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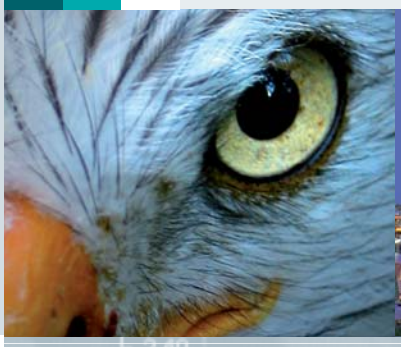
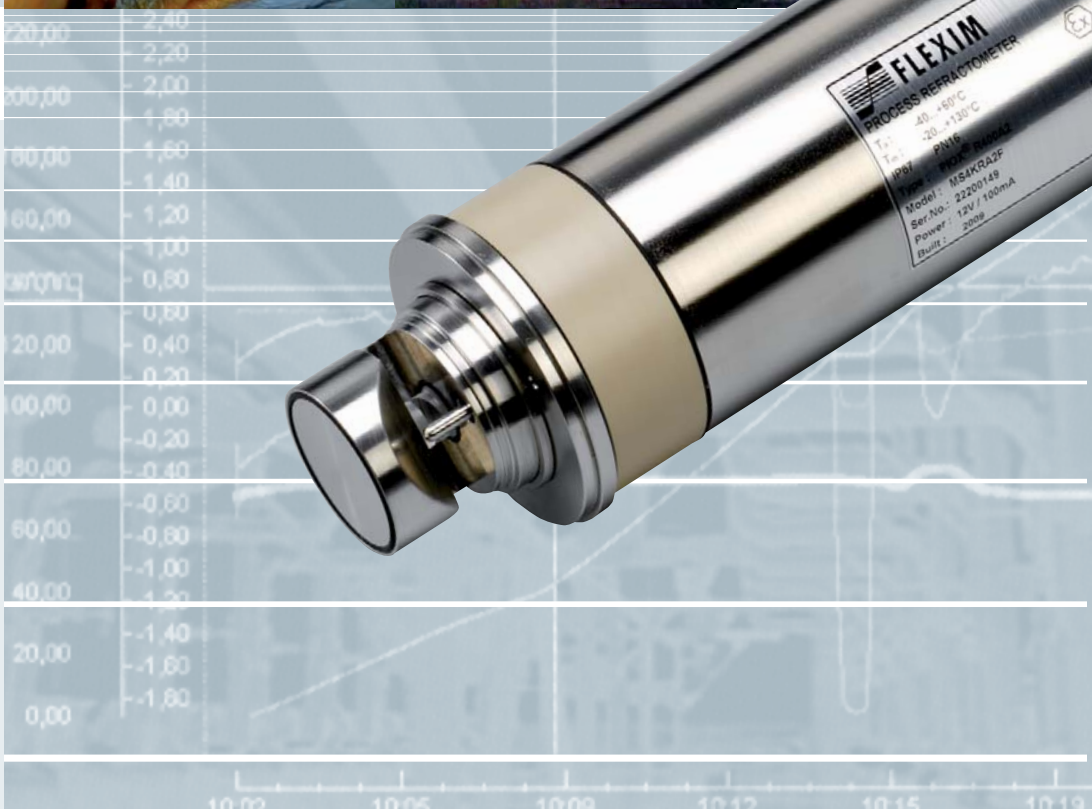
Laboratory Accuracy in Real Time

PIOX® R

Process Refractometer Yields Reliable Process Control

- Concentration Measurement
- Process Control
- Conversion Rate Determination
- Phase Detection
- Product Identification
- Density Measurement





Process Insight Through Transmitted Light

Precision in the Process

Process Refractometry

Measurement in “Real Time” – not “from Time to Time”

Modern production would be unthinkable without modern measurement technology. Continual processing demands continual process control. Inline monitoring of the end product quality by means of process analytical methods becomes ever more important. The advantages are obvious: continual quality management, process optimization, resources savings, higher operating reliability.

