JEBENS
MASSARBEIT IN STAHL

Under extreme pressure

Precision press line gets railway wheels for high-speed trains into shape

According to experts, in less than 20 years from now 60% of all people will be living in megacities, increasing to 75% by as soon as 2050. They will all be dependent on well-functioning transport infrastructures to get them to work and back home over increasingly long distances. Trains will play a key role in this scenario, especially high-speed trains. Increasing volumes of passengers and faster and faster trains will put heavy demands on the railway wheels used. Cast wheels are no match for the extreme strains involved. For this reason, especially in Germany, the European countries, China, Russia and Japan, forged wheels are already standard for trains. With its turnkey machines for the forging and rolling of these monoblock wheels, the world's largest press manufacturer, Schuler, repeatedly sets new international standards. For the production of press-frame plates with unit weights of up to 48 tons, Schuler relies on the special expertise of the company Jebens GmbH, which is headquartered in Korntal-Münchingen, Germany.

All over the world, cities are growing at a staggering rate of 170,000 inhabitants a day. This rapid urbanisation, according to estimates of the Organisation for Economic Cooperation and Development (*OECD*), will triple the distance travelled by people on their way to and from work and leisure activities. The consequence: the already severe congestion in the megacities will get worse. For this reason – especially for mid- and long-distance commutes – rail transport is seen as the only viable future backbone for the urgently needed mobility. Today, high-speed trains run at top speeds of 350 kph. Such performance expectations – along with other similarly increasing requirements for safety, comfort and reduction of noise and wear – are all demands that impact on the quality requirements for

railway wheels. As the technological and global market leader in forging equipment, the company Schuler Pressen GmbH is represented in over 40 countries with a total staff of around 5,170. Although the family business, which now belongs to the Austrian ANDRITZ Group, has only been active in the railway market for 10 years, Schuler has already succeeded in securing three orders for turnkey machines and equipment for the manufacture of railway wheels. The company's innovative technology and the automated interlinking of its individual machines fulfil the most demanding requirements on the manufacturing process, from continuous casting material through to the finished railway wheel. Schuler is currently manufacturing a turnkey machine for forging and rolling railway wheels for a customer in Asia. The machine is scheduled to be delivered in November this year.

A new wheel every 45 seconds

The integrated process of wheel manufacture on this forging line begins with the charging robot that loads the rotary hearth furnace with 400 to 800 mm long billets. Next, a robot transports the billets, after they have been heated over up to five hours to a temperature of 1,250ºC, to the descaling machine. From there, they are forwarded by robot to the pre-forging press, where, in two forming stages, the wheel blanks are forged with a press force of 10,000 tons and the hub is also formed. The central cylinder – typical for Schuler wheel presses – and the slide that moves beneath it give the pre-forged form an almost near-net shape. Thanks to the high degree of force and precision during pre-forging, the required material input is reduced by up to 10%, which impacts positively on the cost-efficiency of the wheel manufacturing process. Patented hydraulics enable super-quick opening of the press and thus reduce the contact time between the workpiece and the forming die. This not only increases productivity but also extends the service life of the contact dies by reducing the thermal strain on them. In addition, with Efficient Hydraulic Forming (EHF) technology, Schuler also reduces the power consumption of the machine, because, just

like with a start-stop system in a car, this module allows the drives to be selectively switched on and off. Unlike conventional hydraulic presses, which need over a half a minute for the drives to start up, the Schuler pre-forging press is ready for operation within 1.5 seconds. This means that energy-intensive idle times can be almost completely avoided. From the pre-forging press, a gantry robot then conveys the wheel blanks to the core component of the forging line, the wheel roller. A total of nine rollers – four central rollers, two conical rollers, one main roller and two web rollers – give the wheel its final form in just 45 seconds. The central rollers hold the blank in a vertical position while the web rollers press the wheel flange against the main roller and, at the same time, the conical rollers form the width of the flange. In this way, the diameter of the wheel is enlarged parallel to the forming of the wheel flange. With a diameter of 1.7 metres, the main roller is ideally equipped to form the up to 1,500 kg heavy forged parts. To overcome moments of inertia, the forming rollers have their own drives. This means that the rollers, which are subjected to high thermal stress, can also be turned during idling, thus enabling them cool down again after each forming pass much faster than is the case with conventional machines. So longer service life of the forming dies is an additional efficiency benefit of this system. In the downstream dishing press, the wheel is given its finished form under 5,000 tons of press force. Its height is calibrated, the hub is offset axially and the web is given an S-shaped or bell-shaped form. This creates a cushion effect which significantly reduces noise emission when the wheel is running. Then, a punch integrated into the press cylinder stamps a hole of about 150 mm diameter into the up to 350 mm long hub with a press force of 1,000 tons. The end of the forging line consists of the flexible marking station – where the wheel is indelibly marked with a 10- to 15-character combination of numbers and letters – and a laser system that performs a contact-free measurement of the finished wheel.

