

# Spark for change

Curing press manufacturers are innovating to meet tire companies' demands for greater accuracy, efficiency and automation in production

by Graham Heeps

Since the first hydraulic curing press was introduced by Krupp (now HF Group) in the early 1970s, this technology has emerged as the standard in the curing of passenger car tires, offering ease of maintenance and greater accuracy over the press's life. Nowadays, mechanical presses are typically chosen only for larger-size TBR or OTR tires, or when the cost of the press takes priority.

"Many mechanical press manufacturers are in China and the prices are relatively low, perhaps 20-30% less than hydraulic," says Jiro Agawa, deputy director of the rubber and tire machinery division at Mitsubishi Heavy Industries (MHI). "It's not a big difference, though, and the major tire manufacturers are going hydraulic for small tires."

So what will be the next revolution in curing press design? At Tire Technology Expo in February, one word was on every leading press manufacturers' lips – efficiency. As we'll see, this takes the form of both reducing the energy consumed during curing, and increasing process efficiency by raising the throughput of the presses, which are commonly a bottleneck in the tire production process.

## Energy efficiency

To reduce energy consumption, press manufacturers are exploring alternative sources of power.

"Energy saving is the big trend," says Agawa. "The energy losses in the body of the press and the piping are key. We are looking at electrical heating as a long-term development because when you use steam you need a long pipeline, and even with insulation some of the energy is wasted. Some other tire equipment manufacturers have released electrical solutions but they're not a total success in our view."

India-based Larsen & Toubro is also developing electrically operated platens for curing. "They result in a more user-friendly and energy-efficient press that avoids line losses," says S Kalyanaraman, head of marketing. "So we're currently trying to apply that to the smaller PCR range. After that has been successfully trialed, we will extend it to other sizes – it could work for TBR tires too. But with OTR tires, because of the high curing time, we'd have to think twice before going for electrically heated platens."

"There's not been much demand up to now for electrically heated presses, although there are interesting points to the technology, such as independence from steam," says Jörn SeEVERS, director of curing presses at HF Group. "There may also be the opportunity to have the tread cured at a different temperature from the sidewall, for example. But there are some issues. One is higher energy costs if the electricity isn't cheap in a particular country. You also have slower heat-up/heat transfer within the press, which isn't easy to manage. Some manufacturers have started to use





Left: 52in UZER floating-column type hydraulic press. Clever packaging in the latest presses is enabling them to accommodate larger tire sizes but still sit within the footprint of older designs, enabling tire makers to make straight swaps when updating machinery, or allocate less floor space in new-build factories



Above: All of HF Group's curing presses are made in Croatia. The company's headquarters remains in Hamburg, Germany

them, but there hasn't been a big breakthrough so far. Steam is still the cheapest and fastest option."

Nevertheless, HF is working on energy-saving measures and Seevers hopes to reveal more in 2016. "It's more evolution than revolution," he teases. "We follow our customers' wishes, but it's always about improving tire performance while keeping the cost at a reasonable level."

Meanwhile, others are researching ways to introduce electrics into further areas of the press. UZER Makina, for example, has projects underway to develop electric movements on the press to replace the hydraulic cylinders.

"We have found that in Japan in particular there is a strong focus on environmental issues and a reluctance to use hydraulics," explains Seyfullah Bozkurt, UZER's managing director. "Some manufacturers have developed electric presses in-house. Sumitomo