A proven method …

Refractometry – in other words, the measurement of light refraction – has proven itself as a method of analysis in the laboratory time and time again. There, refractometers are used daily to determine the purity, concentration, or density of liquids. Increasingly, refractometry is moved from the laboratory to the production process, so that the advantages of this method can be used with online measurements: speed, accuracy, reliability, environmental friendliness, and independence from color, turbidity and gas bubbles.

… fit for the 21st century

Transferring laboratory measurement technology to the process involves special challenges concerning materials and technology. In fact, the conventional laboratory measuring principle has disadvantages when implemented in the process: Since the critical angle refractometer uses only an extremely thin layer for the acquisition of measuring values, even a slight deposit on the prism causes drift in the measured value, and thicker coatings mean measurement failure.

The transmitted light method is the solution. The process refractometer PIOX® R combines laboratory accuracy with process reliability.

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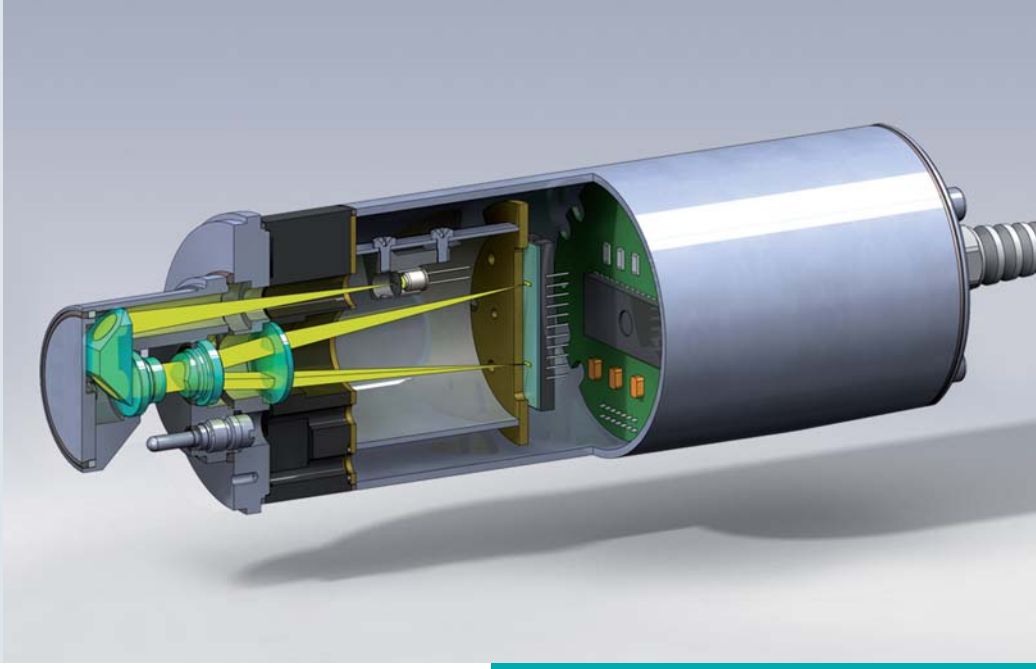


Doubly Innovative

Transmitted Light Makes the Difference

PIOX® R measures with transmitted light. The refraction measurement occurs directly in the probe volume flow and not indirectly at the boundary layer. This method is especially reliable and not affected by deposits.

Drift free through differential measurement

With PIOX® R, there is not only one light beam whose refraction is being measured, but two: the monochromatic measuring beam is refracted by a biprism in two different directions. The difference between the two resulting peaks is measured. The patented measuring method ensures stable measuring results, even in case of temperature and pressure fluctuations in harsh process environments.

Reliable even in case of fouling

If deposits form on the prism, an automatic adjustment of the LED's intensity occurs. Additional cleaning devices are therefore normally not necessary. When measuring media with a strong tendency to form deposits, the simultaneous evaluation of the signal amplitudes makes it possible to trigger the required cleaning procedures.

