Special sensors for a smooth melt

Solutions from ipf electronic increase the operating life of rollers at Stollwerck

As before, chocolate is one of the most popular confectionary products in Germany. Last year alone, the Ger-mans consumed 9.32 kilograms of chocolate products per head – bakery products came in second at 7.47 kilo-grams per head. A basic paste (which (among others) is made by Stollwerck GmbH from Berlin in large roller mills) is the basis of all chocolate creations. Sophisticated sensor systems are also required for these rollers.

As Michael Rees, electrical technician at Stollwerck in Berlin states: “The cocoa beans come to our company as a raw material and are further processed here to form a chocolate base.” For this to happen, the beans are first roasted, separated from their skin and are then made chopped up to form so-called nibs. These nibs are then processed in a quintuple roller mill with other ingredients to form a flaky cocoa mass. Apart from cocoa, butter is also needed to produce this base as well as milk powder and sugar. These are mixed according to a special recipe. As Michael Rees explains: “In order that we have a fine chocolate base at the end, all ingredients, including granulated sugar, have to be ground in a rolling mill.”

A long drawn out process for top quality

Here, the mixed ingredients pass through a pre-roller which makes the coarsest ingredients smaller. This pre-product is then made smaller (up to 30 µm) via another four fine rollers. As a result of this roller process, the surface area of the mass increases noticeably until, at the end, a product is produced consisting of dry flakes. These are fed via conveyor belts to a so-called conche and there, they are dissolved. As Michael Rees explains: “The chocolate base is produced in this conching process, which can last between ten and twenty hours.”

Dry running is something to be avoided

Five years ago, Stollwerck decided to modernise the roller mills step by step. The electrical technician:

“Measuring approx. 1.80 m long with a diameter of 40 cm, the rollers do not tolerate any dry running at all. This is why, when running, a clean film of chocolate has to be on the surface of the rollers at all times. If the rollers run dry for longer than 20 seconds, a burnt streak appears. Then, in a complex process, the rollers have to be taken down and stripped by a specialist company. Not to mention the lost production, this is in itself quite a costly exercise.”

The integration of a new sensor system as part of the modernisation

At Stollwerck, the roller mills have been equipped with special sensors for monitoring the rollers (on the part of the manufacturer). As Michael Rees goes on to state: “We have now been working with this equipment for over 20 years. Over the course of time we had increased problems with repairing the equipment and/or the sensors, e.g. due to spare parts not being available. For us, the planned modernisation of the first roller mill was an ideal opportunity to additionally integrate the latest sensor technology.”

First of all there was no solution in sight

However, all this is easier said than done. Sensor solutions on the part of the manufacturer were out of the question. This would be too costly and as well as this, it would involve complex structural alteration works on the roller mills. Stollwerck then, had to look for alternatives. As Michael Rees recalls: “Even this was not so easy. I contacted every single manufacturer. Either we did not feel that they could solve our problem at all, or a solution would involve high development costs. Nobody was able to offer me a really feasible and at the same time, cost efficient solution – until I contacted ipf electronic.”

A way out of the dilemma

In a short period of time, the Lüdenscheid-based sensor specialist was able to offer Stollwerck a specific sensor based on a modular system.

This solution consists of two brightness sensors that were installed on a duct in one of Stollwerck’s roller mills (right and left above a roller). The sensors have to be able to detect a sufficiently large part of the roller surface and in doing so, ensure that neither too little nor too much chocolate film is on the roller (Fig.1-2). “If this film is not available in a sufficient enough quantity, the rollers will run dry. If however, there is too much of the chocolate base on the roller, this is an indication that the gap between the rollers is too large and we are not achieving the desired quality when grinding. For the rest, as they turn at great speed, the detection of a roller via ipf electronic’s sensors is sufficient to ensure that the film of chocolate on the rollers corresponds to the target values. For example, the last roller runs at 2,800 rev./min.”

