THE TECHNICAL ISSUE

Laser welding system is heart of increased competitiveness

Auto-crane manufacturer Manitowoc invests in future technology

By Dipl.-Ing. Walter Lutz, freelance journalist from Haiger

Photos: CLOOS/Lutz

WILHELMSHAVEN – The Manitowoc Group is one of the world's leading crane manufacturers. The US Group produces its GROVE brand auto-cranes at the Wilhelmshaven site. To increase competitiveness, the company is currently investing in state-of-the-art production technology and optimised material flow in the traditional manufacturing shops. Its heart is a 60 m-long CLOOS laser welding/cutting system around which the production of the telescopic booms flows.

Where Krupp once manufactured harbour cranes, today around 500 yellow and black GROVE auto-cranes leave the traditional factory in Wilhelmshaven every year. The applications of the current range of vehicles are diverse. 16 current types from 4 to 7 axes lift loads of 50 to 450 tonnes to heights of 135 m, e.g. for installation of large-scale wind energy plants.

With the new CLOOS robot laser welding system Manitowoc moves into state-of-the-art production technology. The top and bottom of the auto crane boom sections which measure up to 14 m (max. 19 m) are welded and drilled on the system.

The performance capacities of the Manitowoc mobile cranes depend to a great extent on the boom. A boom comprises a main element and up to 6 six telescopic sections, each of which can measure up to 14 m. "To optimise the manufacture of our crane booms, we have changed a few things in the conversion to the laser welding system" says Michael Hüneke, the production manager and welding expert at Manitowoc. The lower half is made of a thicker sheet than the upper half. "The abutting elements thus provide the laser with a precise fillet weld path along which it can travel cleanly." High-strength fine-grained steels with material thicknesses from 4 to 15 mm are used to produce the boom sections.

Compared to previous production processes increased welding speed are not the only benefit of the new laser system. "On the old system we could only weld under powder in the PA position. We had to rotate each part through 180 degrees for the second weld" recalls Hüneke. In the CLOOS system a 7-axis QIROX robot on a mobile 4 m high gantry moves the laser hybrid torch precisely to the left and right along the boom in the PC position, i.e. at 3 and 9 o'clock. At the same time the new process has considerably increased the welding speed from 60 cm/min formerly to 150 cm/min.

The CLOOS QIROX robot with its 7 axes is suspended below a gantry which travels along a precise rail system through the 26 m-long cabin. Processing is in the PC position, i.e. at 3 and 9 o'clock, so the boom need not be rotated.

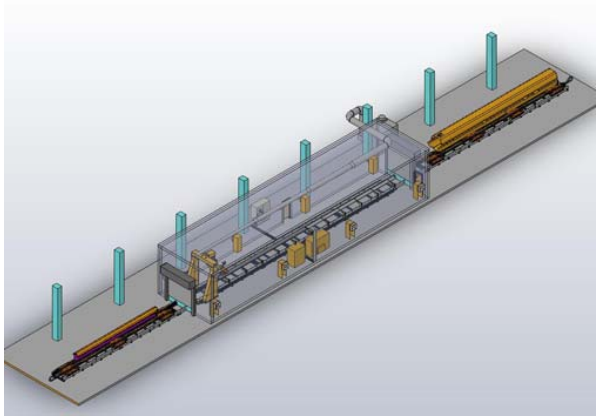
"The laser hybrid welding process also saves us welding on the backing (pool protection) for the UP weld seam, the weld preparation (chamfer) and the set-up of the internal pressure equipment", says Hüneke citing further savings. There are also reductions in filler materials. Even the expensive disposal of powder is now a thing of the past. "So the investments in the new laser system and the conversion of the production will pay for themselves in the foreseeable future" says the energetic production manager. The CLOOS laser hybrid system with 12 solid-state lasers guarantees optimum and clean welds with just one welding layer. There is no need to weld several layers which means further cost reductions.