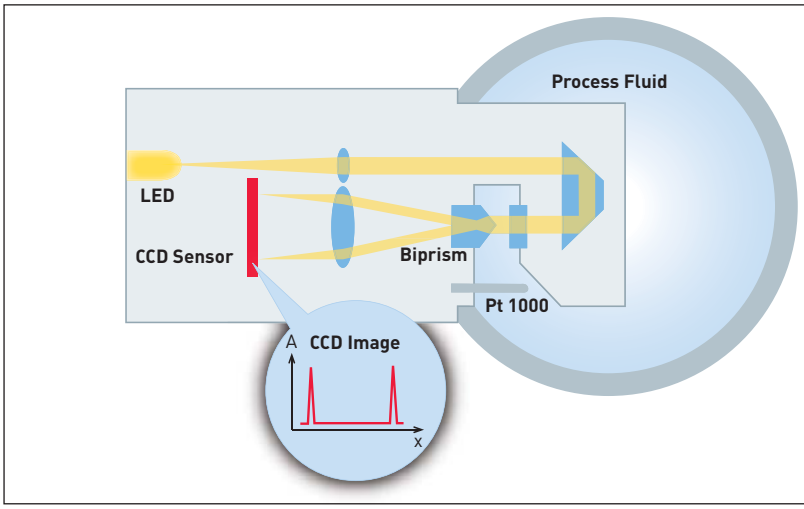
Facts:

Reliable and accurate: wide measuring range with constantly high precision

Highly functional: not sensitive to fouling

Biprism enables difference measurement

Drift free: unaffected by external process conditions



The light emitted by the sensor's LED is parallelized and bundled before it crosses the fluid to be measured. At the surface of the measuring prism, the light beam is refracted and split in two. On the CCD sensor behind the prism, two intensity peaks are detected. The distance between them is correlated with the refractive index of the fluid through Snell's law.

High Quality, Fast, Reliable

The Sensor

Through the use of materials optimally adjusted to the process, the PIOX® R sensors can cope with all process demands. All sensors are equipped with high-quality sapphire optics and – in order to shorten the reaction time – with a fast Pt1000 temperature probe located directly in the medium.

The sensor can be installed in small pipelines as well as in vessels or tanks. All conventional process connections are available: DIN or ASME flanges, Varivent, Tri-Clamp, etc. Additionally, special solutions such as linings or installation in glass tubes can be realized. Metal-free sensors with integrated PTFE, PP, or PEEK measuring cells can be used in smaller pipes.

Intrinsically safe sensors for operation in explosion hazard areas (ATEX 0/1) are available.

Facts:

Sapphire optics with high chemical and mechanical resistance

All usual process connections

Explosion protected versions (ATEX 0/1)

Special materials available for wetted parts

Integrated Pt1000 temperature probe

Self-diagnosis (sensor temperature, signal amplitude, sensor humidity)

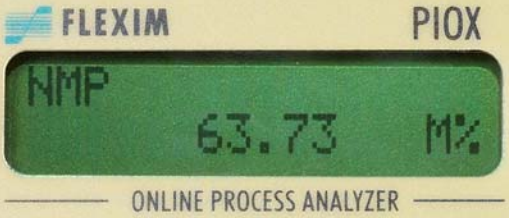
Typical Applications with PIOX® R

Refractive index measurement makes a determination of the concentration or density of liquids possible. For many measuring tasks, refractometry is a standardized method introduced long ago, for instance for the determination of the concentration of sugar solutions.

Basically, whenever a refractometer is used to measure in the laboratory, it is also suited for the same task in the process. Additionally, the process refractometer PIOX® R can be used for many applications where measurements were done by a different method up to now, or not at all.

