

Continuous real-time Quality Control in confectionery production



The mother of Tom Hank's movie character Forrest Gump, used to say: "Life is like a box of chocolates - you never know what you're going to get," but when it comes to making chocolate fillings, process controllers demand much higher levels of confidence. This can be achieved with the latest inline refractometers from Vaisala (Finland), which are used at various points in the process, providing continuous measurements of Total Solids (TS) or Brix (dissolved solids) concentration.

In-line Refractive Index (RI) monitoring with automatic feedback control and alarms when measurements approach warning levels, enables process operators to ensure a consistent and reliable product, so that ongoing production complies with regulations and product specifications. While this technology finds application in a wide variety of industries, this article will focus on the monitoring of processes associated with sugar confectionery and chocolate fillings.

Case Study - quality control in the manufacture of luxury pralines

One of Vaisala's chocolate manufacturer customers has the slogan 'Quality Above Everything,' so it is hardly surprising that the company has invested in Vaisala's K-PATENTS[®] Sanitary Refractometers to continuously monitor Brix for final quality control.

The pralines contain cherries soaked in a cherry brandy liqueur and covered in a rich, dark chocolate coating. The pralines are individually wrapped, and the brand is popular around the world.

The chocolate maker uses Vaisala refractometers for the quality control of the liqueur; checking that production adheres closely to the recipe. Alcohol is added to the brandy to meet the correct liqueur concentration,

and Brix measurements are taken immediately prior to the addition of the brandy to the cherries.

Production areas containing products with a high level of alcohol must be at least ATEX zone 2. So, in addition to the monitoring device being approved for sanitary applications, it must also have an ATEX classification. In this case, it was necessary for the refractometer to be Intrinsically Safe and compliant with the requirements of ATEX Zone 0/1. Vaisala's solution therefore combined both 3-A and EHEDG + ATEX zone 2, 1 or 0.

Prior to the installation of the Vaisala refractometers, testing was undertaken by manually sampling for laboratory analysis. This was costly and time-consuming; incurring a delay in the provision of test results. Any deviation from specification could therefore result in the loss or wastage of product, but with the benefit of inline monitoring, issues are detected immediately so that appropriate measures can be undertaken without delay.

Cocoa Dutching

There are two types of cocoa powder. Natural cocoa powder, which is brown and naturally acidic (pH 5 - 6), and Dutch process cocoa powder or 'Dutched cocoa powder' which is made from cacao beans that have been washed with an alkaline solution to neutralize their acidity. Dutching produces a variety of cocoa powders that can be used

in different applications. However, the qualities of the Dutched cocoa powder are significantly affected by the type and concentration of the alkali, so Vaisala K-PATENTS process refractometers are employed to ensure that the process operates within tightly defined concentration limits or specifications.

After fermentation, cacao beans are cleaned and usually broken into pieces known as nibs before the manufacture of chocolate or cacao products. For Dutching, the particle size of the cacao material is further reduced and the ground cacao material is then mixed with an aqueous alkali solution.

The Dutching process takes place in a closed jacketed vessel at about 120 °C. The total cooking time depends on many factors including the alkali concentration, the cacao material being treated, and the temperature employed, but it is usually 10-30 hours. The Dutched cacao material is then removed, and the nibs are roasted, cooled to room temperature, milled to form a chocolate liquor and pressed to remove fat and create a cocoa presscake. The presscake is pulverised, dried and screened to obtain a final Dutched cocoa powder product.

The Vaisala K-PATENTS Sanitary Refractometer can be installed directly in the alkali preparation tank to measure the concentration in real-time as the aqueous alkali solution is prepared. The refractometer can also be installed in a recirculating line, or directly in the vessel.

Quality Control in Confectionery Production

Sugar confections and chocolate fillings are produced by preparing a diluted mixture of the ingredients, and then concentrating the sugar content to the desired level by cooking and evaporating the water. The final Brix of the mixture determines the flavour, consistency, and overall quality of the final product. Careful monitoring is therefore necessary in order to ensure consistent, reliable product quality.

Incorrect moisture content can harm the physical characteristics of the final product; causing processing problems upstream and affecting final product quality. Excessive moisture can also cause product deterioration by promoting the growth of microorganisms.

The Vaisala K-PATENTS Sanitary Refractometer continuously measures the Brix level of the cooking solution. This provides real-time information to determine the end-point of cooking, and to ensure consistent product quality.

The refractometer can be installed directly in the cooker or in the cooker's outlet pipe. In a batch process, a flush-mounted refractometer is installed at the bottom of the vessel. For continuous cooking, the refractometer is installed at the outlet of the cooker. A flush-mounted refractometer can be installed in a cooker without impeding the action of scrapers or mixers, and the prism is washed with steam or high pressure

water from a wash nozzle which is installed together with the refractometer.

A further refractometer can be installed at the pre-mixer to ensure the correct feed concentration to the cooker. Continuous measurement is particularly important to ensure continuous operation of cookers that work under vacuum.

The refractometer provides Ethernet and 4-20 mA output signals that can be used for real-time process control. If the Brix level after cooking varies from the specified value, the refractometer sends a signal to the process controller for valve control. For example, the controller opens the valve to recycle the product for re-processing, and sends information to adjust the ingredients ratio.

One technology; multiple applications

In contrast with many other liquid concentration methods, the Vaisala K-PATENTS refractometer is not affected by particles, bubbles, crystals or colour, so these instruments can be employed in a wide variety of solutions for measuring liquid concentration. Importantly, the Vaisala K-PATENTS refractometers are 3-A Sanitary Standards and EHEDG certified. In addition to the confectionery industry, Vaisala's refractometers are commonly employed in many different food and beverage applications as well as other industries such as semiconductor, chemical and refining, pulp and paper, textiles and pharmaceutical.

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