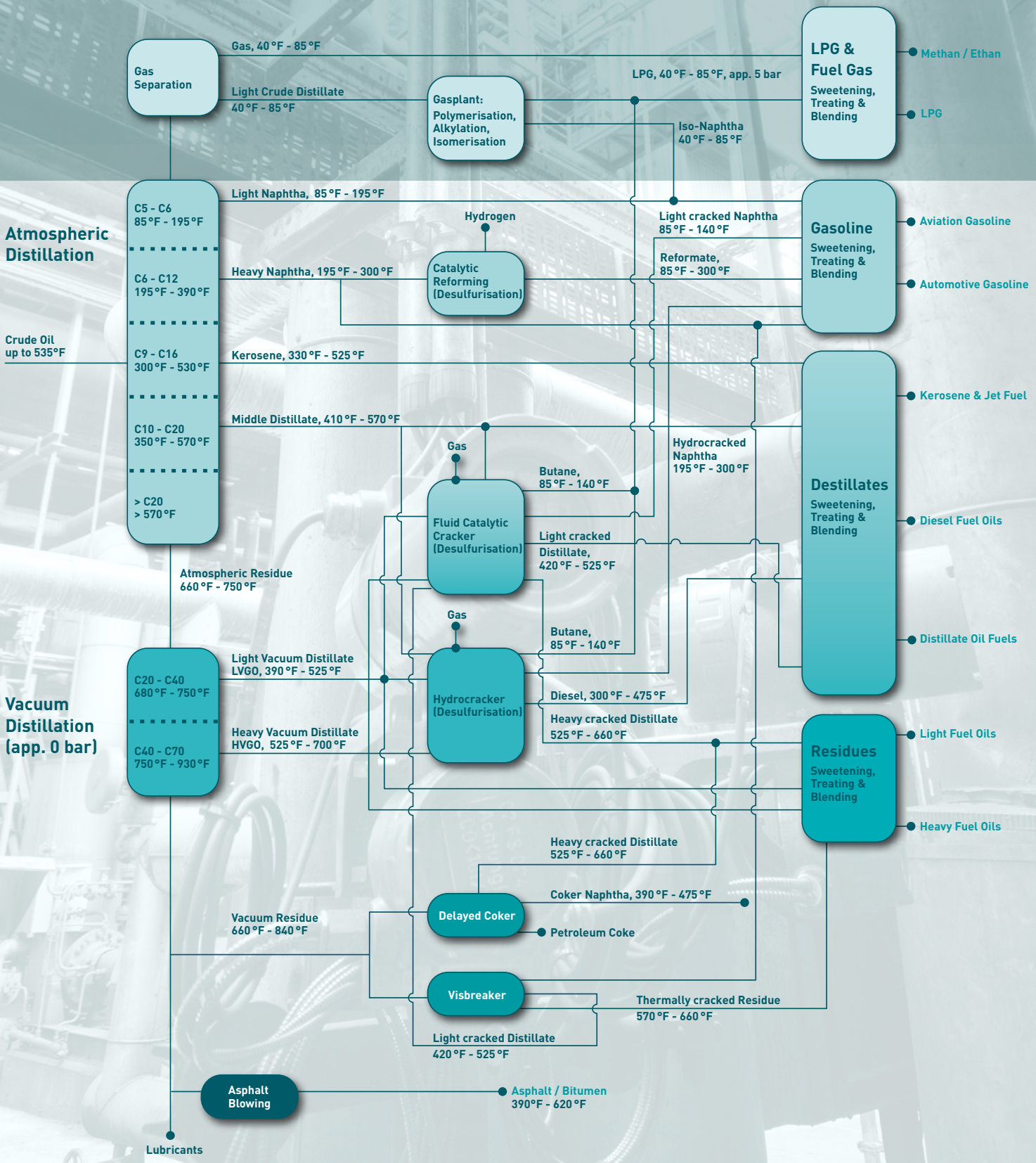
In Suncor's Fort McMurray mine, about 500,000 tons of oil sands are mined every day using shovels with buckets that hold 100 tons. Some of the world's largest trucks, carrying close to 400 tons per load, transport the ore to the processing unit. At the extraction plant, the raw bitumen is separated from sand, water and clay.

The recovered and heated bitumen is sent by pipeline to the upgrading facility. The upgrading process involves thermal treatment of the bitumen called coking. In this operation, the bitumen flow (or coker feed) needs to be measured at temperatures of 650 °F to 700 °F. Traditionally, this flow measurement is done with DP instruments (venturi or orifice plates) or vortex shedding meters. All of these technologies are in-line devices and therefore subject to wear-and-tear.

Non-intrusive flow measurement with FLEXIM proved to be a better alternative. A test done on a 6" bitumen line with the portable flow meter and the WaveInjector® transducer mounting fixture for measurements at high temperatures, demonstrated the suitability of the technology as it revealed the malfunction of an automatic valve which did not close as was indicated by plant operations. The result of subsequently closing the valve manually could be observed directly on the display of the flowmeter.

Impressed with the performance, the customer installed a fixed FLEXIM meter with a WaveInjector® on this pipe. The flow measurement values collected at this point are used for mass balancing in the upgrader process.