Chemical Industry	Oil and Gas Industry, Petrochemistry	Polymer and Fiber Chemistry, Membrane Production
→ organic and inorganic acids → dissolved salts (chlorides, phosphates, sulfates) → solvents → fungicides → ureas → urea ammonium nitrate → aniline	→ glycol in gas drying → MEA, DEA, MDEA for the absorption of sour gas → quality control for lube oil distillates and raffinates → aromatics, solvents for aromatics extraction	→ solvents, intermediate and end products, e.g. → caprolactam → cellulose spinning solution → DMAC, DMF → NMP → polycarbonate

Food and Beverage Industry	Pharmaceutical Industry	Other Applications
→ sugar and artificial sweeteners in the candy and beverage production → original wort (hot wort and cold wort) in beer production → whey products → pectin	→ different media in process development → ascorbic and cetogulon acid during the manufacturing of vitamin C	→ glycol measurement in the recycling process of airplane de-icing agents in the airport → measuring starch concentration in paper and cardboard production



Optimally Flexible

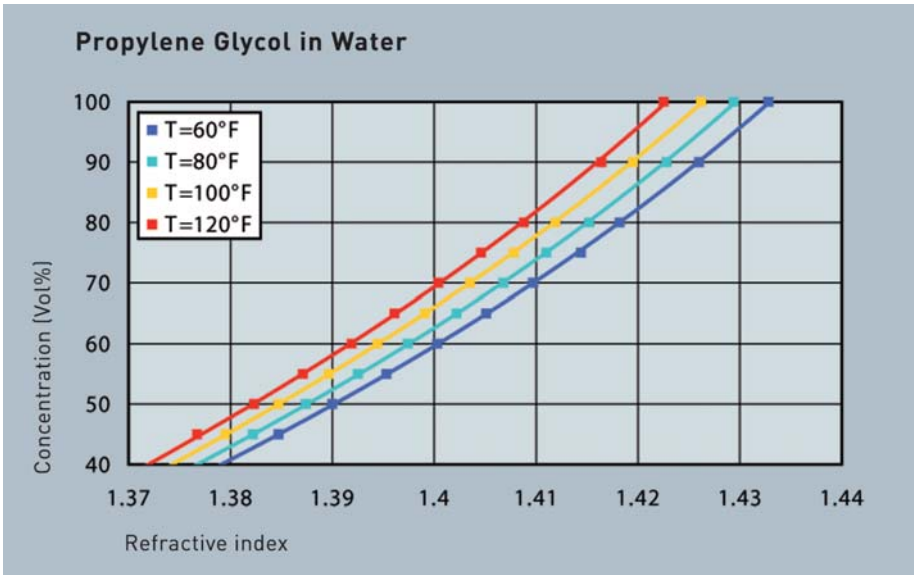
The Transmitter PIOX® TR

Facts:

- **Flexibly configurable inputs and outputs**
- **Calculation of user-defined output quantities**
- **Output of all measuring and diagnosis values**
- **Use of two sensors per transmitter possible**

The transmitter PIOX® TR calculates the quantities relevant for process control, e.g. concentration, solids content, density, etc. In addition to the refractive index and temperature values recorded by the sensor, other measuring quantities (e.g. pH value, density, and sound velocity) can be taken into account when calculating the output quantity. The Brix scale is stored in the transmitter by default. User-defined scales can be defined with FLEXIM's "RMKoeff" software supplied with each instrument.
On request FLEXIM can determine such user-scales in our laboratory or in the field.

Not only the calculated output quantities, but also all diagnostic values of the sensor can be sent to the outputs of the transmitter. Thus, by way of the integrated self-diagnostic feature, a system failure can be prevented. In addition to the outputs (current, voltage, frequency, alarm, RS485), a data logger with memory card can be installed in the transmitter.



