VAISALA

The power of inline Brix for food and beverage applications

with Vaisala Polaris™ Sanitary Process Refractometer

eBook

www.vaisala.com

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> *"Accurate Brix measurement that is not affected by color, air bubbles, particles, fruit pulp, flow or pressure changes, vibration, or temperature shocks."*

> *"No laborious sampling and measurement errors. Operators can now concentrate on other important tasks."*

Why accurate Brix measurement is important for food and beverage production

The food and beverage industry produces one of the largest globally traded commodities and must address a variety of regulations, guidelines, requirements, and expectations. Inadequate process control presents a major risk to production. Even when they have adequate measures in place, food producers and processors are required to implement better and more reliable process controls to guarantee the safety and quality of their products. The major driving force behind this requirement is the constant need to improve the efficiency of processes, make more sustainable use of resources, and maximize yield while maintaining quality and eliminating costly unplanned shutdowns. Producers must also meet consumers' expectations regarding food variety, taste, appearance, and consistency.

Brix concentration measurement as a process control tool helps manufacturers to successfully perform the food and beverage production tasks mentioned above. Traditionally, this would be done by collecting samples manually and analyzing them in a laboratory. Manual sampling is a costly procedure and results in a significant delay between sampling and the availability of a result. Consequently, any measurements outside of the acceptable values are likely to have travelled throughout the process before an alarm can be raised, and this may result in significant product wastage. Unlike time-consuming and laborious sampling, which poses a risk of product contamination, inline measurement of Brix concentration allows for real-time continuous process control without compromising measurement accuracy. Moreover, automated inline measurement does not require operators to be physically present on site.

Using the Vaisala Polaris Sanitary Refractometer for inline Brix measurement enables the automation of liquid food and drinks processing, and ensures:

- Robust product quality control
- A quick response to product quality deviations
- Elimination of product contamination
- Accurate product labelling
- Optimized energy and raw-material consumption
- Improved overall production sustainability
- Higher production efficiency, capacity, and yield
- Reduced waste
- Reduced risk of product recalls, lost sales, and legal expenses
- Products conform to consumer expectations in terms of appearance, mouthfeel, and taste

Vaisala Polaris™ PR53AC Sanitary Refractometer – a state-of-the-art tool for inline Brix and concentration measurement

With over 80 years' experience in industrial, weather, and environmental measurements and over 40 years' experience in refractometer technology, Vaisala has deep knowledge of the needs and requirements of processing industries, in particular the highly regulated food and beverage industry. The Vaisala Polaris™ PR53AC Sanitary Compact Process Refractometer was designed to solve the critical challenges in food and drink production with state-of-the-art inline Brix and concentration measurement. The sanitary refractometer's technical features and unique benefits include the following:

- Built-in CORE-Optics element eliminates the risk of drift
- Completely digital Refractive Index optical image detection
- Measurement is not affected by color, air bubbles, particles, fruit pulp, flow or pressure changes, vibration, or temperature shocks
- Works over the full Refractive Index (nD) 1.32–1.53 measurement range, which corresponds to 0-100 Brix
- Withstands low and high process temperatures: compact model -40°C...150°C (-40°F...302°F), probe model 40°C...150°C (-40°F...302°F)
- Built-in temperature sensor provides fast process temperature measurement and automatic temperature compensation
- 3-A Sanitary and EHEDG certified
- Withstands CIP (clean-in-place) and SIP (sterilization-in-place) processes and other cleaning and rinsing processes
- Pre-calibrated and easy to use out of the box
- Compact size enables challenging installations
- A variety of installation options from small pipelines to large tanks and vessels without bypass arrangements
- Built-in 4 ... 20 mA and Modbus RTU outputs
- Connectivity options include mA, HART, and Modbus RTU as a standard

Image: Vaisala Polaris™ PR53AC Sanitary Compact Process Refractometer

46-04

3-A SANITARY STANDARD

The 3-A symbol guarantees that the Sanitary Refractometer's hygienic design complies with the 3-A Sanitary Standards, and conforms to the 3-A Sanitary Standard number 46-04 for refractometers used on fluid products equipment for sensing concentration.

CERTIFIED EHEDG TYPE EL CLASS I JULY 2020

EUROPEAN HYGIENIC ENGINEERING & DESIGN GROUP

EHEDG certification authorizes the compliance of the Sanitary Refractometer with the EHEDG hygienic design criteria according to EL Class I for closed equipment, wet cleaned-in-place (CIP) without dismantling.

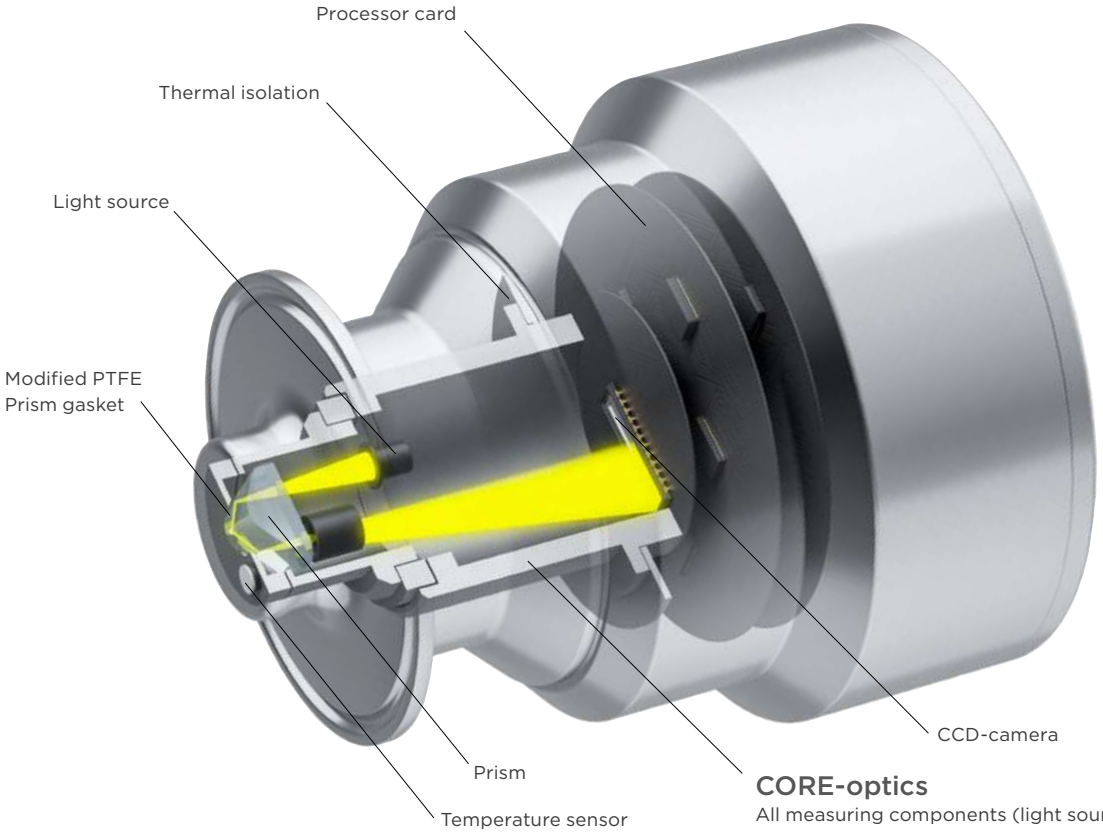
How does the system work?

The Vaisala Polaris™ PR53AC Sanitary Compact Process Refractometer is designed to measure liquid concentrations, such as Brix, inline. Measurements can also be shown in total solids, Oechsle, Baume, or Plato. Other measurement units include concentration of sucrose, gelatin, lactulose, and hydrogen peroxide.

The refractometer can be interfaced directly, or it can be connected to a Vaisala Indigo520 transmitter. It has a measurement range of 0 to 100 Brix and built-in 4 … 20 mA and Modbus RTU outputs.

The product design welcomes both cleaning-in-place (CIP) and sterilization-in-place (SIP) systems. Stainless-steel wetted parts, PTFE and sapphire, are suitable for direct contact with the process, and traceability ensures safety.

Most applications do not need wash systems due to the self-cleaning effect: the shear force of the process flow keeps the measurement point clean. For the most demanding applications, the powerful wash system ensures correct measurement when process conditions are sticky.



CORE-optics

All measuring components (light source, prism, temperature sensor, and CCD-camera) are in one solid CORE-optics module.

The CORE-optics is mechanically isolated from the influence of external forces and vibrations. The CORE-optics requires no mechanical adjustments.