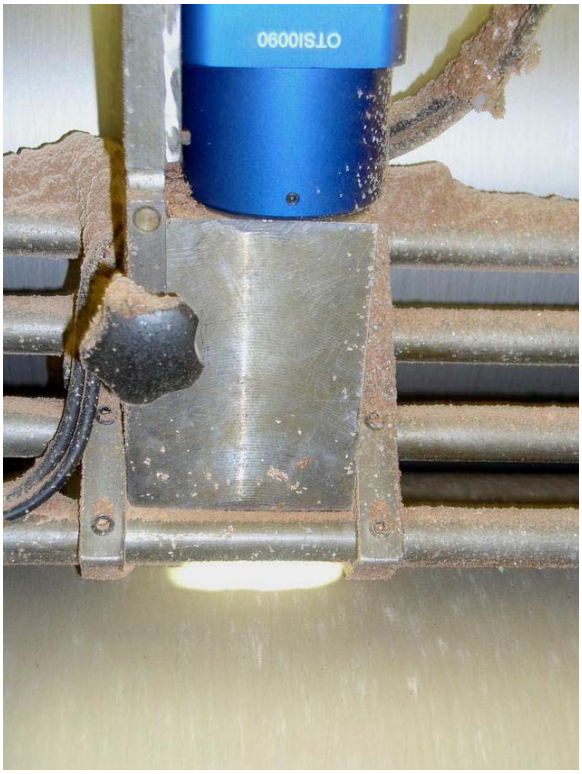

Fig. 1

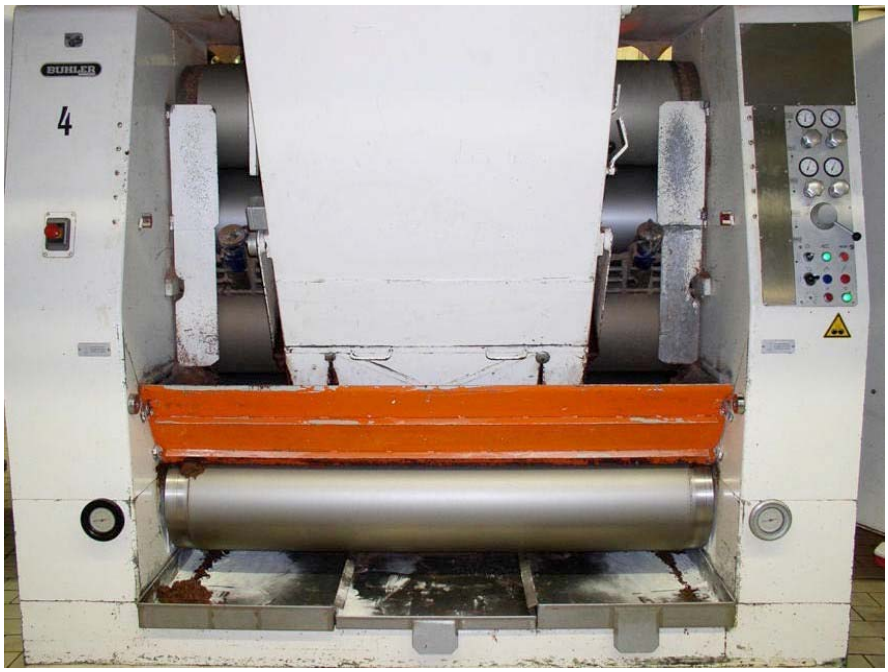

Fig. 2

A special lens assesses a large area

The brightness sensors from ipf electronic have a diameter of 80 mm and are mounted above the third roller at a distance of around 100 mm to the roller surface. In order that a relatively larger area of the roller surface can be assessed, the sensors have a special lens. To begin with, a ring of white light LEDs ensures that as much light as possible reaches the roller surface. In order to eliminate the influence of external light during the detection process, the systems work with synchronized light.
Located effectively in the centre of the ring of white light (transmitting diode), there is a receiver which picks up the reflection signal from the roller surface. Parallel to this, the transmitting power and/or quantity of radiated light is established by an additional internal receiver. The software of the brightness sensor scales these two measurements, establishes a relationship between them and in doing so, forms the so-called brightness factor, which is represented as a figure.

The area of the roller detected by the two brightness sensors is 80 mm on each of the two sides. If there is too little chocolate film on the surface the brightness will be stronger and the reflection signal from the surface will increase. If however, there is too much mass on the roller, the reflection signal will be correspondingly less and as a result, the brightness factor as well.
In order that the reflective behavior and/or the brightness factor of the roller surface can be assessed with absolute certainty, the sensors were calibrated via software to a specific target teach value using a roller coated with chocolate film. In addition, it was possible to define a reliable deviation from the target value.

Small gaps in the film? No problem

As Michael Rees states: “We took the parameters for the target value and the difference by which the actual value is permitted to fluctuate around this ‘teached in’ value from the settings of the old equipment. This way, together with the relatively large detection range of the sensors, we ensure that the roller mill does not shut down straight away if for some reason, there are small gaps in the film of chocolate which would otherwise be within the tolerances and as such, not represent any risk of the roller running dry.

Greater comfort, more security

The electrical technician from Stollwerck is highly satisfied: “The brightness sensors from ipf electronic were available for an initial test run already three months after making the enquiry.

The system worked smoothly straight away! In the course of modernizing a second roller mill, we also disposed the old pressure switches for monitoring the water pressure, hydraulic pressure and lubrication pressure, and replaced them with pressure sensors from ipf electronic (Fig. 3). The pressures can now be set and monitored comfortably on a touch panel via the new PLC. Now, all parameters are configured and controlled by a master display without having to resort directly to the roller mill."

Fig. 3

Optical sensors monitor the fresh supply

Stollwerck also used the modernization of the second roller mill to cope with another challenge. As Michael Rees states: "In addition to the brightness and pressure sensors we are also using an optical sensor with background suppression from ipf electronic on this plant. This monitors the supply container for the raw material and, in doing so, ensures that enough material is always supplied to the rollers. Here, a particular problem with this fill level monitoring system was the different colors of the raw material for white, milk and dark chocolate. As such, we needed a sensor which guaranteed color-independent sensing at a sensing range of approx. 500 mm to the colored surface of the raw material."

This specific task is now performed by an optical sensor from the OT59 series. If the fill level in the supply container should fall below a certain level, the sensor no longer transmits a switch signal and an appropriate quantity of raw material is added. The robust sensor also works perfectly if the lens becomes soiled or charged with dust from the raw material.

Economic advantages through successful partnership

Longer plant operating times and greater roller availability: In terms of a longer service life for the rollers, these are the economic benefits that Stollwerck gained through cooperation with ipf electronic. As Michael Rees concludes: “In addition, in the course of the projects, the company supplied us with several solutions for the various challenges. The rest of the equipment will now be brought successively up to date.”