

Teqwave H

Product presentation



Personal Introduction

- Manuel Martini
- Product Manager Ultrasonic and Teqwave
- Located in Switzerland
- 9 years with Endress+Hauser as Product Manager



Ways to measure concentration



Coriolis (density)



Vibronic (density)



Radiometric (density)



Endress+Hauser offers a wide range of possibilities for measuring concentration. Each measuring principle has specific advantages depending on the industry, application and customer.

The advantages of concentration measurements based on ultrasound are high accuracy, reliability and very low maintenance or recalibration effort



Conductivity



pH



Ultrasonic

Challenges and trends in F+B industry

Challenges and trends in F&B industry

- Meet legal hygiene requirements, comply to food safety and quality standards
- Reducing losses in core processes and utilities is important for an efficient resource conservation
- Food producers search for solutions to increase the plant efficiency
- Standardization initiatives lower costs and are key to ensure high plant availability
- In-line quality measurements guarantee a stable food quality to ensure repeatability in processing

Endress+Hauser Teqwave H is developed according global Food & Beverage trends. It complements the Endress+Hauser portfolio, to help customers to simplify concentration measurement of different beverages.



We help you to improve quality while reducing operational costs

The way we do this:

- **Ensure repeatability in processing**
Stay flexible while ensuring stable and consistent food quality and taste
- **Compliance to food safety and quality standards**
Lead the way to food safety for you and your family
- **High plant availability**
Save time and cost by running smart and efficient through information driven operations
- **Resource conservation**
Feed the world with minimal food, energy and water waste in production

Density

- Promass
- Liquiphant

Ultrasonic

- Teqwave H

Conductivity

- CLS/CLD
- QMW43
- Promag

Teqwave H: Application packages for analysis parameters



Cleaning agents and disinfectants

- Hydrogen peroxide
- Sodium, potassium hydroxide
- Nitric acid, sulfuric acid
- 8 different cleaning fluids of:
 - Wigol
 - Ecolab



Distilled beverages

- Alcohol concentration in liquor 10 % vol to 99 % vol
- Sugar concentration in alcohol beverages
- Invert sugar concentration in alcoholic beverages



Soft drinks and fruit juices

- Sugar concentration 0% inversion (saccharose)
- Sugar concentration 100% inversion (glucose, fructose)
- Sugar concentration according to ICUMSA
- Degree of sugar inversion in syrup

Technical specification Teqwave H



Transmitter

- Touch screen or LED status indication
- Optional: IP67 stainless steel housing
- 24V DC
- 0 to 60 °C ; 3 to 140 °F
- All in one: 4 to 20 mA / relay / Modbus TCP

Sensor

- DN25 (DIN) ; 1" (ANSI)
- 1.4404 (316L)
- IP67, opt. IP69
- Max. 16 bar/232 psi
- 0 to 120 °C ; 32 to 248 °F
- Full-bore hygienic design without protruding parts
- Same process connection as Promag H