"We also used the laser for marking (scoring) positions on the booms where attachments will be welded or openings will be made later" says Hüneke. "Scoring by hand would take a good two hours. "Now the robots manage it in 20 minutes." The CLOOS robot automatically changes the laser welding head for a laser cutting unit which produces holes and openings along the boom. "By hand, each hole took 15 min. The laser produces up to 30 holes in the same time."

Clean weld seams are achieved by the laser hybrid head with minimum weld preparation or rework. The laser cutting head produces all holes and cut-outs along the boom within a few minutes.

Laser welding – the process with future

For several years Michael Hüneke considered, researched and worked meticulously to get modern future-proof crane boom manufacturing up and running. Initial tests with a CO2 laser showed clearly the benefits of this new technology. "When CLOOS arrived with the idea for the laser hybrid welding process we used the chance together to design and realise this brand new system." At the same time, Hüneke started work convincing the corporation to invest the in new technology. "Lower material costs, significantly shorter manufacturing times and the quality benefits convinced them" says the production manager, happy with the positive decision. "It increases our competitiveness and ultimately secures our site with its thousand employees."



Layout of the 60 m long CLOOS laser hybrid system with the laser-proof cabin in the centre and the two loading and unloading stations which permit optimised work-piece flow.

In the summer of 2012 the laser system concept was ready and CLOOS received the order to go ahead. In autumn the conversion of the venerable old production shop began. Stable foundations were needed and a laser-proof cabin measuring 26 m long, 6.5 m wide and 5.5 m high had to be built. "Thanks to Manitowoc's close cooperation we quickly found solutions to every challenge" says a satisfied CLOOS project manager Gerd Zimmermann. In January 2013 the Haiger welding technology specialist delivered the system components to Wilhelmshaven. After construction proceeded to schedule, commissioning followed in April. "It was a challenge" says Michael Hüneke, not least because the laser system had to be integrated into the ongoing production environment. At the same time the Manitowoc employees were receiving awareness and training on the new technology. The motivated specialist staff learnt about setup, operating and programming over a few weeks in a series of courses at the CLOOS application centre in Haiger as well as on the system on site.

On the safe side: laser system is completely enclosed

A cabin made of sand lime bricks with integrated laser-proof roller shutters at the front prevents the escape of hazardous stray radiation.

The CLOOS safety controller also enables the working area of the robot to be defined such that the laser radiation cannot cause any damage. The system has been inspected by an expert according to the current safety standards EN 60825 and EN 11553. It is operated and monitored externally via the control unit and via video camera and monitor.

While the laser is working in the enclosed cabin, the operator has a constant view of the processes inside the cabin on the monitor.

The entire system is controlled by the sophisticated Cloos Qirox controller which is located outside the system. With the programming teach pendant (PHG) with its large keypad and clear touch screen Manitowoc operators have the CLOOS system safely under control. Respectively to the left and right of the brick-built laser cabin there are 17 m long loading and unloading zones for the two suspended transport carriages to which the booms are fixed for welding. "This minimises waiting times" explains Hüneke. What's so special: the transport carriages and the robot gantry travel back on one and the same continuous 60 m rail system to achieve maximum possible positioning accuracy.

"On the 26 m front wall of the laser cabin a local artist (Burkhart Königshoff) has depicted the long history of joining technology in pictorial form to our specifications, from riveting through manual welding to our laser robot" says Michael Hüneke rather proudly. "It's the perfect crowning feature for this plant.“

CLOOS project manager Gerd Zimmermann (l.) and Manitowoc production Manager Michael Hüneke in front of the laser cabin on which is depicted the history of joining technologies at the traditional factory.

Some 500 GROVE-brand auto-cranes every year leave the Manitowoc factory in Wilhelmshaven. You can clearly see the structure of the yellow crane boom with its grey telescopic elements, one inside the other. Hook heights of up to 135 m are possible together with a lattice extension.

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