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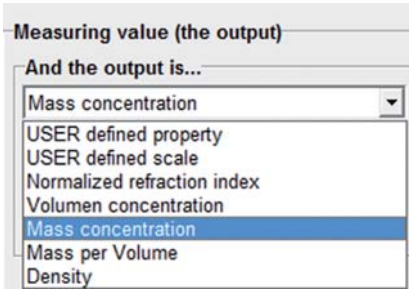
Perfect Parameterization

The RMKoeff Software

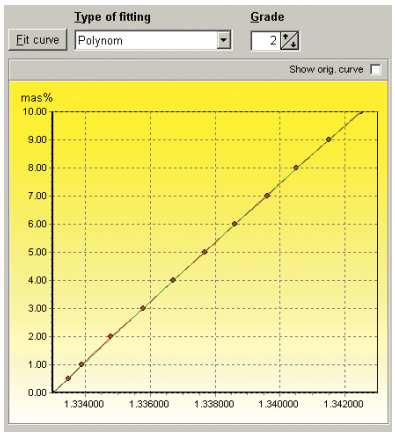
In addition to the Brix scale already stored in the transmitter, user-defined data sets can be created and transferred to the PIOX TR transmitter using the RMKoeff software.



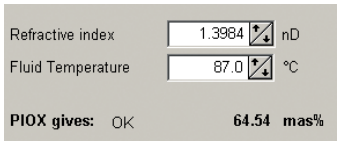
1.) Selection of the output quantity. Standard quantities such as w% and vol% are available in the default selection list. User-defined output quantities are also possible.

nDT	mas%
1.333	0
1.3335	0.5
1.3339	1
1.3377	5
1.3425	10
1.3523	20

2.) In order to define the relation between refractive index and output quantity, data pairs, – such as refractive index and w% – have to be entered in a table. These values are derived from technical literature or from measuring data collected by the user.



3.) RMKoeff performs a polynomial curve fitting in order to generate a set of coefficients describing the entered data.



4.) The PIOX® TR output can then be checked by entering test measuring values.

5.) The calculated coefficients set is subsequently transferred to the transmitter via the serial interface.

Facts:

- Simple creation and management of user-defined data sets
- Automatic mathematical modeling
- Output quantity selectable by customer
- Simple data transfer to the transmitter via RS232/USB
- Easily understandable user interface
- Suitable for all Windows™ versions

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PIOX® R400

Technical Data

Measuring principle:	Transmitted light refractometry	
Measuring quantities:	Refractive index, temperature compensated refractive index, fluid temperature, °Brix, w%, additional quantities programmable with RMKoeff	
Measuring quantities for diagnosis:	Signal amplitude, sensor temperature, sensor humidity	
Accuracy:	nD: 0.0002 corresponds to 0.1 °Brix, typically 0.1 w%	
Repeatability:	nD: 0.00002 corresponds to 0.01 °Brix, typically 0.01 w%	
Resolution:	nD: 0.000001	
Sensor		
Degree of protection:	IP 67	
Operating temperature:	Fluid temperature:	(–20 to +150) °C; (–4 to +302) °F in ATEX zone 0 to 2: (–20 to +130) °C; (–4 to +266) °F
	Ambient temperature:	(–20 to +60) °C; (–4 to +104) °F
Explosion protection:	Sensors are available for ATEX zones 0, 1 and 2	
Process connection:	Flanges as per DIN or ASME, Varivent or Tri-Clamp, for pipe or tank installation	
Transmitter		
Operating temperature:	(–10 to +60) °C; (+14 to +140) °F	
PIOX® TR374:	Standard field device Degree of protection IP 65 Also available for connection of explosion protected sensors. Version for use in ATEX zone 2 available	
PIOX® TR379:	Unit for installation in 19" racks Degree of protection IP 20	
Outputs:	max. 4 current outputs 0/4 ... 20 mA, usable for all measuring quantities (including diagnosis quantities), alternatively voltage or frequency output, additional binary outputs, RS485/USB	
Inputs:	Current or voltage, for calculation of additional output quantities	

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