Concentration
Accuracy: up to 0.01%

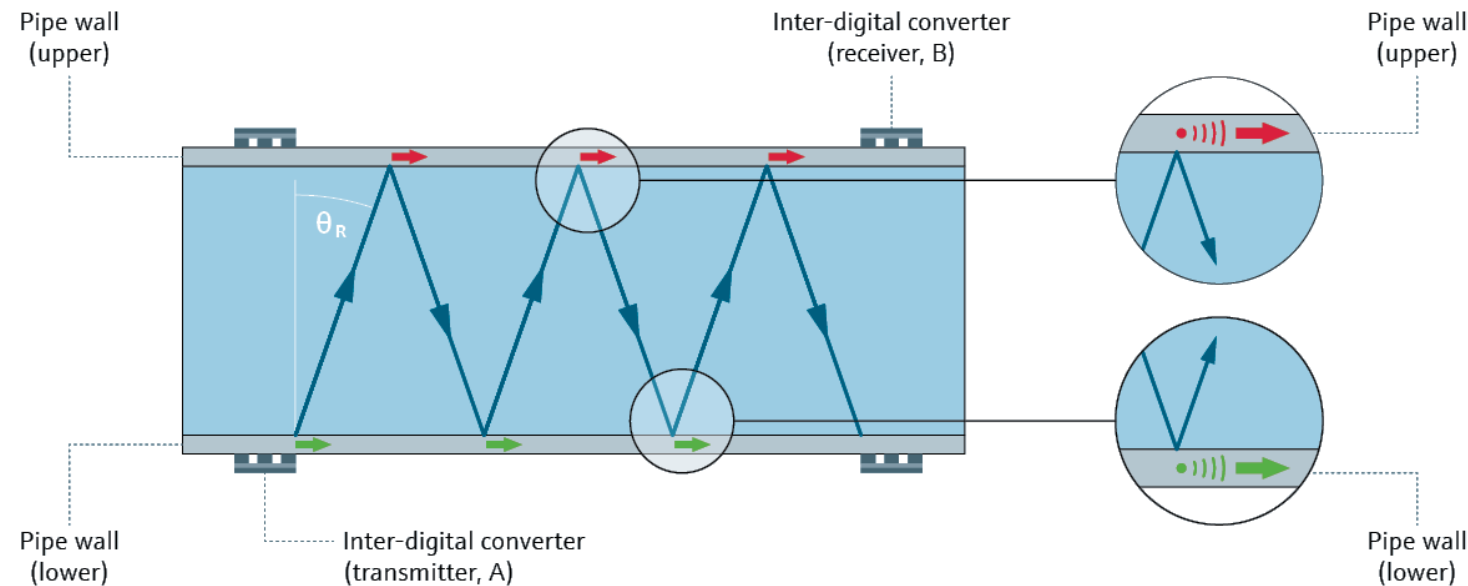
Speed of sound
Accuracy: ± 2 m/s

Temperature
Accuracy: ± 0.5 °C / 0.9 °F

Acoustic density
Accuracy: ± 0.01 g/cm³

Measuring principle – Teqwave

Interdigital transducers generate ultrasonic waves that travel along the measuring tube and through the liquid. Both ways of the waves will be evaluated and analyzed.



Identifying

... speed of sound due to

- Transit time
- Transit time difference

... acoustic density due to

- Amplitude Ratio
- Frequency Shift

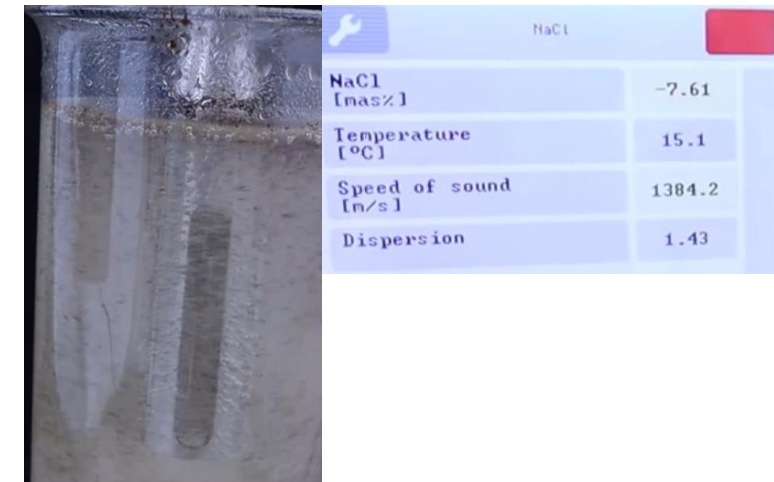
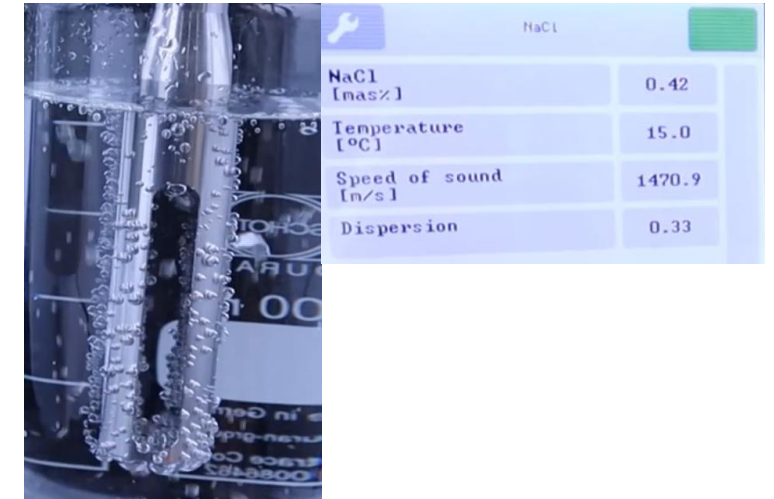
... Temperature due to

