Modern automobile tires are a high-tech product consisting of more than 20 components, which need the highest levels of precision at every stage of the production process from the rubber recipe through to vulcanizing. At Continental’s plant in Lousado, Portugal, the mixing processes are operated and monitored using Siemens A&D’s SIMATIC WinCC operating & monitoring system.

At the entrance to the Continental tire plant in Lousado a half hour’s drive north of Porto, your attention is first attracted by souvenirs of the past. A place of honor is dedicated to the first tire that was produced on Portuguese soil in 1946. Nobody can remember the vehicle that drove on Portuguese highways with this tire way back then. The cover of a Continental-Echo magazine dating from 1913 that is on the wall of the reception area, reminds us that the tradition of the Hanover, Germany based group of companies goes back much further. The picture shows a Grand Prix racing driver accelerating against the headwind. The speed – which for the time was almost unimaginable – is today’s highway driving speed.

Today’s automobile tires have to stand up to much more strain than they did 50, 80 or even 99 years ago when Continental started production in 1898. The tire, which is still the vehicle’s only link with the road, is a high-tech product today. Everything must be right – and above all the rubber composition. In the last 50 years, little has changed in the mechanical process, according to William Kulmacz, Senior Engineer at the factory in northern Portugal where 850 employees manufacture up to 32,000 tires every day. However, the latest technology is needed to ensure consistent quality, to avoid plant unwanted shutdowns, and to ensure the highest levels of profitability.

Since 1996, Continental has been using Siemens A&D’s (Automation & Drives) SIMATIC WinCC® (Windows Control Center) as the Human Machine Interface (HMI).

100 Recipes

In the central blender control room (Figure 1), Pedro Moreira da Silva, the blender department manager is literally on top of things. In the factory located one story below him, a seemingly endless stream of rolled sheets emerge from the masticators and rolling machines. The action below is visualized in the control room on the monitor in a schematic way. Pedro types in a password to get a view of mixer number 3. On the menu bar, he clicks on item Selection and then Order List. A total of 80 batches of composition D-458-4 were needed with another still to be produced. At exactly 7:42 this Thursday morning production started at this mixer. The target time for this batch is three hours and twenty-five minutes.

Another batch is almost finished. The WinCC station knows that there are 167 kg on the polymer scales at the exit side of the masticator. However, 177 kg are needed, but this is no problem. At 177.7 kg a bar on the monitor changes color from yellow to green. A guillotine is activated. The load is dispatched and the next batch is started with the same recipe.
Making Tires Using SIMATIC WinCC

The mounted blank is not solidified into a finished car tire until the vulcanization press. Photograph: Continental Aktiengesellschaft

Before his lunch break, Pedro enters the order list to be able to start a new recipe without the plant coming to a standstill or wasting time. For this, he only needs to change the proportions of the main ingredients – rubber, carbon black and oils – with the time and effort involved being minimal. Because the electronics and data processing facilities ensure that every mixture is exactly right.

All of the details of the recipes are stored in a database on a separate SQL server, which is linked to the WinCC client of the respective mixer line by means of a PC network. When the order list is completed, WinCC receives the necessary data of the new recipe from the SQL server and starts the process. The database contains a total of about 100 recipes that can be called.

You may think that a tire looks like a product that is a seamless whole – it just looks like that. According to Continental, a modern automobile tire consists of between 20 and 25 components for which up to twelve different compounds are needed (Figure 2). Regardless of whether the component in question is the airtight innerliner, the bead, the sidewalls or the tread – the process is almost always the same as baking a cake: the ingredients are similar but you use different amounts for each recipe and you blend them at different temperatures. For the latest types of treads, you need to combine three compounds: a non-abrading cap compound ensures good road grip; the base compound ensures low roll resistance; and a virtually unknown skirt profile of sidewall rubber improves the transition from the tread to the side.

Everything in Sight

Thanks to WinCC, Pedro Moreira da Silva can track all the stages of the blending process on the monitor. By entering a simple command, he can get a complete overview in a matter of seconds of plant status conditions, production levels and possible problems. Apart from this, he can call from the electronic shopfloor controller’s SQL server the production data of the finished batches. He can also go down to the shopfloor – where it smells of hot tires and the fork lift drivers load and transport the pallets of rubber strips with all the skill of a Formula 1 driver. A control station is also installed here (Figure 2). If somebody wants to intervene in the production process, they operate a membrane keyboard and click on the integrated touchpad. This visualizes all the plant status conditions and allows you to localize exactly possible disturbances – and eliminated them selectively in an appropriate way.