Figure 1. Vaisala Polaris™ PR53AC Sanitary Compact Process Refractometer design

Optical window to the process

Once installed inline, the Vaisala Polaris™ Sanitary Process Refractometer provides remote access and an overview of the process. Equipped with Vaisala Indigo520 transmitter, it provides access to features such as data storage, graphical interface, and analog and digital interface. The Indigo520 transmitter is required when the application or the installation position requires washing, to control the process. Changing settings, measurement parameters, or other servicing updates can be done directly from the Indigo520, or through a USB cable using Vaisala software.

The diagnostics display on Indigo520 transmitter shows the optical image graph. Together with the raw measurement data and diagnostic values, these provide a clear picture of the process. For instance, the display shows when the process pipe is empty. This function allows for easy remote process diagnostics.

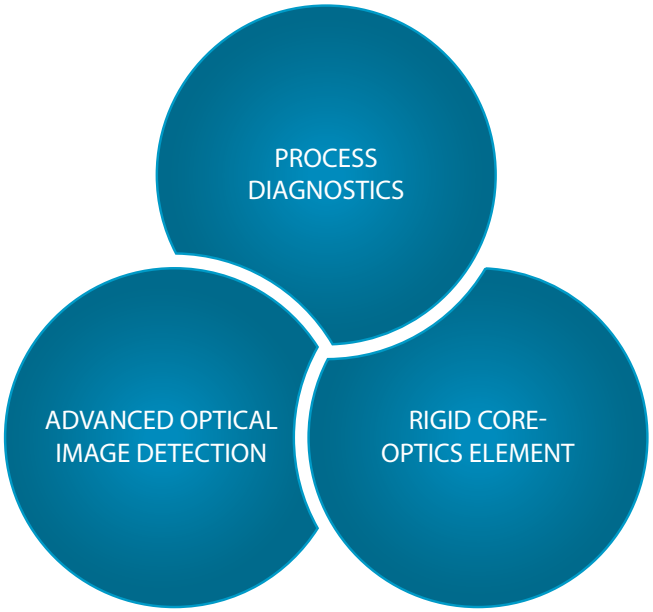


Figure 2. Distinctive features of the Vaisala Polaris™ Process Refractometer

Figure 3. Vaisala Indigo520 provides diagnostics view, access to features such as data storage, change of settings and measurement parameters.

Examples of food and beverage applications optimized with inline Brix measurement

In this chapter, we provide examples of liquid food and drinks applications where real-time inline measurement of Brix, total solids (TS), Plato, Oechsle, Baume, or total density using the Vaisala Polaris™ Sanitary Process Refractometer can help food and drink producers to improve product quality control, recipe management, process data recording, productivity, and efficiency, and realize cost savings.

Click on the applications below to learn more:

These are just some examples of our refractometer applications – there are hundreds more! Contact our application experts to discuss your measurement needs.

Can't find your application?
Contact our application experts!

Dairy and infant formula

Producers in the dairy processing industry must comply with stringent food safety and quality regulations. Inline total solids or Brix measurement with the Vaisala Polaris™ Sanitary Process Refractometer helps to ensure that products are of the highest quality and in compliance with legal milk composition standards. It also enables accurate automated ingredient dosing, optimizes performance at every stage of the process, and helps to reduce energy consumption and operating costs.

Powdered infant formula

Powdered infant formula, or baby milk, is most commonly produced using a wet-mixing process. Vaisala Polaris™ Sanitary Process Refractometer can be calibrated to measure Brix or total solids (TS) to ensure correct inline dosing of ingredients at the hydration tank, to monitor the liquid concentration, to optimize spray-dryer performance, and to enable continuous product quality control as well evaporation performance control.

Powdered milk and sweetened and unsweetened condensed milk

Powdered milk and sweetened and unsweetened condensed milk (evaporated milk) are produced using a process of evaporation. The sanitary refractometer enables better control and monitoring of the milk evaporation process with accurate, real-time total solids measurement. The refractometer measurements ensure that the milk is produced according to the applicable legal standards, product quality and safety requirements are met, and drying operations are optimized to produce a product with a long shelf life.

Whey protein and lactose

Whey protein and lactose are commonly preserved as powder. Whey protein concentrate (WPC) and lactose are produced by ultrafiltration and concentrated by evaporation. The sanitary refractometer can be used to control the feed product concentration and the concentration levels after ultrafiltration and at the evaporator inlet in order to ensure the correct product concentration is fed to the spray dryer or crystallizer, as well as to monitor the lactose solution supersaturation and the seeding point.

Dairy yogurts and desserts

Dairy yogurts and desserts are produced through the lactic fermentation of whole, standardized, and skimmed milks. The sanitary refractometer is used to measure the Brix concentration of flavored yogurt for final quality control purposes before the product passes to the filling machines and is packed. Measurement is selective to the liquid phase and is not influenced by particles, bubbles, the color of the medium, fruit chunks, seeds, or berries.

Find out more about the process optimization possibilities in dairy and infant formula production by downloading our application notes:

- Milk evaporation and drying
- Sweetened condensed milk production
- Whey separation process
- Yogurt and chilled dairy flavoring
- Infant formula production by wet-mixing process

- eBook: Inline total solids measurement for dairy fluids processing

Can't find your application?
Contact our application experts!

"We use the Vaisala process refractometer at several stages of our dairy production: at the standardization stage to check the correct total solids are achieved, after evaporation to control milk concentration levels, in evaporators to monitor sugar syrup addition when making condensed milk, and finally to monitor the feed product concentration to the spray dryer. The refractometer measurement is not disturbed by turbulent flow or air bubbles in the milk at all!"

- Dairy product manufacturer, USA.

"Previously, we produced approximately one million liters of waste product per year during product changeover on filling lines. Instead of measuring volumetric flow and turbidity, we installed a TS meter on the filling lines and were able to cut our 15-minute product changeover time to the legal minimum of 5 minutes, reducing waste by two thirds."

– Dairy, Europe.

"We are using TS measurement for feed forward control in ingredient dosing. The refractometer has been installed in our 2.5-inch pipe and it provides a stable measurement for automated process control of the baby milk processing line."

- Infant formula plant, Indonesia.

Fruit and vegetable processing

The goal of fruit and vegetable processing is to manufacture high-quality products that are safe for consumption, taste good, look appealing, and have a long shelf life.

Jams, jellies, and marmalades

Food preserves such as jams, jellies, and marmalades are produced by cooking. Installed directly in the cooking pan, the Vaisala process refractometer provides continuous monitoring of the cooking process and the final product quality. The sanitary refractometer has a measurement range of 0–100 Brix, is not affected by fruit seeds and pulp, withstands high process temperatures (up to 150°C/300°F), and is suitable for installations with mixers. Inline Brix concentration measurement eliminates the need for batch sampling and off-line analyzing, improves product consistency, and optimizes sugar usage.

Tomato concentrate, puree, and paste

Tomato concentrate, puree, and paste are produced by a process of evaporation. The sanitary refractometer provides continuous concentration information to optimize evaporator performance while reducing energy consumption. Brix measurement is also used for tomato pulp standardization control.

Tomato ketchup and tomato sauces

Tomato ketchup and tomato sauces are commonly produced by diluting tomato concentrate with water to a desired Brix concentration and then adding sugar, salt, and preservatives. The sanitary refractometer's inline Brix measurement is used for continuous product quality control in all stages of the tomato paste preparation process: at the ingredient-mixing stage, after the sterilization and de-aeration processes before the product is stored in the holding tank, and on the filling line before bottling. The sanitary refractometer withstands CIP and SIP cleaning processes.

Find out more about the optimization possibilities in fruit and vegetable processing by downloading our application notes:

- Jam cooking
- Tomato paste evaporation process
- Tomato ketchup and sauces preparation

Can't find your application?
Contact our application experts!

"Installation of the inline refractometer directly in the open cooking pan allowed us to continuously monitor the Brix concentration and ensure it remained within the desired limits for our reduced-sugar and standard product types. Moreover, we started collecting the measurement data records, which significantly improved the manufacturing process and use of raw materials. Also, we eliminated the need for off-line sampling at the cooking and packaging stages."

- Jam producer, Germany.

Fish and meat products

Fish and meat processing often requires the preparation of brines that are used to treat and season the products and to enhance tenderness and flavor with the addition of condiments or herbs. The Vaisala process refractometer can be used to ensure brines are prepared at a consistent concentration and to ensure the desired product quality. Continuous monitoring with inline measurement ensures efficient use of raw materials and allows for automated control of the brine preparation process. The sanitary refractometer provides continuous monitoring and control of percentage by weight of salts (sodium chloride, dipotassium phosphate, or calcium chloride) in the brine.

The sanitary refractometer's inline Brix measurement is used to monitor the sodium hydroxide content in the caustic solution preparation stage when making synthetic sausage skins. The continuous real-time information provided by the sanitary refractometer helps to maintain the target concentration of the solution and eliminates the need for manual sampling and testing.