- Runtime
- Temperature Sensor

= Concentration

Dispersion: Ensuring reliable measuring values

- **Dispersion indicates a disturbance of the liquid.** Disturbances are caused by dispersed gas bubbles or particles and cause the sound signals to spread (see pictures). The dispersion is independent of the flow profile.
- Dispersion is represented as a normalized factor. A dispersion value of less than 1 indicates that the determined speed of sound complies with the specified measurement deviation. For Teqwave users, **the dispersion measurement ensures the measurement accuracy of the concentration measurement.**
- In addition to ensuring measurement accuracy, the dispersion can be used as a **measuring value to detect unwanted gas bubbles or particles**, e.g. for monitoring filter breakage or chemical solution processes.



Application packages for analysis parameters



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Distilled beverages

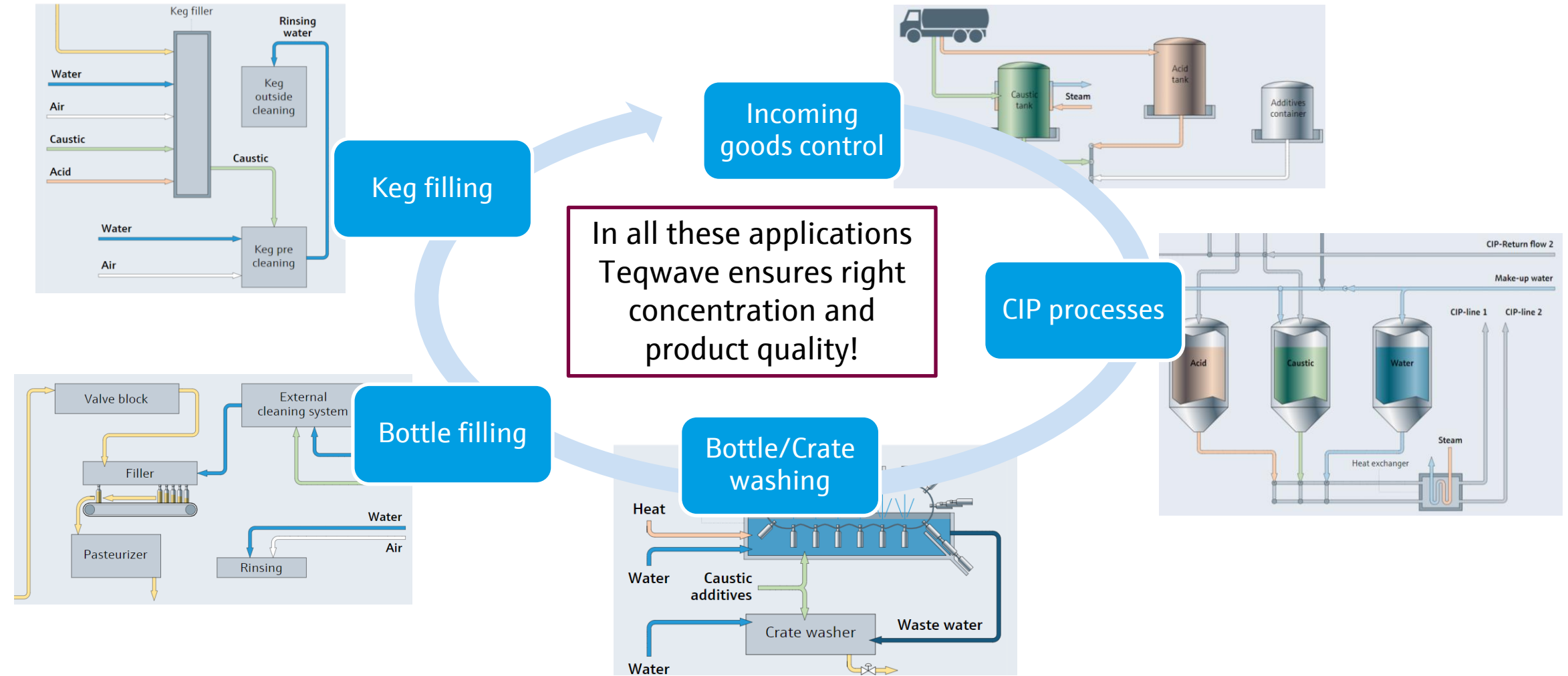
- Alcohol concentration 10 % vol to 99 % vol
- Sugar concentration in alcohol beverages
- Invert sugar concentration in alcoholic beverages



