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Getting under the skin of sausage manufacturing efficiency

Globally, the sausage market continues to expand, and is expected to grow at an annual compound rate of over 4% from 2020 to 2025.[1] As the popularity of sausages continues to grow, manufacturers are increasingly looking for ways to improve speed, efficiency and quality by utilizing artificial casings. In the following article, Markus Huuhtanen from Vaisala (Finland) will explain how these advantages can be gained by using in-line refractometers to monitor and control sausage casing processes.

Background

Traditionally, sausage skins were made from the small intestine of meat animals, especially pigs, but also sheep, cattle and goats. These so-called natural casings have been utilized for centuries, but in recent decades artificial casings have become popular in many markets. Artificial casings include collagen (often derived from animal skin), cellulose (from plant materials), plastic, and more recently alginate (from seaweed).

The growth in artificial casings has been prompted by a number of factors, including the high costs that result from the number of processes necessary to create the natural casing product. Also, natural casings tend to be variable in length, diameter and thickness, so it is more difficult to streamline sausage production, and the process incurs a heavier labour requirement. In contrast, continuous accurate monitoring of the artificial casing process removes the requirement for manual sampling and testing, and enhances both process efficiency and product uniformity.

Alginate casing

Alginate is found in the cell walls of brown algae which is a large group of multicellular algae, including many seaweeds located in colder Northern Hemisphere waters. An important feature of alginate is its ability to hold many times its own weight in water, making it a naturally gelling substance.

As a film-forming natural polymer, alginate can be used as a casing for sausages through its gel formation with calcium ions. During the production process, meat mixture is extruded to form the sausage, and a layer of sodium alginate is simultaneously applied (co-extruded) to the outer surface, before a calcium chloride brine solution is used to for dehydration and to induce gel formation. This creates a layer of calcium alginate film on the sausage, which provides the strength and flexibility required in a sausage casing.

The salt content in the brine solution is very important and needs to be closely monitored because it affects the color, texture and overall quality of the sausage.

The main advantages of co-extrusion over natural casings are:

- Lower purchase cost
- Ideal for automation
- Low labour requirement
- Product consistency
- Flexibility – can be used for

many different types and size of sausages

- Stored as alginate powder, so no refrigerated storage necessary
- Speed and throughput
- Suitable for vegetarian, vegan and Halal (if alginate)

Monitoring alginate brine with in-line refractometers

The brine solution is stored in a brine tank, and spent brine is recycled to this same tank. Consequently, the brine is constantly diluted by the moisture that is removed from the casing gel. It is therefore necessary to monitor the salt solution so that the correct amounts of salt can be added to the brine solution. This function is performed by the Vaisala refractometer which monitors the salt content in real-time.

There are two possible locations for the refractometers; directly in the brine tank itself, and a second refractometer can be installed in the salt supply tank.

The Vaisala refractometer measures the refractive index (RI) of the liquid, which correlates directly with the salt concentration of the brine solution. In-line RI monitoring with automatic feedback control enables process operators to ensure consistent and reliable operations; thereby protecting product quality and reducing downtime. In contrast with many other liquid concentration methods, the Vaisala refractometer is extremely accurate and reliable and needs no regular maintenance. Importantly, these refractometers are not affected by particles, bubbles, crystals or colour, so they can be employed in a wide variety of solutions for measuring liquid concentration. The Vaisala K-PATENTS refractometers are also 3-A Sanitary Standards and EHEDG certified, which is essential for food processing equipment.

The refractometers produce mA and Ethernet output signals that allow automatic operation of the process. Moreover, the refractometers can be calibrated to read the concentration of NaOH in g/L, wt-% or any other engineering unit preferred by the factory.

Co-extrusion with collagen gel

In addition to alginate gel, it is also possible to use collagen gels in sausage manufacture. Collagen casing is largely derived from beef and pig hides, but it offers most of the speed and efficiency advantages presented by alginate gels.

After co-extrusion with collagen gel, sausages are passed through a brine solution in a similar manner to the alginate gel process. Vaisala refractometers are able to continuously monitor the process as outlined above, to ensure that the correct salt concentration is maintained and product quality is protected.

Emphasising the importance of the brine measurement, a sausage manufacturer in the USA said: “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 K-PATENTS® refractometer helps to keep the moisture at the specified level, ensuring a standardized end product.”

Cellulose sausage casing

Vaisala refractometers are also used in cellulose sausage casing processes. In this application a cellulose fiber cloth is used to create the sausage casing, but first the cloth is desulfurized by passing it through a Sodium Hydroxide (NaOH) bath. Also known as caustic soda, this solution is supplied from a tank, and spent caustic is returned to this tank. Consequently, the NaOH concentration needs to be replenished because caustic is lost in the cloth during the impregnation process. A Vaisala refractometer is therefore employed, in a similar manner to the alginate and collagen applications above, to continuously monitor (in this case) the NaOH concentration and ensure accurate replenishment.

Summary

In-line refractometry is the ideal technology for controlling the artificial sausage casing process. By providing continuous data, refractometers enable sausage manufacturers to control many of the key product quality features.

Unaffected by particles, bubbles or colour, the same technology is used for monitoring liquids in a wide range of other industries including semiconductor, chemical and refining, pulp and paper, textiles, pharmaceutical, brewing, beverages and of course food.

The popularity of cellulose and alginate casings is growing as manufacturers look for ways to lower costs, expand production and improve consistency whilst improving product quality, process efficiency, speed and flexibility. However, in order to take advantage of these benefits it is necessary to be

able to continuously measure process liquids with a technology that is accurate, reliable and able to operate in challenging conditions. The Vaisala K-PATENTS refractometers meet that requirement and therefore help to meet the world's growing passion for high quality sausages.

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