Sturdy support for the high-performance press

Up to 75 wheels with diameters of up to 1,450 mm will be produced per hour on this forging line. And the dimensions of this turnkey plant are correspondingly huge: including the furnace it is 80 metres long and 30 metres wide. The undisputed "Hercules" of the line is the hydraulic high-performance press – towering 12 metres above floor level and going down four metres below it – in which the wheel blanks are created under 10,000 tons of press force. The forces exerted during this process call for a press frame with extreme rigidity if the required precision in production is to be guaranteed. Schuler commissioned Jebens, as a leading specialist for large, heavy flame-cut parts and ready-to-install welded components, with the production of the press plates. Arranged in layers and held together with spacers, they accommodate the press axles with the forming dies. Jebens delivered a total of 14 welded plates according to precisely defined rigidity specifications for the press body of the hydraulic press: eight O-profile frame plates, each 14,450 mm long, 4,780 mm wide and 150 mm thick, with a unit weight of 48 tons. Six further plates, 11,060 mm long and 3,600 mm wide, weighed 22 tons each. Apart from the sheer handling of these heavy components, a major challenge was to maintain the required evenness over the plate length of more than 14 metres. But the crucial factor in achieving the specified rigidity of the frame is the overall quality of the welded parts. There are not many welding companies capable of fulfilling the correspondingly demanding welding specifications defined by Schuler. Because of positive experience over many years of reliable collaboration with Jebens, they were the logical choice. As Markus Knebel, Head of Purchasing at Schuler in Waghäusel, explains, "We can look back on over 25 years of successful collaboration with Jebens – initially as a supplier of flame-cut parts, then increasingly also as a supplier of smaller welded components with unit weights of five to 10 tons. So we know that we can rely on Jebens to implement the required quality specifications, and to keep the delivery deadlines. And, last but not least, the price is also right." Uwe Konnerth, Head of Sales for Forging at Schuler, adds, "When

you're making a plate press with a press force of 10,000 tons, the quality of the welding seams is absolutely crucial. With Jebens, we have a competent partner with certified qualifications for the job." For the SME based in Baden Württemberg, Germany, production processes requiring extreme precision are daily routine. Thanks to its own welding specialists and comprehensive certification, Jebens is ideally equipped for high-precision work in reproducible premium quality. After sourcing the raw material, the company produced the welded components exactly to the drawing specifications submitted by Schuler. "For the pre-forging press, the shaping of the components is actually rather easy. The challenge lies in implementing the quality specifications for parts with these dimensions and a total weight of 440 tons," says Uwe Konnerth. With its two welding robots and an XXL annealing and normalising furnace, Jebens had everything it needed for the complete in-house production of these large-format components. First, the flame cutting and chamfering of the giant components was performed at Plant 1, the company's headquarters in Korntal-Münchingen. After being transported to the nearby Plant 2 in Nördlingen, the press plates were then welded, annealed and primed. The required seam precision was ensured by using the welding robot for multi-layer welding with absolutely consistent and fault-free welding seams. The 15 metre long, 5.8 metre wide and 3.8 metre tall annealing furnace had no problem in accommodating the gigantic dimensions of the large-format components in order to enhance them with the specified mechanical properties. Delivery of the welded components to a processor commissioned by Schuler marked the successful completion of the job for Jebens. The production of these press plates has re-confirmed the reliability of the cooperation between Schuler and Jebens and established an excellent basis for future joint projects. And one thing is certain: in the global growth market for long-life forged wheels for high-speed trains, Schuler's turnkey forging lines for efficient wheel manufacture will be in high demand.

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