Soft drinks and fruit juices

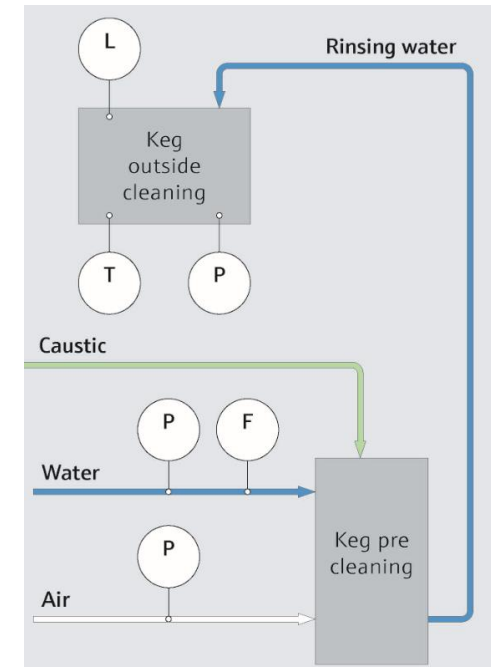
- Sugar concentration 0% inversion (saccharose)
- Sugar concentration 100% inversion (glucose, fructose)
- Sugar concentration according to ICUMSA
- Degree of sugar inversion in syrup

Cleaning & disinfection applications in F&B



Disinfection with hydrogen peroxide

- **Precondition:** Hydrogen peroxide is used in nearly every F&B plant to disinfect.
→ Monitoring of hydrogen peroxide concentration is very important to guarantee food safety
- **Challenge:** Supplier specific detergents. Beside hydrogen peroxide, these contain a lot of other ingredients → preinstalled algorithms of pure hydrogen peroxide concentration do not fit to such supplier specific mixtures. Before Teqwave, the concentration curves had to be figured out and implemented supplier specific with a lot of workload.
- **Solution:** With Teqwave one can order the concentration curves for supplier specific detergents and disinfects.
→ This highly eases our customers the measurement device installation process
→ Changing liquid supplier while using Teqwave can be done easily
- **USP: Preinstalled supplier specific concentration algorithms are unique in the market**



Application packages for analysis parameters



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Focus application: Alcohol concentration in liquors with or without sugar

- **Precondition:** Many spirits contain alcohol and sugar/invert sugar. International spirits regulations allow up to 4%mas of sugar/invert.
- **Challenge:** Even small amounts of sugar change speed of sound and density of the liquids. This leads to substantial errors of the alcohol concentration measurement, when not compensating.
- **Solution:** Teqwave comes with preinstalled concentration algorithms for alcohol in combination with saccharose or invert sugar. This enables the simultaneous concentration measurement of sugar and alcohol in liquors. The possibility of acid compensation additionally increases the accuracy.
- **USP:** - The implemented automatic compensation values for different liquids are unique in the market.
- Teqwave enables sugar compensation during alcohol measurement or measurement of both parameters in combination and therefore helps to ensure great product quality.