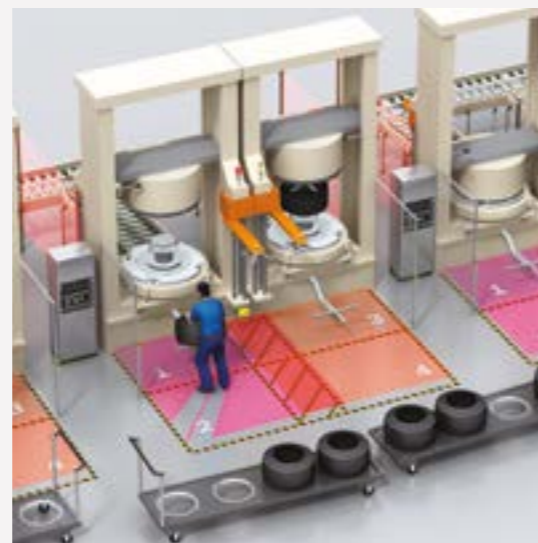
## A SAFER CURE

The curing press area can be one of the most hazardous in the tire factory – something that upcoming international standards in Europe and China will seek to address.

At Tire Technology Expo, Sick presented one of its solutions to the problem, based on the S3000 safety laser scanner and the Flexi Soft safety controller. "The impulse came from the tire manufacturers," says Sick's strategic industry manager for automotive, Alain Klein. "They wanted to improve productivity without compromising the safety of their workers, approaching it from a [curing press] total cost of ownership perspective."

Sick's system divides the area in front of two presses into four zones. The two zones immediately in front of the presses are used to stop them when a worker enters, so that they cannot be injured by the press as it closes. The two further away are used to stop the loading system but not the press, to maintain productivity. Unlike the fields closest to the press, they do not require a reset once the worker steps away. No physical fences are required.

The system interfaces with any automation system that the tire maker has in place and can also be updated for the side or rear of the press to protect maintenance staff. Klein describes it as "proven and reliable", having been used in production by several top tire manufacturers since 2012 and now installed on upward of 1,500 presses worldwide. ■



has its own patented design, for example. We are currently pursuing two R&D projects to eliminate hydraulics completely from the press, one with one of our Japanese suppliers, the other with Rockwell Automation, for whom we are an OEM partner."

Being able to generate the forces to open the press, unload and reload it using electric power alone, while restricting the motors to a practical size, is a challenge. Bozkurt thinks that servo motors and ball screws could provide the answer, although powerful linear motors – as used in the new five-axis CNC machines



**"There's not been much demand up to now for electrically heated presses, although there are interesting points to the technology, such as independence from steam"**

Jörn Seevers, director of curing presses, HF Group

at UZER's premises in Kocaeli, Turkey – may also merit investigation. But he adds the proviso that cost will be key to the viability of any electric solution.

That note of caution is echoed by Agawa, who says that Mitsubishi has a number of electric presses in operation, some of them used for curing rubber earthquake reduction equipment rather than tires.

"Energy saving was behind the development of these presses, but at the moment, the price of electric presses isn't as good as for hydraulics, so the market isn't very big," he adds, while noting that technology advances could bring the price down in the future.

## Machine efficiency

Machine and process efficiency is the second major area of R&D for curing press manufacturers. A reduced curing time is among the benefits of replacing steam with nitrogen, for example, albeit at a slightly higher cost. Nitrogen also improves tire quality by eliminating the condensation that can form as the press heats up during the pre-shaping phase, and its higher pressure within the press – as high as 28 bar – can be useful for shaping very complex tread patterns.

The adoption of separate shaping units (SUs) and post-cure inflators (PCIs) is also raising efficiency in the curing press area. Both offer the chance to reduce curing time by moving part of the process outside the press.

Japanese company Ichimaru-Giken's shaping unit was first used by customers eight years ago, but has been commercially available since 2013.

"The curing area needs more automation," urges Hironobu Ichimaru, VP of engineering and production. "Right now there are some green-tire handling systems, but there are still some shaping problems resulting from loading the green tire. The shaping unit makes handling easier and the curing press can be more compact because it doesn't need a center post."