Smooth handling of the blending process is the crucial factor for the success or failure of the rest of the production process. In an extruder, the rubber strips are shaped appropriately – depending on whether they are to be used for the bead, the sidewall, the innerliner or the tread. They are subjected to the same critical quality inspections as the other components of the tire, like the steel and textile cords and the steel belts. All of the components are gradually put together. For the layman, who sees the process for the first time, the culmination is the
vulcanizing process. In a press, an oversized cylinder is placed over the semifinished product. A bladder presses from inside against the blank. From outside, the tire is subjected to pressure of around 12 bar at a temperature of between 170° and 200° C to engrave the tread pattern. A tire emerges that only has to go through final inspection.

**Totally Integrated Automation**

The Lousado plant as a foreign subsidarie of the Continental group had great success in using WinCC – and will prepare more ambitious projects in the future. “We are in a clear growth situation,” says Senior Engineer Kulmacz and sketches the recent history of the plant in Lousado. Large-scale tire production started in 1990. In the previous year, the Continental Mabor Indústria de Pneus SA company was set up as a joint venture with the Portuguese Mabor company. Since 1993 the company is 100% German-owned. Originally the plant – which had a turnover of more than DM 200 million in 1996 – was designed to produce 18,000 tires per day. In the meantime, the average daily production is 30,000 units, with Uniroyal, Semperit, Mabor, Viking and Gislaved brand tires being produced in addition to the ones sold under the Continental mark. Between 80% and 90% of the production is exported. The most important domestic customer is AutoEuropa in Palmela (south of Lisbon), which is a joint venture between Ford and Volkswagen for the production of luxury automobiles. When the original production capacity is often exceeded by up to 33%, then this is achieved “with the same plant and with no additional investment,” according to Kulmacz. „We are proud to occupy a leading position within our group.“

While WinCC already ensures the consistent quality of the rubber compositions and smooth production at Lousado, it will to be introduced in to other Continental plants in Europe in the near future. At Barum Continental in the Czech Republic, the entire blender department is already being equipped with this concept. The next plant at General Tire in Casablanca is the next in line.

Pedro Moreira da Silva’s workplace illustrates the extent of this development: On the wall of the control room that measures six meters by nine, an obsolete monitoring system as large as a closet is a reminder of the old days. Outside, the plant picture appears with its red, green and yellow lights for manual control.

With SIMATIC WinCC everything looks quite different. A compact computer cabinet (Figure 4) hides the heart of the new high-tech solution, what computer specialists call a “client-server application”. The significant difference between this approach and conventional operating & monitoring solutions with individual stations that all need their own databases is that the system manages data in a central and homogeneous way on the same SQL server (under Windows NT) for all the WinCC stations in the manufacturing process. Even if this central brain
Making Tires Using SIMATIC WinCC

should fail once in a while, management doesn’t need to worry about the daily production targets being achieved. Because in this case, you can also control and monitor production from the individual stations without functionality being restricted.

With WinCC, Continental hasn’t purchased just one product – but rather a comprehensive automation solution, which with its components from the SIMATIC HMI, SIMATIC NET and SIMATIC PLC product families represents a ready-made plant component in the Totally Integrated Automation concept. The ATD company in Hanover configured the system and tailored it to the specific requirements of Continental, and it is currently being introduced into all of Continental’s production facilities all over the world.

Accompanying Training

The crucial advantage of the WinCC solution that William Kulmacz quotes is its greater flexibility in recipe management and the better visualization functions. As a result, the American wants to convert to WinCC several plants that currently use a different recipe management system. In this connection, he knows that this is in complete agreement with Continental’s company philosophy, which gives the highest priority to precision and repeatability of the recipes, and to confidence and quality. Within the company, according to Kulmacz, WinCC is not a revolutionary innovation, but rather a logical evolution.

Silke Lay, Jürgen Speck
In addition to operator panels, touch panels and pushbutton panels, text displays, the ProTool configuration software and the ProTool/Pro local visualization software, the SIMATIC WinCC operating & monitoring product is a member of the SIMATIC HMI (Human Machine Interface) range within the Siemens Totally Integrated Automation concept.

WinCC is the process visualization system in the SIMATIC family. At the level below this system, there are available programmable logic controllers (PLCs) like SIMATIC S5s and S7s. If you choose WinCC, you get a complete plant visualization system, including, of course, the necessary data processing equipment.