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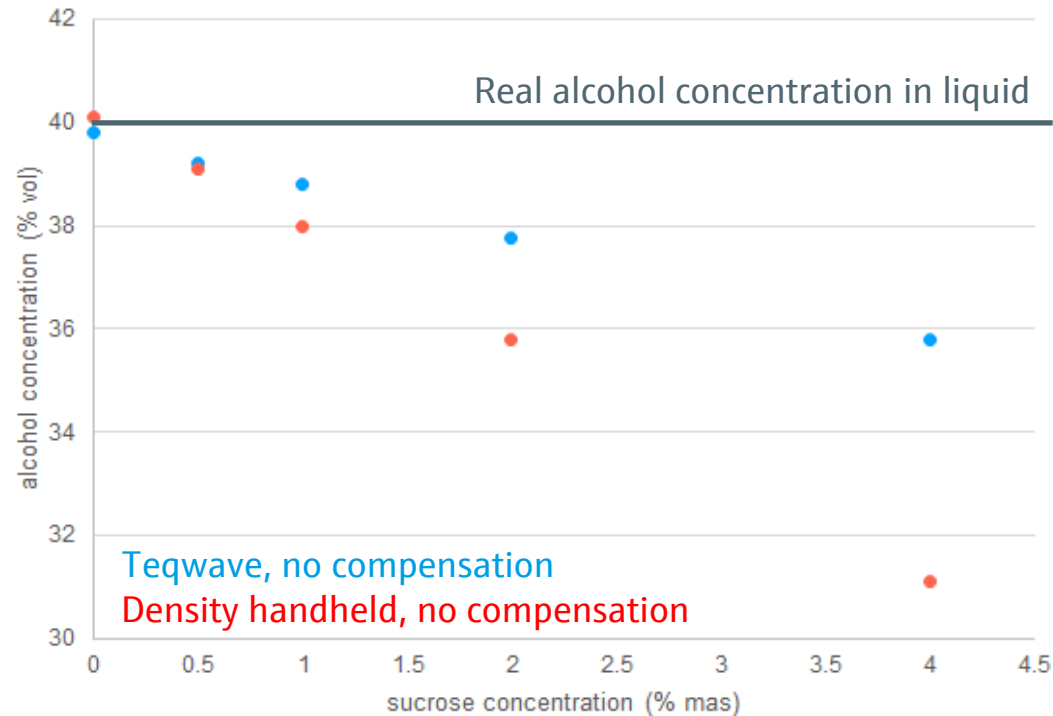
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Alcohol concentration error: no compensation of sugar