Refinery Flows



Distillation Columns (ADU / VDU)

Especially at the heavier hydrocarbons and residue lines, conventional inline flow measurement technologies, such as DP meters, often struggle with impulse line clogging causing operational and safety issues. FLEXIM's WaveInjector® measures from the outside of the pipe wall, independent of the internal pressure and temperature, solving flow applications such as:

- Crude oil heating prior to ADU
- ADU outlets with various distillates
- Overflash circulation
- ADU and VDU residues
- LVGO outlets
- HVGO outlets
- Slop oil

Moreover, with the WaveInjector® there is **no need for process shut-downs** during installation and **preventive maintenance is not required.**

Coking (DCU) and Visbreaking

Delayed Coking works under extreme process conditions with the high viscosity liquids, containing solids (coke fines). The stream can solidfy inside the pipe, causing a blockage.
Thus, a very reliable but also accurate flow rate monitoring at the coker feed lines is essential to prevent such premature coke formation and avoid operational safety risks.
Numerous times, the WaveInjector® **has proven its high reliability at such extreme conditions** without showing any measurement drift, **not causing internal pressure drops** and offering a virtually maintenance-free solution.

Hydro Cracking (HCU)

Hydroc Cracking operates at high temperature and pressure ranges with highly dynamic flow rates. Such conditions place high demands on the employed inline flow meters, such as Vortex meters, and often require NACE compliant material certificates. Being mounted outside the pipe wall, **the WaveInjector® can never be a safety risk for the process by itself.**

Recognizing this advantage, the ultrasonic measurement system has already **been put in place at many HCU loop control points with pipe temperatures up to 750 °F and pressure rates of around 3000 psi.** Because the FLEXIM flow meter is maintenance free and does not require a process shut-down, it is **a safe and cost effective metering solution.**
For measuring hydrogen streams, **FLEXIM also provides non-intrusive ultrasonic gas flow meter solutions eliminating the risk for potential leaks.**

Fluid Catalytic Cracking (FCC)

Flow meters in FCC reflux lines or fractionator bottoms face the challenge of the abrasive catalyst particles in the slurry causing a high degree of abrasion on any inline measurement systems. FLEXIM's clamp-on ultrasonic flow meters are **neither affected by wear and tear, nor can be a risk for leaks.**

Tank Storage - Hydrocarbon Product Identification and Tank Dewatering

With FLEXIM's HPI meter, it is possible to combine flow metering with **hydrocarbon product identification.** As hydrocarbon products can be distinguished through the ultrasonic signal, the HPI meter is the meter of choice in **tank storage applications** when different hydrocarbons are successively passing through the lines. Moreover, it is also the ideal tool for **tank dewatering applications** as water / hydrocarbon cuts can clearly be detected.

Portable Flow Surveys

Not every measurement point within a refinery needs to be constantly monitored by a permanent meter. Thus, it is helpful to employ FLEXIM's range of hazardous area portable liquid and gas flow meters for **regular surveys and check metering / verification tasks**.

Flow Measurement of Gases

FLEXIM also offers the accurate and reliable non-intrusive flow measurement of gases such as hydrogen, natural gas, fuel gas and many other media.
The FLEXIM gas flow meters are **independent of the pipe material, wall thickness and diameter, do not cause internal pressure losses and aren't limited by any maximum process pressures.** Even low pressurized gas lines down to 70 psi can be precisely monitored.
Another significant advantage of the non-intrusive measurement solution lies within the fact, that the system **can never be a risk for leaks** by itself and the installation **does not require any process shut-downs.**

Other Refinery Applications

FLEXIM's non-intrusive ultrasonic flow meters are the ideal choice for a wide spectrum of flow applications within a refinery.

Previously proven flow applications include the measurement of:

- Heat transfer oil lines
- Cooling and circulation water lines
- High pressure quench water and coker cutting water applications. Both vibrate violently due to jet pumps, which is not an issue for FLEXIM.
- Pipes within a refinery's wastewater treatment plants
- Technical gases and compressed air lines
- Small diameter lines with very low flow velocities (e.g.anti-foam agents and chemical mixing / dosing)
- and many other support processes

Spent Acid Strength Measurement

Within alkylation plants highly concentrated sulfuric or hydrofluoric acid is used to form high molecular weight olefins from lower molecular weight fractions. It is of **crucial importance to continuously monitor the concentration level of the process fed and spent acid** for acid recovery processes and further process improvements. FLEXIM's process analyzers PIOX® measure the acid's concentration either non-intrusively from the pipe wall outside by determining the liquids sonic velocity, which stands in distinct relation to its temperature compensated concentration, or inline by refractometry.

Hydrocarbon Quality Control

The online analysis of hydrocarbon products, such as aromatics, oil distillates or raffinates is of utmost importance to guarantee agreed quality levels. FLEXIM's inline Process Refractometer PIOX® R is the ideal measuring solution for such real time analysis and can either determine the content of saturated aromatic and olefin compounds or, as another example, the quality of oil distillates and waxes,**making cost intensive laboratory testing obsolete.**

FLEXIM

In partnership

FLEXIM is an active leader in many areas of process instrumentation. As a worldwide pioneer in the non-intrusive flow measurement of liquids and gases, FLEXIM has been leading the way in ultrasonic clamp-on flow metering for more than 20 years. In addition to non-intrusive flow measurement, FLEXIM specializes in innovative online process analytics using ultrasonic technology and refractometry. Year after year, the Berlin-based company continues its substantial investment in research and development in order to maintain and further improve its position as an industry leader. In keeping with its core principles, FLEXIM takes customer feedback very seriously. Every generation of FLEXIM products is directly driven by customer and industry needs.

The FLEXIM Commitment to Customer Service

FLEXIM considers itself not only a manufacturer of measuring instruments, but also a provider of technical and consulting services. These services include on-site measurements, laboratory analysis, project handling, training, commissioning, instrument rentals and consulting services. The company's focus and dedication is directed towards providing the highest quality equipment with the best support and service possible.

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