"We were looking for a solution to lower the freezing point of brine in the production of seafood preserves. For this, we had to find a way to increase the salt concentration in the brine – hydrometer technology was not suitable as it was highly inaccurate. After we installed the inline refractometer, we were able to keep the brine solution at the eutectic point. This allowed us to achieve the freezing point faster and we had no frozen pipes and pumps anymore!"

– Customer, USA.

Find out more about the optimization possibilities in sausage production by downloading our application notes:

- Inline brine concentration measurement in co-extruded synthetic sausage production
- Inline caustic solution monitoring in cellulose sausage skins production

Can't find your application?
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"We treat co-extruded sausage casing with dipotassium phosphate to control the moisture, which directly affects the color and texture of the final product. Too much moisture in the casing makes the sausage too dark and the texture too chewy, while too little means the sausage will be too light and the texture too soft. The Vaisala process refractometer helps to keep the moisture at the specified level, ensuring a standardized end product."

- Sausage producer, USA.

Egg products

Egg products such as egg white, egg yolk, whole eggs, and egg powder are produced by a process of separation and by adding additives, typically sugar or salt. Special attention is paid to hygiene control at every production stage to avoid product contamination. The Vaisala process refractometer is used for real-time product quality control, in particular at the ingredients-mixing stage and the final product-mixing stage prior to packaging. The sanitary refractometer's inline Brix measurement replaces periodic sampling of the water-to-dry-solids interface, helping to increase production yield and significantly reducing waste.

Find out more about the optimization possibilities in egg separation processes by downloading our application note:

Egg separation process

Can't find your application?
Contact our application experts!

"We use the inline refractometer for control of dry solids in liquid egg processing. The measurement helps us to adjust the dry solids in standardized egg yolk and whole egg by adding the necessary amount of egg white. The inline refractometer replaced manual sampling, improved the process efficiency, and gave us better control over product quality. All in all, we utilize the inline refractometer measurement in blending, standardizing, breaker yield monitoring, automated control over water push, and waste-stream monitoring."

-Customer, USA.

Fats and oils

Margarine and spreads

Margarine and spreads include popular butter substitutes used as a spread or as a cooking ingredient. The Vaisala process refractometer can be used in the fat blending phase before the emulsification stage to maintain the correct fat and oil ratio, which is critical to the performance of the final product.

Soybean oil

Soybean oil is used as a cooking oil for food or as a feedstock for biodiesel production. The sanitary refractometer can be used to optimize the efficiency of the extraction process and control the crude oil refining stage with concentration measurement of caustic soda to ensure an efficient neutralization process.

The sanitary refractometer brings the following benefits in these applications:

- Real-time product quality monitoring
- Improved production efficiency
- No need for manual sampling and laboratory testing
- Increased yield
- Reduced batch time

Find out more about the optimization possibilities in fat and oil processing by downloading our application notes:

- Margarine and spreads production
- Soybean oil production

Can't find your application?
Contact our application experts!

Food ingredients, additives, and flavors

Food ingredients and additives are widely used alone or as part of another product. For example, pectin powder is used for gelling purposes, and yeast is used for baking or as a flavoring and seasoning component, as well as an ingredient in cosmetics.

Pectin powder and yeast

Pectin powder and yeast are commonly extracted from natural resources using a solvent. The Vaisala process refractometer is used to detect the amount of extracted substance (dissolved solids) in the liquid after the extraction process. The measurement is not affected by undissolved solids, only by the dissolved matter, making it ideal for monitoring extraction efficiency. Inline measurement by the refractometer enables adjustments to be made in real time, which increases productivity and reduces costs. The sanitary refractometer can also be used in yeast fermentation to monitor the amount of sugar added to the yeast strain and to ensure removal of the residual sugar after fermentation. In the concentration stage, inline measurement using the sanitary refractometer helps to optimize energy consumption.

Monosodium glutamate

Monosodium glutamate (MSG) is widely used as a flavor enhancer in foods such as sauces, salad dressings, snacks, and seasoning mixtures. The sanitary refractometer can be used to measure the total density at the crystallization step of the MSG production process to ensure evaporation efficiency, which in turn ensures that the target concentration is achieved, energy consumption is reduced, and overall process consistency is maintained.

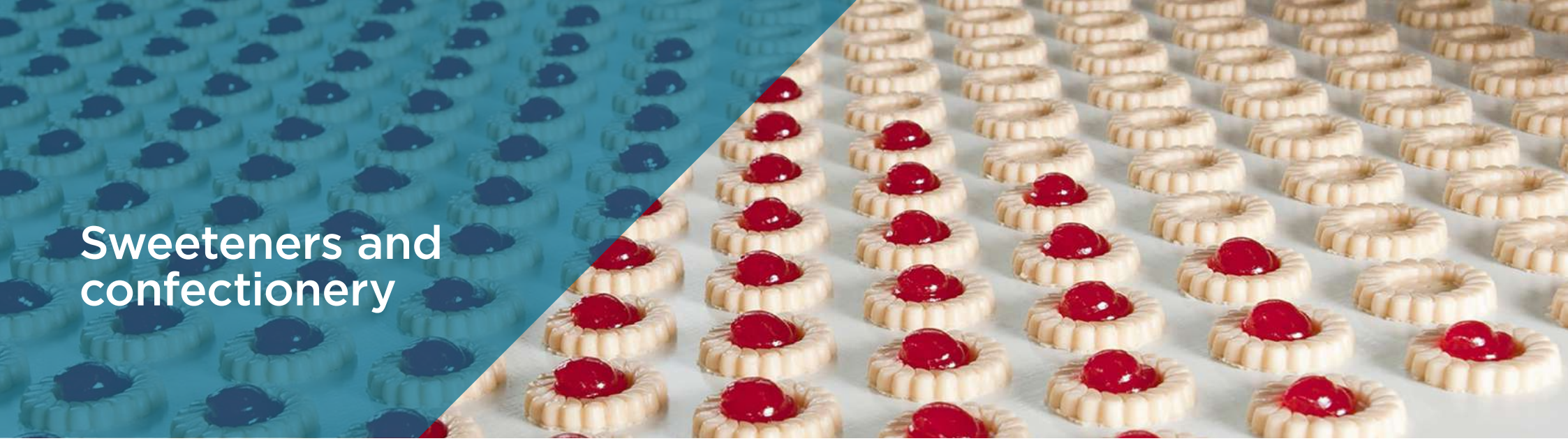
Find out more about the optimization possibilities in food-ingredient production by downloading our application notes:

- Pectin extraction and evaporation control
- Yeast extraction
- Monosodium glutamate crystallization

Can't find your application?
Contact our application experts!

"We produce extracts from spices and plants for use as food ingredients, among other things. The Vaisala process refractometer helps us to ensure that the product reaches the desired concentration after evaporation. We also use the measurement for inline control of recovered alcohol concentration."

- Natural extracts producer, Italy.



Sweeteners and confectionery

There is a wide variety of confectionery products, desserts, and sweeteners on the market. Popular products such as donuts and chewing gum have a sugar coating, chocolate-flavored foodstuffs contain cocoa, and candy takes various forms and can be filled with caramel or chocolate. Accurate Brix measurement is required to ensure the quality, texture, and consistency of these ingredients as they have a significant impact on both consumer satisfaction and product shelf life.

Sugar syrup

Sugar syrup is commonly used in beverage, confectionery, and canned products. Sugar confections and fillings such as chocolate require the sugar content to be concentrated to a high level by cooking and to evaporate the water. This is typically done in a closed vessel and in vacuum conditions to reduce the energy consumption. The inline Vaisala process refractometer can continuously monitor the Brix level of the cooked solution to determine in real time when cooking should be stopped. This eliminates the need to disrupt the vacuum for sampling.

Sugar confections and chocolate fillings

Sugar confections and chocolate fillings are produced by mixing ingredients and concentrating the sugar content by cooking and evaporating the water. The sanitary refractometer can be used to continuously measure the Brix level of the cooking solution.

Honey

Honey products such as liquid honey, cut comb, and creamed honey are produced using a filtration and heating process. In honey processing, it is important to monitor the moisture content as too-low concentrations can cause undesired crystallization, while too-high concentrations can trigger fermentation of the sugar-tolerant yeast. The sanitary refractometer can provide real-time measurement of the concentration of honey to ensure the moisture content is kept at a safe level.

Cocoa

Cocoa is the main ingredient in chocolate-flavored confectionery, baked goods, sweets, ice creams, and drinks. Cocoa powder can be natural or dutched. The latter is produced in a dutching, or alkalization, process. The sanitary refractometer can be used to measure the concentration of the alkalizing agent in the aqueous solution, usually potassium hydroxide, potassium carbonate, sodium hydroxide, sodium carbonate, sodium bicarbonate, ammonium bicarbonate, ammonium hydroxide, or some combination of these. The alkali must remain at a specific concentration in order to give the cocoa powder the desired properties.