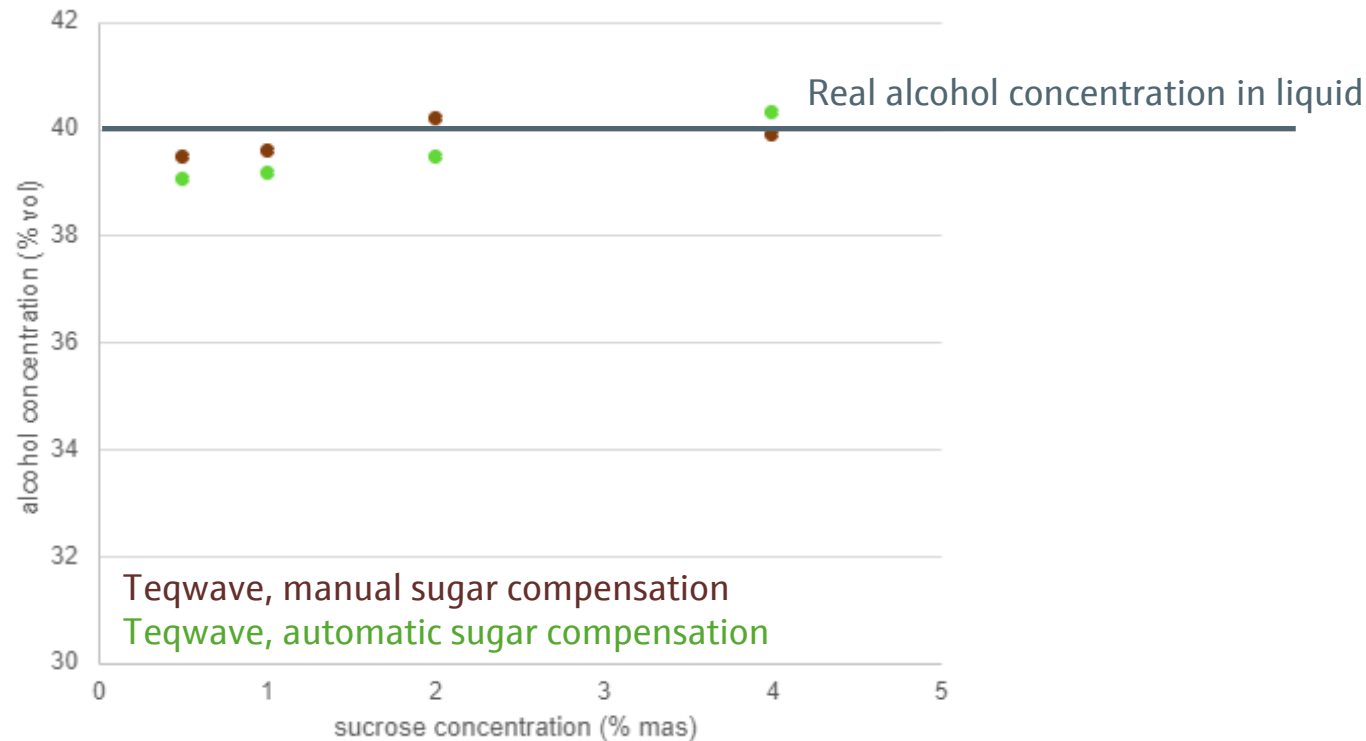
Test conditions

- Prepared solution: alcohol content 40 % vol without any sugar
- Addition of sucrose (0,5 – 4 % mas)
- 20 °C liquid and ambient temperature
- Measurement with Teqwave and competition handheld density meter

Result

- Not compensating sugar content leads to tremendous measuring errors of alcohol concentration
- Not compensating sugar content with density meter worse than with speed of sound meter/Teqwave

Benefits of Teqwave's compensation features



Test conditions

- Prepared solution: alcohol content 40 % vol without any sugar
- Addition of sucrose (0,5 – 4 % mas)
- 20 °C liquid and ambient temperature
- Measurement with Teqwave

Results

- Teqwave's automatic sugar compensation leads to very good alcohol concentration measurement
- Understandably manual compensation with highly exact knowledge of sugar amount leads to best performance

Summary: advantages Teqwave in distilleries

- Plug&play with no adjustment for highest accuracy

Compensation of pressure, acid, mineral content and of sugar (automatic or manual) in the concentration measurement of high-alcoholic liquors

- Reliable measurement, even in demanding applications

Unique gas bubble and particle compensation always included with *Dispersion* measurement



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Sugar concentration in beverages: Focus application Teqwave

Precondition: Sugar has an important influence on taste. °Brix is the most common measurement unit. It tells the saccharose content in demineralized water, based on mass.

Challenge: Density can change, even when sugar concentration remains stable. Especially when the beverages include acids or CO₂. If these cross influences are not compensated, devices calculate the °Brix value by assuming all density changes base on sugar variations. This leads to tremendously wrong measurements and risks product quality.

Solution: Teqwave comes with preinstalled concentration algorithms for saccharose and invert sugar. In addition to that, customers can easily compensate cross influences, such as acidity, pressure, mineral content and CO₂.

USP: Automatic compensation values for different liquids. Example on the next slide.



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Example: Benefits of Teqwave compensation features

- This example is based on a typical sparkling orange lemonade sweetened with sugar (partially inverted), produced by different big beverage companies globally

Without compensation					
Degree of inversion:		50%	50%	50%	50%
Acidity			2,96 g/l	2,96 g/l	2,96 g/l
CO ₂				7 g/l	7 g/l
Pressure, abs.					5,5 bar
Result (Brix ICUMSA)	=11.06 °Brix	=9.80 °Brix	=9.65 °Brix	=8.78 °Brix	= 8.59 °Brix

- For users with highest accuracy expectations, Teqwave's sugar concentration measurement can be fine-tuned easily. Even a combination with density meters is possible.

Summary: customer benefits of Teqwave in soft drink industry

- Users save time and effort – Plug&play with no/easy adjustment

Pre-installed algorithms with unique compensation features, e.g. of CO₂, pressure, acid and degree of sugar inversion.