He adds that productivity is increased because the bladder exchange, shaping and preheating of the green tire are all done away from the press, which cuts the curing time. The green tire/SU assembly can then be positioned more precisely in the press, improving the accuracy of the tire. Moreover, the use of conventional production elements like the curing bladder make it easy to switch to the SU system, he claims, with customers able to use their existing presses



## SMART THINKING

Curing presses are becoming smarter and more flexible in response to the proliferation of tire sizes and types. UZER Makina will soon begin building smart presses for a new greenfield factory. A scanner on the loader will detect the tire specification and adjust the cure accordingly, eliminating problems arising from operators mixing up green tires.

At HF Group, one of the newest products is a quick mold-change device, but there are other uses of technology on the horizon to increase the intelligence and efficiency of the curing press. "I see



there are perhaps two topics in the development stages here," expands Jörn Seevers. "One is data storage and access via the HMI for process analysis and

optimization, real-time adjustments to curing time, etc. Some companies already have fully networked plants that enable them to spot trends such as longer curing times due to condensation or worn valves.

"The other development is with an eye to energy saving, which is currently a bigger topic in some countries than others. The ways we would do that include process control (fast open/close to trap the heat), better insulation and maybe some heat recovery, too. The latter might require higher investment, but would pay for itself in lower process costs." ■

but with the center post removed. Ichimaru-Giken has further developments of the system in mind.

"After curing, a disassembly system removes the cured tire," Ichimaru explains. "So far our passenger car customers have wanted to move the cured tire quickly to the PCI, so it is removed from the SU in the curing press, as it would be from a conventional center post. For situations where a PCI is not needed, however, we are considering an automated solution where it would be possible to remove the SU and the cured tire as one and separate them offline. This would be a good solution for a TBR tire, for example, because of the size of the center post, or for retreaded tires."

Not everyone is convinced that SUs are the way forward, however. At HF Group, Seevers says that customers have their own philosophies, "so we have different center mechanisms for different customers, and it depends on the tire size and type, too. It's a big area of customization. Going the route of separately supplied pre-shaping units incurs higher cost because you need a lot of units and you have to automate the transfer in and out of the unit. I don't see comparable cost performance, nor a big performance advantage."

He's more convinced by PCIs, though. "Some customers love them, others are still unconvinced, but they are definitely becoming more popular," he confirms. "We have our own patented stack PCI that we can put behind our presses, or install as an upgrade to older ones, to improve uniformity – including for older mechanical presses. In that scenario the customer does not need to invest in a new press to improve uniformity. It can also cut the cycle



Top: The large operator panel for a 45in UZER hydraulic press

Above: Ichimaru-Giken's shaping unit is used with conventional curing presses with the center posts removed

time and thereby raise output, because the curing effectively finishes outside the press, although it depends on the type of tire. We're selling a lot of PCIs, particularly for passenger car and scooter tires."

Other improvements in curing press efficiency are coming from automating the press itself (see *Smart thinking*, above) and integrating it more closely to the factory's overall automation strategy. In the future, real-time adjustment of the curing cycle may yet be achievable based on sensor data from within the press. Reosense's CureSense, for example, won Tire Manufacturing Innovation of the Year in our 2011 Awards. The company believed that cure times could be cut by at least 10% using its technologies, with knock-on benefits to both process and energy efficiency. Unfortunately, according to former MD, Jonas Lundberg, development for the tire application proved difficult and work had ceased by 2013.

"Tire curing times typically contain some tolerances when they are set by the manufacturer," observes Bozkurt. "Sometimes you may overcure it, but if it were possible to get real-time data from the tire during vulcanization then you could decide when the cycle could be stopped.

"Machine efficiency is everything," he concludes, "because the tire manufacturers will decide on the number of presses they need based on the machine efficiency ratio. Some might install eight presses per TBM, others 10 – a 20% difference. It all depends on the efficiency value you can give your customer. That not only reduces the investment in presses, but also decreases the factory space required, which is a further cost saving." **tire**

**"Machine efficiency is everything because the tire manufacturers will decide on the number of presses they need based on the machine efficiency ratio"**

Seyfullah Bozkurt, managing director, UZER Makina