The sanitary refractometer brings the following benefits in these applications:

- Compliance with product specifications and food safety regulations
- Consistent final product quality
- Stable real-time measurement not affected by air bubbles in mixed sugar solutions
- Optimized raw-material usage and processing and preparation time
- Suitable for installation in scrapers and mixers

Find out more about the optimization possibilities in sweetener and confectionery production by downloading our application notes:

- Sugar coating in bakery products
- Standardized sugar syrup preparation
- Sugar confectionery and filling cooking
- Dutched cocoa powder preparation

These are only some examples of our refractometer applications – there are hundreds more! Contact our application experts to discuss your measurement needs.

Can't find your application?
Contact our application experts!

"For a long time, we had quality differences between product batches, and relied solely on operators' expertise in defining the final cooking point of the caramel. With the Vaisala process refractometer we are able to automatically regulate the sugar syrup concentration and standardize the product quality. The measurement remains stable through the required concentration range of 65-72 Brix irrespective of pipeline vibrations."

- Caramel desserts producer, Argentina.

"We have a range of confectionery products manufactured in a batch process. The Vaisala process refractometer made the cooking process more automated and reliable due to the inline, repeatable, and accurate Brix measurement. Earlier, we relied on laboratory analysis and operators' skills and faced batch re-cooking and even product waste. With the sanitary refractometer, we no longer have these problems."

- Confectionery producer, Sweden.

"We have optimized the sugar slurries control with the inline Brix measurement from the Vaisala process refractometer. Now, we have no sugar loss and can recycle sugar water that's over 5% concentration and send the water to the waste if it is under 5%. This way our waste treatment costs are under control. Moreover, we have seen overall product quality control improve with less equipment."

- Cereals producer, USA.

Ready-made foods and desserts

Ready-made desserts such as rice pudding and dulce de leche are popular among consumers. Product homogeneity, consistency, appearance, and mouthfeel are important properties of these types of desserts, and can be ensured with the Vaisala process refractometer. For example, inline measurement of total solids with the sanitary refractometer can be used to control the cooking stage of rice pudding. Measurement stability and accuracy is not affected by rice grains in the slurry.

Find out more about the optimization possibilities in ready-made dessert production by downloading our application notes:

- Real-time control of rice cooking
- Sugar confections, e.g. dulce de leche cooking

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Can't find your application?
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"We use the Vaisala process refractometer for inline wastewater stream monitoring and control in the production of various ready-made snacks. This way we can be sure the effluent is delivered to the wastewater plant at a constant Brix level that is within regulations. The excess sugar slurry is forwarded to a controlled effluent tank."

- Ready-made desserts producer, Sweden.

"As a ready-made dairy desserts producer, we need to ensure three things: consistent product quality, product homogeneity and integrity, and efficient use of energy and human resources. For this purpose we use the Vaisala process refractometer, which can withstand CIP cleaning and provides us with reliable process and product quality control."

- Dairy desserts manufacturer, Spain.

Wine, beer, and other alcoholic beverages

The alcoholic beverages industry offers consumers a range of products that cater to different tastes. For example, there are drinks made from fermented juices, such as wines, beers, and ciders; distilled spirits like rum; and carbonated alcoholic beverages such as whisky or vodka mixed with juices or soft drinks.

Wine

Wine is prepared by fermenting grape juice, and the sugar content of the juice is important as it determines the alcohol content of the final product. With inline measurement using the Vaisala process refractometer, sugar content can be measured in °Oechsle, °Brix, or °Baumé.

Measurements from the sanitary refractometer enable continuous inline control of the sugar concentration in the grape juice, which depends on the sweetness of the grapes. Measurement performance is not affected by grape seeds or peel in the juice.

The sanitary refractometer can also be used for inline wine interface detection. Automated monitoring and control of product-to-product and clean-in-place (CIP) interfaces using the sanitary refractometer allows wines to be switched without the need for a shutdown. This way, higher productivity is achieved without compromising end-product quality.

Find out more about the optimization possibilities in wine production by downloading our application notes:

- Wine grape processing
- Wine interface detection
- Alcoholic fermentation

Beer

Beer is produced in a multi-step process. The Vaisala process refractometer can be used at different stages of the brewing process to determine the concentration of dissolved solids accurately and in real time. The sanitary refractometer takes an optical measurement of the refractive index of a solution and its output can be calibrated in Plato, Brix, Balling, gravity, or density, depending on the preference of the brewery.

Download our application note to find out more about the benefits of Vaisala Polaris™ Sanitary Process Refractometer in the various beer production stages:

- **mash tank**
- **lauter tun**
- **wort boiler**
- **hot wort from boiler to whirlpool**
- **chilled wort from heat exchanger**
- **fermentation**
- **filtering**
- **packing**
- **interface detection**

Beer brewing process

Rum

Rum is prepared by fermenting and distilling molasses and sugar cane juice. The Vaisala process refractometer can be used to measure and control the dilution operations in the pretreatment of molasses. Later, during fermentation, the sanitary refractometer can be used to determine the end point of the reaction. Finally, the sanitary refractometer can be used to monitor the concentration of low wine and raw rum to ensure only high-quality rum is sent to the maturation vats.

Download our application note to find out more about the benefits of the sanitary refractometer at the various stages of the rum distillation process:

- **molasses clarification**
- **fermentation**
- **stillhouse**
- **maturation vats**

Rum distillation process

Carbonated alcoholic drinks

Carbonated alcoholic drinks are produced by mixing flavored carbonated water with alcoholic beverages such as whiskey or vodka. The Vaisala process refractometer can be used for product identification and set-point detection, as well as for quality control monitoring, ensuring correct product and bottle combinations, and compliance with product specifications.

Download our application note to find out more about the benefits of using the sanitary refractometer in blending operations for concentration control in the pasteurizer:

Carbonated alcoholic drinks production

These are only some examples of our refractometer applications – there are hundreds more! Contact our application experts to discuss your measurement needs.

Can't find your application?
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Juice, soft drinks, bottled water, coffee, and tea

There is a wide variety of drinks available to satisfy different consumer tastes. Common tasks in drinks production include accurate ingredient dosing, compliance with product specifications, product quality control, and ensuring product safety. Inline Brix measurement using the Vaisala process refractometer helps to automate production operations and reduce the risk of costly shutdowns and undesired product variations.

Juices

Juices are preserved as concentrates to lengthen their shelf life, minimize packaging, and make transportation and handling easier. Typically, juices are concentrated by evaporation.

Find out more about the optimization possibilities in juice and soft drinks production by downloading our application notes:

- Inline juice blending
- Juice evaporation

Nectars, still drinks, and soft carbonated and non-carbonated drinks

Fruit and vegetable juice concentrates are used to produce nectars and soft carbonated and non-carbonated drinks. For this purpose, juice, water, sugar, and other ingredients are blended to achieve the desired concentration.

The Vaisala process refractometer provides stable, reliable, real-time inline Brix measurement to ensure efficient juice evaporation and control the juice blending process. In the case of filling machines running several different products, the sanitary refractometer can instantly detect product-to-product and product-to-CIP cleaning interfaces. Measurement performance is not affected by fruit pulp, color, fibers, solid particles, or air bubbles.

Find out more about the optimization possibilities in nectars, still drinks, and soft carbonated and non-carbonated drinks production by downloading our application notes:

- Soft drink mix production
- Standardized sugar syrup preparation

Low-concentration beverages

Diet soft drinks and flavored water

Diet soft drinks and flavored water are low-sugar-concentration beverages whose production requires high measurement accuracy and repeatability. Process variations are low and operating ranges are limited to 0–30 Brix and 4–30°C. The Vaisala process refractometer can be used to detect concentration variations in these types of products with good measurement accuracy and repeatability, enabling advanced process control.

“We produce a range of flavored soft drinks including flavored mineral water and diet drinks. The Vaisala process refractometer provides us with accurate and repeatable inline Brix measurements for soft drinks blending and product interface detection. We chose the digital refractometer for our production lines as it is not affected by air bubbles or liquid color.”

- Soft drinks producer, Finland.

Coffee and tea

Coffee and tea are available as instant powder for convenience. These powdered products are produced using an extraction process. The Vaisala process refractometer can be used as a reliable real-time indicator of extraction efficiency in these processes and to ensure the correct product concentration is fed to the dryer, thus optimizing the energy consumption. The sanitary refractometer can also be used to measure the concentration of the recovered coffee dust after filtration.

Find out more about the optimization possibilities in instant coffee and tea production by downloading our application notes:

- Coffee and tea extraction, evaporation, and recovery
- Tea extract reverse osmosis membrane filtration

Can't find your application?
Contact our application experts!