- Reliable measurement, even in demanding applications

Unique gas bubble and particle compensation always included with *Dispersion* measurement



Teqwave Portfolio

Concentration: up to $\pm 0.01\%$



	Teqwave F – Flange	Teqwave I – Insertion	Teqwave T - Transportable	Teqwave H – Hygienic
Diameter	DN 8/15/25; 3/8 to 1"	180/500 mm ; 7.08/19.785"	180mm	DN 25; 1"
Process connection	Flange/Thread	Flange/Thread	–	Flange/Thread/Clamp
Material	Stainless Steel 316Ti or 316L	Stainless Steel 316Ti or 316L	Stainless Steel 316Ti or 316L	Stainless Steel 316L
Process temperature	0...100 °C / 32...212 °F	0...100 °C / 32...212 °F	0...100 °C	0...120 °C / 32...248 °F
Ambient temperature	0...50 °C / 32...122 °F	0...50 °C / 32...122 °F	0...50 °C	0...60 °C / 32...140 °F
Process pressure	16 bar / 232 psi	16 bar / 232 psi	16 bar / 232 psi	16 bar / 232 psi
Protection class	IP66/68	IP66/68	IP66/68	IP67/69
Output signals	4...20mA + Modbus TCP	4...20mA + Modbus TCP	Internal Memory	4...20mA + Modbus TCP

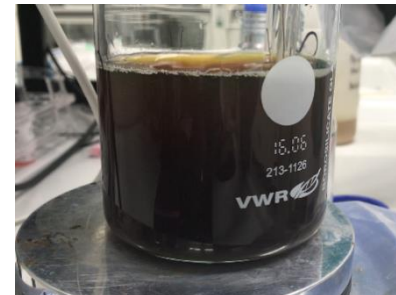
Further Applications of Teqwave

- Leakage detection
- Filter damage detection
- Glycol concentration in cooling circuits
- Polymer concentration

Retentat
(before filter)



Permeat
(after filter)



References/Case Studies

Products Solutions Services

Continuous Brix measurement of soft drinks

Teqwave H replaces manual refractometer measurement at Kreuzberg Quelle



Kreuzberg Quelle Ackermann has been producing over 20 different non-alcoholic beverages since 1971. These include a variety of sodas, tea beverages, fruit juices, mineral waters and spritzers, all produced with water sourced from the Kreuzbergquelle. The soft drink producer, headquartered in Hallertendorf in Germany's Upper Franconia region, is also active as a contract bottling company.

"Teqwave H from Endress+Hauser is a major relief to us with its continuous and automatic monitoring of the sugar concentration. During filling, for example, it is now no longer necessary to carry out time-consuming manual measurements using the refractometer. I am very satisfied with the device and appreciate the accuracy and reliability of the concentration measurement."

Jürgen Ackermann
Managing Director
Kreuzberg Quelle Ackermann GmbH

Continuous Brix measurement of soft drinks
Teqwave H replaces manual refractometer measurement at Kreuzberg Quelle

Jürgen Ackermann, Managing Director

Teqwave H monitors sugar concentration directly in the filling process

Kreuzberg Quelle Ackermann wanted to automate the monitoring of the sugar/invert sugar content during the soft drink filling process and was therefore looking for an inline measuring device. Endress+Hauser offers the ideal solution with the Teqwave H concentration meter. Its state-of-the-art calculation methods enable compensation for cross-influences on a product-specific basis. This makes it possible to determine the sugar content of a wide variety of non-alcoholic beverages very accurately in the process.

The customer requirement When manufacturing soft drinks, monitoring the sugar concentration plays a major role in ensuring consistent product quality. Kreuzberg Quelle had previously used a handheld refractometer for monitoring the Brix content of soft drinks during the filling process. The sampling and manual measurement, necessary for each batch, were very time-consuming. Moreover, this monitoring method meant that potential product fluctuations could not be discovered until late in the process. Therefore, Kreuzberg Quelle was looking for a concentration meter that monitors the Brix content continuously and reliably during the filling process – even for challenging soft drinks with CO₂ and higher acid contents. Another goal was to eliminate the effect of cross-influences to increase the reproducibility and accuracy of the measured values. To reduce the manual work steps and, as a result, make the work sequence more efficient, Kreuzberg Quelle wanted to have the ability to monitor the measured values from various workstations.