“Our goal was to stop losing product as a result of inefficient product-to-CIP interface control. Conductivity meters had difficulties detecting the optimum point at which product and water had to be separated. Instead, the Vaisala process refractometer showed high measurement accuracy in the range of 3–6 ºBrix. The sanitary refractometer was also an ideal solution for us because it withstands high temperatures during the CIP cleaning process.”

- Beverages producer, Spain.

“As a producer of ready-to-drink beverages from tea extract we had difficulties finding a Brix measurement device that would withstand the vibration from RO units. After we had the Vaisala process refractometer installed, we were amazed at how stable the measurement is! Prism fouling was a constant problem with other measurements. This was successfully solved with a high-pressure wash nozzle integrated into the sanitary refractometer.”

- Ready-to-drink beverages producer, USA.

Summary of typical food and beverage processes and the benefits of inline Brix measurement

In food and beverage production, changes in liquid concentration take place in many operations. Continuous inline monitoring of concentration brings benefits throughout a processing plant's operations, from product intake to product processing and wastewater treatment, substantially improving the plant's overall sustainability and resource efficiency.

In this chapter we summarize the typical operations seen in a food and beverage plant and explain how they can be optimized using inline liquid concentration measurement performed by the Vaisala process refractometer.

Image: Vaisala Polaris™ PR53AC Sanitary Compact Process Refractometer

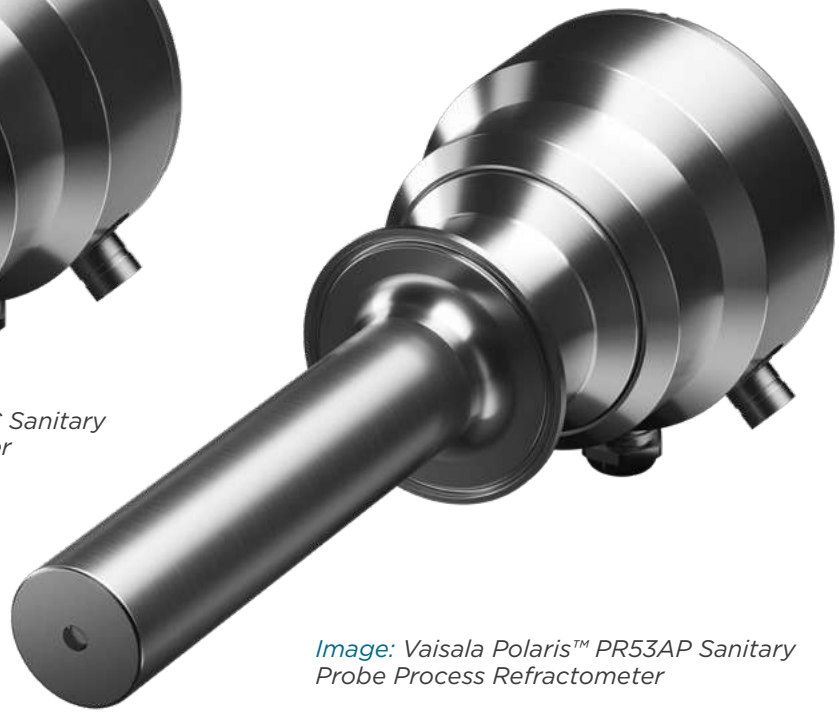


Image: Vaisala Polaris™ PR53AP Sanitary Probe Process Refractometer

Evaporation

The purpose of evaporation is to increase the solids content of food by removing water. The process destroys microorganisms, preserves the nutritional properties of the food, and prolongs the product's shelf life. Evaporation is commonly used in food, beverages, and dairy-product manufacturing processes.

In the evaporation process, inline concentration measurement is required on the evaporator outlet. The signal is then connected to the controller, which adjusts the evaporator inlet flow and thus regulates the concentration value.

The benefits of using the Vaisala process refractometer in evaporation processes are as follows:

- Optimizes evaporation performance
- Reduces energy (steam) consumption
- Ensures target concentration is achieved
- Enables real-time monitoring of evaporator efficiency

Installation points: inlet, outlet, and intermediate flows

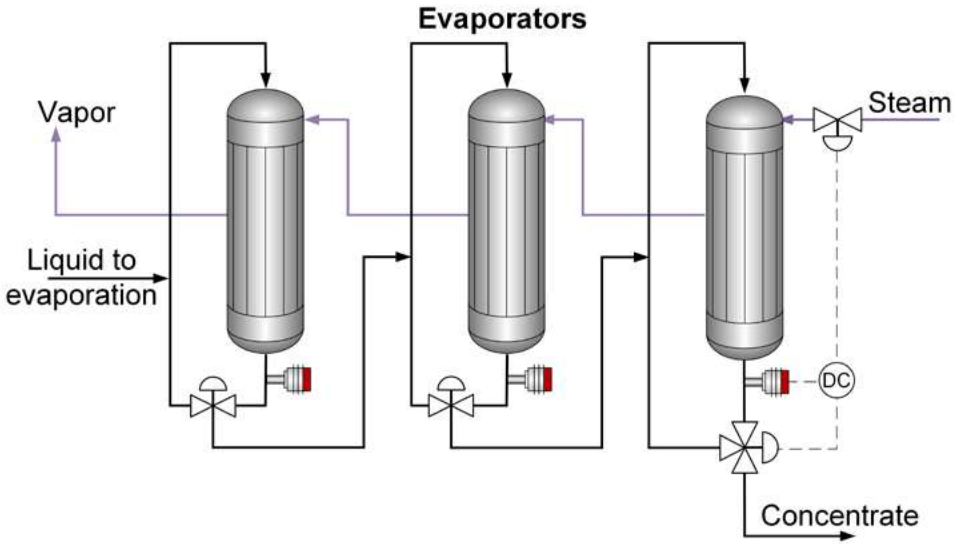


Figure 4. Evaporation control with the Vaisala process refractometer

Find out more about the benefits of using the Vaisala process refractometer in evaporation control applications by downloading our application notes:

- Juice evaporation
- Instant coffee and tea evaporation
- Milk evaporation
- Tomato paste evaporation
- Pectin evaporation

Dilution, dissolving, and blending (mixing)

Dilution or blending are used to produce drinks by mixing water, concentrated juice, alcoholic beverages, or soft drinks. For a dissolving operation, sugar, salt, or powder are required.

The Vaisala process refractometer can be used in dilution, dissolving, and blending to help achieve and maintain the desired final concentration of a liquid. Measurement performance is not affected by air bubbles in sugar solutions. Determining the inline Brix measurement using the sanitary refractometer has the following benefits:

- Prevents excess consumption of raw materials
- Ensures high and consistent product quality
- Enables automated operations
- Ensures stable measurements regardless of the presence of suspended particles

Typical installation points: product line after mixing, tank circulating line, or directly in the tank.

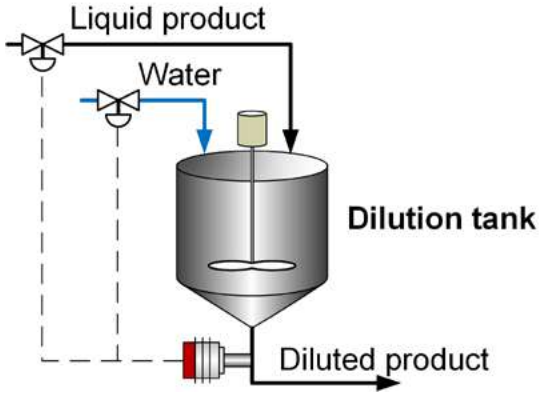


Figure 5. Dilution control with the Vaisala process refractometer

Find out more about the benefits of using the Vaisala process refractometer for inline control of dilution, dissolving, and blending operations by downloading our free application notes:

- Inline brine concentration measurement in co-extruded synthetic sausage production
- Juice, nectar, and still drinks preparation
- Standardized syrup preparation
- Quality control in carbonated soft and alcoholic drinks production

Spray drying

The importance of spray-dryer monitoring can be explained using the example of a powdered infant formula production process. In this process it is crucial to maintain the dry solids content at a specified level as a too-low solids content will result in a small particle size, poor wettability, and a shorter product shelf life. On the other hand, an excessively high dry solids content increases the viscosity of the milk, which results in larger particles and affects spray-dryer capacity.

The benefits of inline total solids measurement in this process using the Vaisala process refractometer are as follows:

- Ensures correct solids concentration to the spray dryer, resulting in the correct particle size
- Ensures efficient drying operation, resulting in smooth product packaging in correct bag size
- Ensures a completely dry product with a longer shelf life
- Reduces energy consumption
- Improves product quality

Installation point: feed to the spray dryer

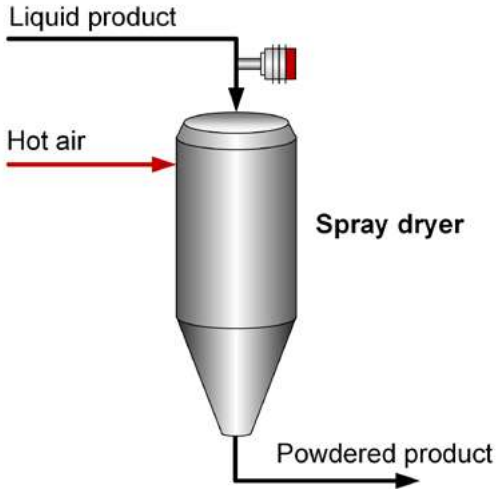


Figure 6. Inline spray-dryer monitoring with the Vaisala process refractometer

Find out more about the benefits of using the Vaisala process refractometer for spray dryer monitoring by downloading our application note:

Powdered baby milk drying.

Solid-liquid extraction

Extraction is commonly used in food and beverage applications to obtain ingredients from natural raw materials.

The Vaisala process refractometer can be used to detect the amount of extracted substance (dissolved solids) in the liquid after the extraction process. Measurement performance is not affected by undissolved solids in the liquid, making it an ideal tool for monitoring extraction efficiency. Inline measurement enables process adjustments to be made in real time in order to increase productivity and reduce costs. The sanitary refractometer can also help to ensure that the correct amount of dry solids continues to the next processing step.

Installation point: after the extractor

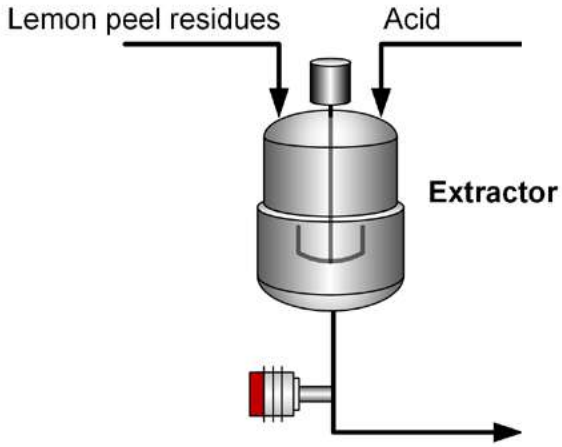


Figure 7. Extraction efficiency control with the Vaisala process refractometer

Find out more about how the Vaisala process refractometer can be used for extraction efficiency control by downloading our application notes:

- Ready-to-drink tea
- Pectin extraction

Quality control

Inline Brix measurement can be used for final product quality monitoring. As all liquids have a unique refractive index value, the Vaisala process refractometer can determine the final quality of the liquid and ensure that the product meets the required specifications. Real-time detection provides timely warnings about process disturbances and potential quality variations.

Installation point: in the blending unit

Find out more about how the Vaisala process refractometer can be used for final product quality control by downloading our application notes:

- Quality control in carbonated soft and alcoholic drinks production
- Quality control in inline juice blending
- Quality control in egg separation processes

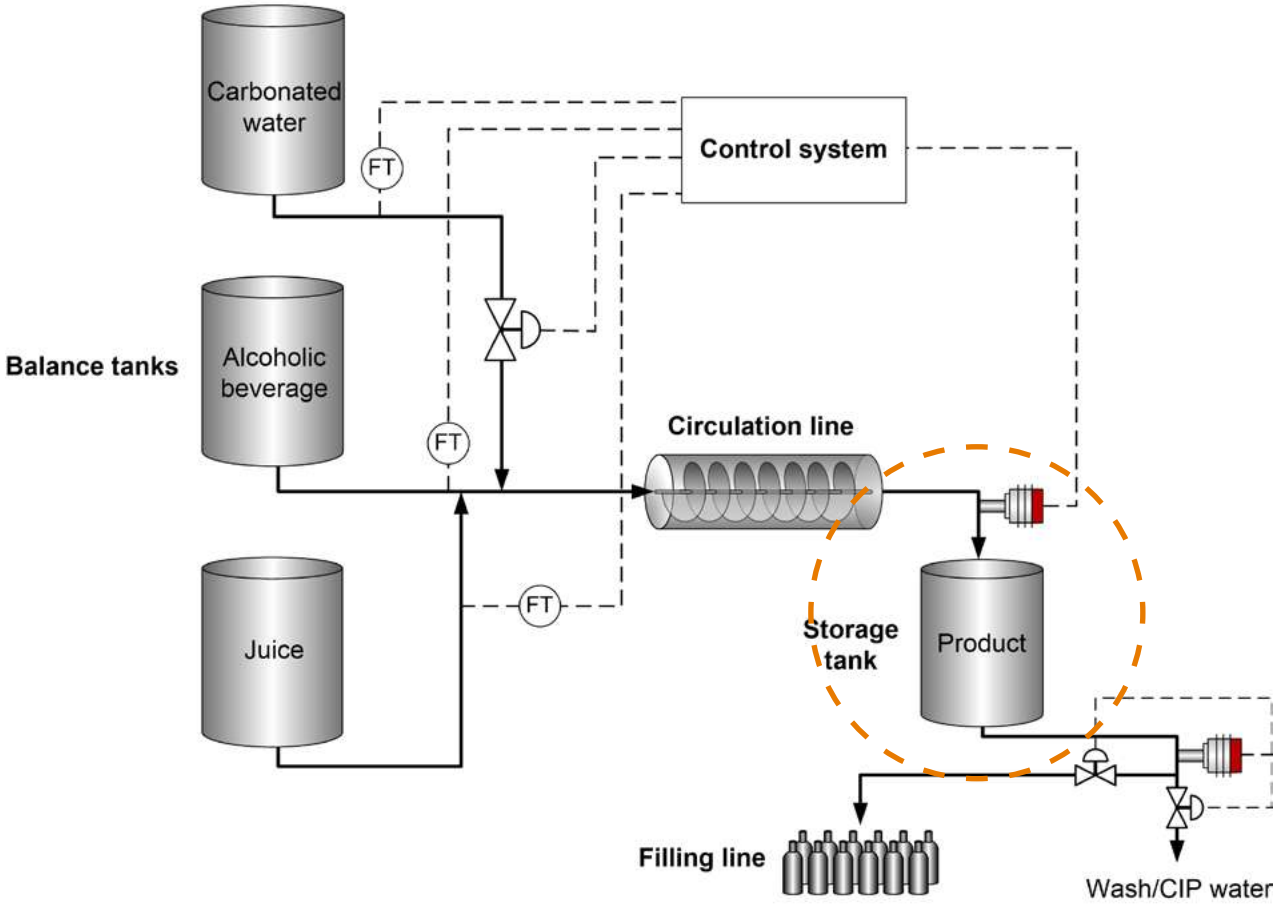


Figure 8. Quality control of final product in carbonated drinks blending process

Cooking process

Cooking is commonly used in the production of jams or sugar confections. In this process, a mixture containing sugar is cooked until the right concentration is achieved.

The Vaisala process refractometer can be used for continuous inline monitoring of the Brix concentration during batch preparation to determine the end-point and increase cooking yield and efficiency. Inline measurement eliminates the need for batch sampling and off-line analysis, improves product consistency and quality, ensures that product labelling specifications are met, and optimizes sugar usage.

Typical installation points: open boiling pan, vertical vacuum cooker, horizontal vacuum cooker, or pipe cooker

Find out more about how the Vaisala process refractometer can be used to optimize cooking processes by downloading our application notes:

- Jam cooking
- Sugar confectionery and filling cooking

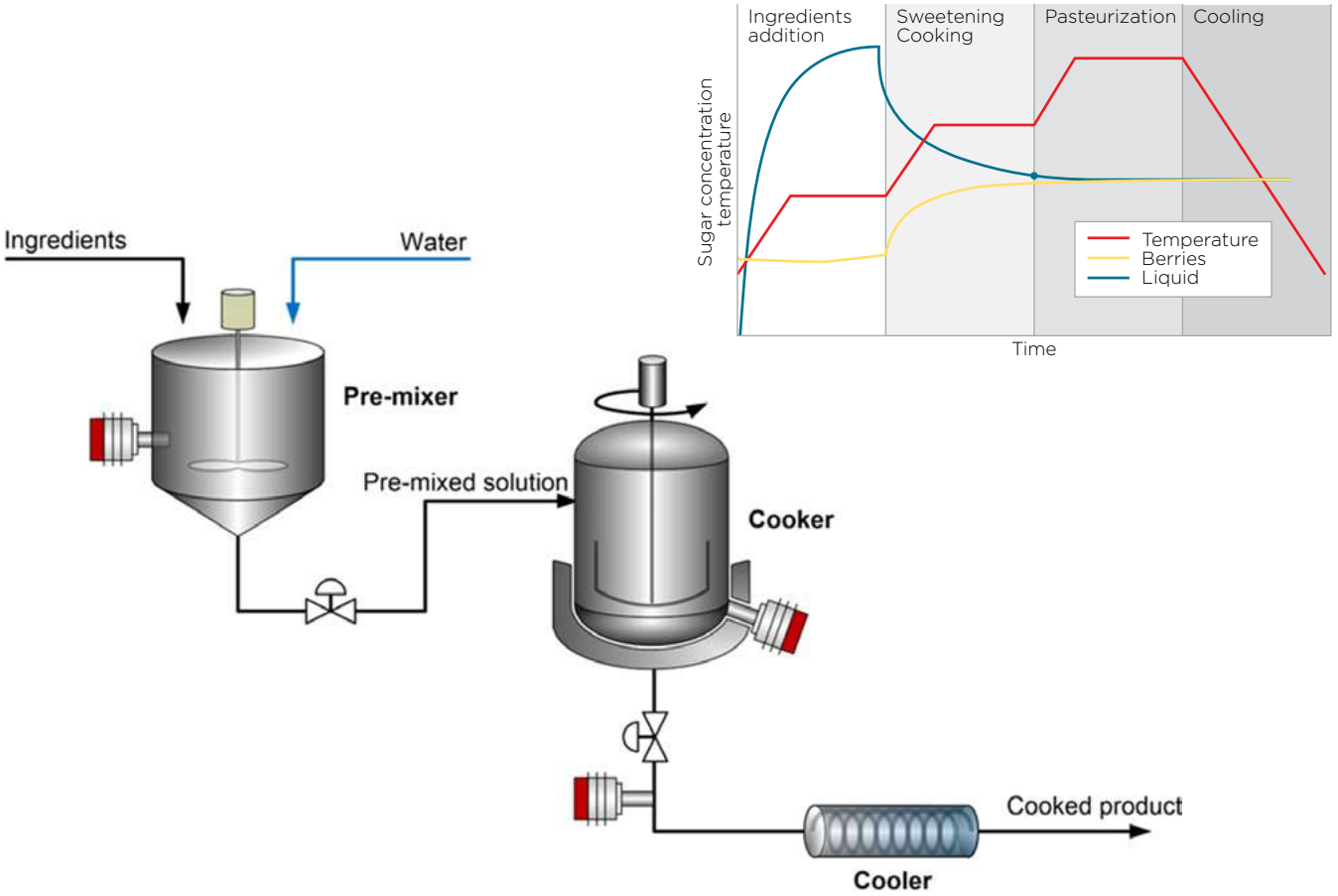


Figure 9. Inline Brix concentration measurement in jam preparation with the Vaisala process refractometer

Alcoholic fermentation

Alcoholic beverages such as wine, beer, and cider are produced through a fermentation process. The alcoholic fermentation determines the strength and quality of the final product. It is therefore very important to monitor the overall fermentation process in order to achieve the desired product quality.

The Vaisala process refractometer ensures flawless product manufacturing by monitoring the Brix content at different stages of the fermentation process. At the start of the fermentation process, the Brix content indicates the starting gravity of the feed that is fed into the fermenter. In the fermentation vessel or in the by-pass to the fermentation vessel the Brix content determines the degree of fermentation as alcohol is produced. At the final stage of the fermentation process, when installed after the fermenters, the sanitary refractometer monitors the quality of the final product in real time and helps to determine when the batch is ready as well as if the target alcohol level has been achieved.

Typical installation points: before the fermenters, in the fermentation vessel or in the by-pass to the fermentation vessel, on the bottling line

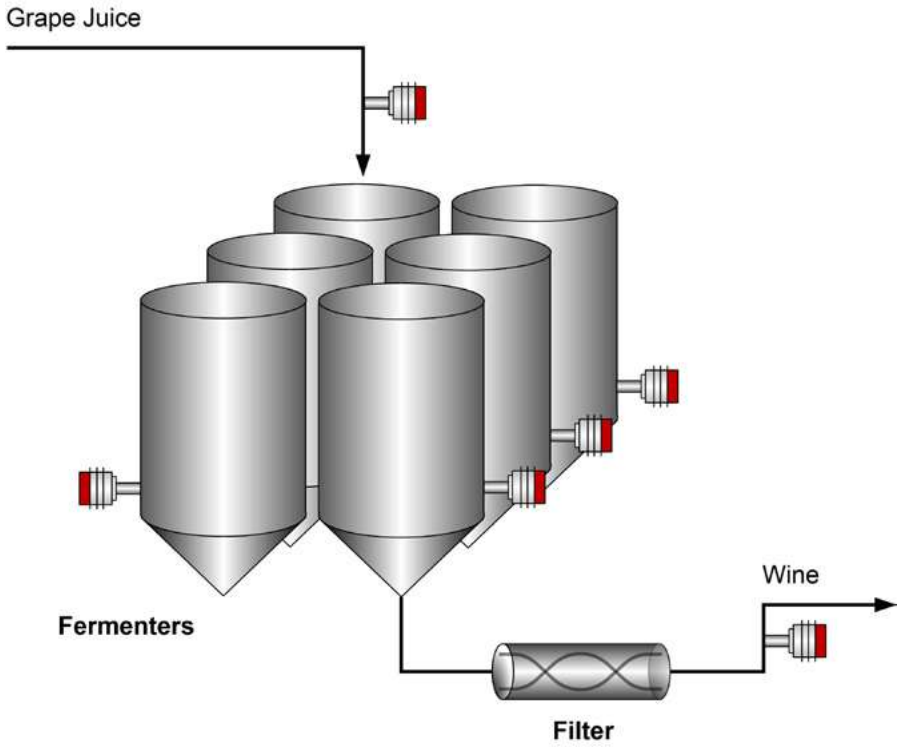


Figure 10. Alcoholic fermentation control using the Vaisala process refractometer

Find out more about how the Vaisala process refractometer can be used for alcoholic fermentation process optimization by downloading our application note:

Alcoholic fermentation

Alcohol distillation

Distillation is commonly used to purify alcoholic beverages. The process takes place in a distillation column, which separates the feed stream into two or more product streams, one of which must meet product specifications. The Vaisala process refractometer provides automatic control over the separation of the binary mixtures:

- Continuous concentration measurements of top and bottom products help to maintain optimal operation and allow for adjustment of product concentration by reflux or boilup control.
- Accurate measurements help to ensure that the product meets specifications, which translates into optimal performance and reduced costs and energy consumption.

Typical installation points: feed to distillation column, bottom product outlet

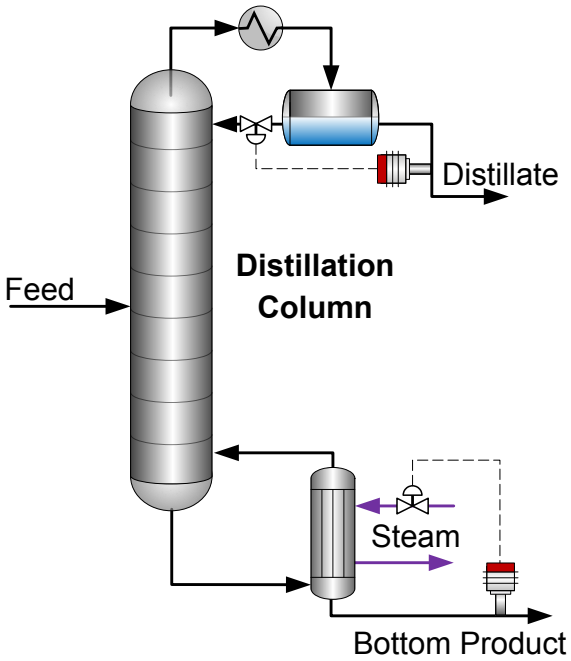


Figure 11. Distillation process control with the Vaisala process refractometer

Find out more about how the Vaisala process refractometer can be used for distillation process optimization by downloading our application note:

Rum distillation process

Product interface detection

Processing plants with multi-product lines and clean-in-place (CIP) operations require product-to-product, product-to-water, and product-to-CIP liquid identification. The Vaisala process refractometer's optical detection of the liquids' Refractive Index can be used as a "fingerprint" for interface detection. Automated monitoring and control of the CIP process allows products to be switched without the need for a shutdown, increasing productivity without compromising end-product quality.