Our solution With Teqwave H, Endress+Hauser offers an EHEDG- and JA-certified concentration meter that continuously measures the sugar content in various soft drinks in real time. It can also be used to compensate for existing cross-influences such as acid or CO₂ in the beverage as well as the process pressure and thus further

Sugar/°Brix concentration measurement

Products Solutions Services

Waldbrand Distillery monitors alcohol concentration using Teqwave

Simplified quality control in distilleries



Waldbrand GmbH, based in Wald in Bavaria, Germany, is a producer of high-quality distilled beverages.

"Teqwave enables us to measure the alcohol content of our products accurately and reliably. We are very satisfied with the measuring system. In particular, we appreciate the simple operation, automatic measurement of the actual alcohol content and convenient cleaning."

Ms. Carina Kain
Distiller
Waldbrand GmbH

Team - Waldbrand GmbH

Waldbrand Distillery now uses Teqwave from Endress+Hauser as a measuring device for monitoring alcohol concentration that can compensate for cross-influences from sugar or mineral content, enabling automatic measurement of the actual alcohol content. This device also meets the requirement of being adaptable to beverage-specific properties. This makes it possible to continuously determine the alcohol content of distilled beverages accurately, even in the presence of sugar/invert sugar, acids, etc.

The customer requirement One of the core tasks in quality management of distilled beverages is determining their alcohol concentration before bottling to ensure consistently high product quality. Waldbrand GmbH had previously done this using a manual measuring procedure that required extensive manual calculations to correct the

wrong alcohol concentration measurements due to errors caused by cross-influences of sugar and/or acid. This was a time-consuming and error-prone process. The challenge was to simplify the calculation of the actual alcohol concentration, which deviates from the apparent alcohol concentration in the presence of even small quantities of sugar. The manual measurement also required significant cleaning work after each measurement. This was the only way to eliminate the possible drift of measured values. Therefore, the distillery was looking for a robust measuring device that is easy to clean. For alcoholic beverages with sugar/invert sugar content, accurate and automated measurement of the actual alcohol content needed to be possible in the future as well.

Our solution Teqwave from Endress+Hauser can ensure simultaneous measurement of alcohol and sugar/invert sugar concen-

Alcohol concentration

Products Solutions Services

Optimized cleaning for maximum product quality

thyssenkrupp measures cleaner concentrations with Teqwave I



thysenkrupp Presta AG in Oberrang, Switzerland

Mario Hörler
Project Leader of Metallurgy

In its Business Area Components Technology, thyssenkrupp produces and markets high-tech components for the automotive and mechanical engineering industries around the world.

"Using Teqwave I for parts cleaning enabled me to fulfil the stringent process requirements for accuracy and safety. Endress+Hauser has totally convinced me with the function, performance and technical design of this high-precision solution."

Mario Hörler
Project Leader of Metallurgy
Tooling/Component Center
thyssenkrupp Presta AG
Oberrang, Switzerland

Teqwave I from Endress+Hauser provides thyssenkrupp Presta AG with a new reliable solution for monitoring cleaning media in its spray and flood part cleaning machines. Teqwave uses special sound waves to create an acoustic "fingerprint" of the high-quality cleaning media being used. This enables Teqwave to detect their concentration in cleaning baths continuously and with high precision.

The customer benefits

- Safeguarded process quality thanks to real-time measurement with high accuracy
- Quick reaction through immediate readjustment in case of changes in the cleaner concentration
- Simple and efficient operation of Teqwave I by thyssenkrupp employees
- Continuous measurement ensured – independent of the technical staff in charge as a given time

Seamless monitoring and documentation in real time

- Minimum risk of errors, for example, as caused by writing down measured concentration values by hand

The challenge

The concentration of the cleaning medium used to be measured once a week by a trained and qualified specialist using an elaborate titration method. This process included documenting the measured concentration values, which are crucial in maintaining the desired process stability.

Both the measurements and the documentation were very time-consuming and made intensive use of consumables. In addition, the process of reading out measured values manually during titration and documenting them proved to be very error-prone.

Factory automation, metal parts cleaning

Thank You!

Thank You!