Installation point: end of filling line (the refractometer signal is used to switch valve direction)

Find out more about how the Vaisala process refractometer can be used for interface detection by downloading our free application note:

Quality control monitoring in product and CIP liquid interface detection

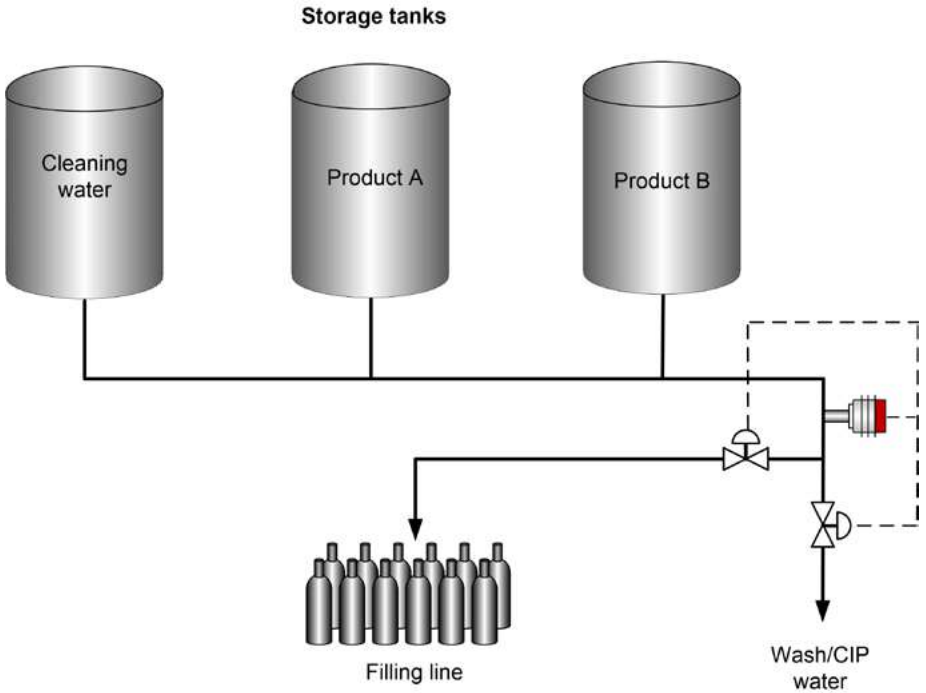


Figure 12. Interface detection and filling-line control with the Vaisala process refractometer

Organics monitoring in effluent streams

The sustainability of food, beverage, and brewing production facilities is directly related to their side-streams and wastewater treatment practices. Organic pollutants from food and beverage industries include oils and fats, alcohol, proteins, and carbohydrates. Wastewater from production must be monitored to ensure compliance with environmental regulations. Moreover, high concentrations of organic materials must be quickly detected to ensure proper operation of the water treatment system. Traditional methods of monitoring chemical oxygen demand (COD) and total organic carbon (TOC) in wastewater can be expensive to maintain and calibrate, and do not provide real-time information continuously.

The Vaisala K-PATENTS Sanitary Refractometer enables industrial food and beverage production facilities to monitor and treat their effluent streams before discharge. Inline water quality control and organics content monitoring provides fast and accurate data in real time.

Typical installation points: waste lines, recycling lines, condensates, etc.

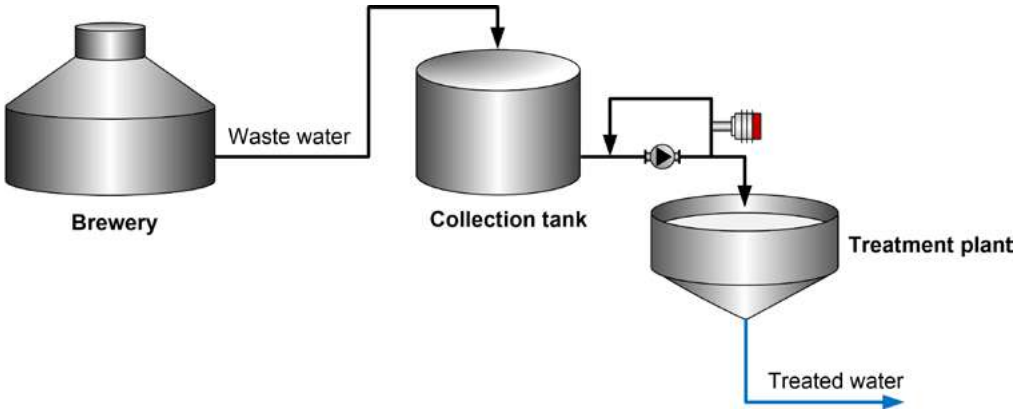


Figure 13. Organic effluent treatment monitoring with the Vaisala process refractometer

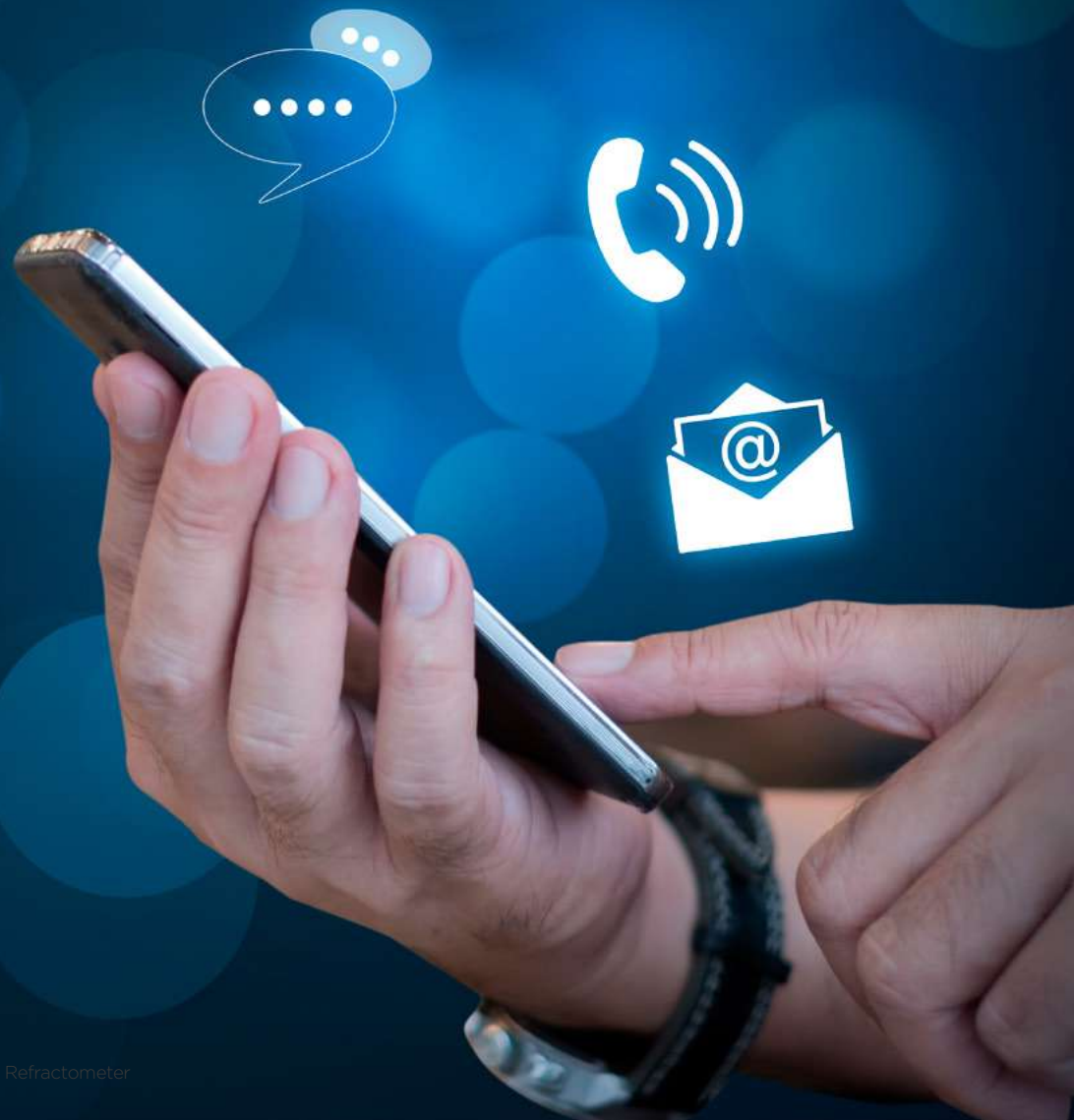
Find out more about how the Vaisala process refractometer can be used to monitor organics in food and beverage side-streams and wastewater streams by downloading our application note:

Inline total dissolved solids measurement for organics monitoring in food and beverage side-streams and wastewater streams

Get in touch

Thank you for taking the time to read this eBook. If your specific application or medium doesn't appear in this eBook, it doesn't mean it can't be measured with the Vaisala process refractometer.

Contact our application experts
to discuss your process and measurement needs!



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K-Patents Oy, an industry leader and supplier of K-PATENTS® Process Refractometers, was acquired at the end of 2018 by Vaisala. Following the acquisition, all K-Patents group companies are part of Vaisala.

Contact our expert team to discover our full offering and discuss how we can help you to improve your process and applications.

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