

**Flexible Production Technologies for Electric Powertrain  
– 3<sup>rd</sup> Reutlingen E-Mobility Days (RED)**

From October 18 – 20 the third edition of the 3rd Reutlingen E-Mobility Days (RED) took place at the WAFIOS headquarters in Reutlingen. The annual technology show with the focus on "**Flexible Production Technologies for Electric Powertrain**", which has been established in expert circles for some time now, has become an integral part of the event calendar of WAFIOS and cooperation partner GEHRING as well as numerous renowned co-exhibitors. A popular meeting place for professionals to exchange ideas and learn about the latest developments. This included presentations from research and practice on current topics throughout the days of the event.

The exhibition focused on the entire stator assembly process as a turnkey production line or stand-alone solution. The focus topics ranged from wire material to insulation stripping by laser, bending technology, hairpin assembly, twisting, welding, measuring and testing technology, and services such as prototype production for customer components. In addition, WAFIOS showed many manufacturing solutions for further applications in the e-mobility sector for both prototyping and series production.

This year saw the world premiere of the adaptive straightening system just developed by WAFIOS. Straight wire is a prerequisite for producing dimensionally accurate hairpins. The straightening process is thus the key technology for the production of dimensionally accurate hairpins. With adaptive straightening, WAFIOS has succeeded in ensuring fully automatic adjustment of the straightening devices, regardless of the operator's experience.

For this purpose, the fully automated AI-based straightening management system was developed in a research project using FEM simulation, artificial intelligence and practical experience gained from over 100 years in the field of wire processing. The aim was not only to produce a straight wire but rather to achieve a robust and largely constant straightening result in case of varying input variables, such as a change in the wire's curvature when it is pulled off the coil or changing material properties.

In other words, a technology that uses artificial intelligence to take into account the complex factors influencing the straightening process and then leads to an according initial adjustment of the straightening rollers. After a subsequent 3D measurement of the straightness, the advance feed of the straightening rollers takes place adaptively. The automatic straightening system ensures high straightening quality and, as a result, high accuracy of the hairpins. It also reduces setup time and material consumption.

Cooperation partner Gehring presented their capabilities as a supplier of entire turnkey production lines. Here, the machinery manufacturer can draw on its extensive expertise in customer-specific design and manufacturing production machines for the automotive industry. Gehring showed the latest technologies in stator production for setting and inserting the hairpins into the laminated core. This included the robot-based, highly dynamic setting process of hairpins for the construction of wire baskets as well as reliable insertion into the laminated core with alignment and paper protection devices. The overall system impresses with a low cycle time that is adjusted to the WAFIOS SpeedFormer and a high degree of flexibility in implementing different winding schemes. Thanks to automated evaluation of the setting pattern and the optimal machine design, several workpiece types can be formed on one setting machine.

In the field of prototype production of plastic tubes, the versatile and flexibly applicable WAFIOS HotBend 35 was shown. This innovative technology enables the bending of straight plastic pipes in the 3D bending process, comparable to a classic tube bending machine. In this process, the area of the bend is heated by hot air in the patent-pending heating system and is then formed using the conventional rotary-draw bending technique. The proven TWISTER<sup>2</sup> technology is used to support the tube geometry. Prototypes or small series in particular can be produced flexibly, quickly and economically.

Automation is a central component for manufacturing tasks in electromobility in order to enable more economical manufacturing solutions in the future. WAFIOS offers customized automation solutions. These include complete manufacturing solutions with robot interlinking as well as the integration of handling robots. With EasyRobot, WAFIOS showed at the RED how the perfect connection of robot and machine works. Presented on the FMU 40 E for hairpin production with interlinking to a Kuka handling robot. EasyRobot sets new standards in operation and fully integrates the robot into the WAFIOS Programming System WPS 3.2. This merges the part program for the hairpin with the robot program. The separate, very time-consuming setup of the robot is no longer necessary, nor is special programming knowledge and training for the robot, see also Fig. 3. User guidance and programming of the motion functions are performed on the machine's touch screen monitor. All sequences performed by the robot can be implemented directly in the program of the machine. The robot axes can be conveniently moved using the machine's hand-held operating device. The robot program that corresponds to the bending program is saved and can be reloaded as required. The robot forms a safe and CE-compliant overall system with the machine. With EasyRobot, WAFIOS sets new standards in the field of robot applications for simple handling tasks. This makes cost-effective and easy-to-use robotic solutions accessible at a new level and also very attractive for SMEs.

Another core area of the e-mobility activities is busbar production both as stand-alone solutions or fully automated production cells, see Fig. 4. WAFIOS has for the first time developed a bending machine for profile parts and busbars with the CNC-controlled BMF 60, which has the latest process technologies (patent pending) to form complex parts with the tightest radii and torsions. In addition to the conventional straightening, bending and cutting process, an insulation stripping and twisting process can be integrated into the machinery system.

"With numerous manufacturing solutions for electromobility, WAFIOS has become an important player in recent years. In the area of hairpin production, more than 30 customized projects have been implemented," summarized Dr. Weigmann, CEO of WAFIOS AG, at the end of the event, adding, "In close cooperation with our partners, we continue to develop and work on innovative solutions for even more efficient production of electric powertrains."



Fig. 1. 3rd RED logo with exhibitors



Fig. 2. (from left to right) WAFIOS Executive Board Members Dr.-Ing. Uwe-Peter Weigmann and Martin Holder at the HotBend for bending of plastic tubes





Fig. 3. WAFIOS EasyRobot on FMU 40 E for the production of hairpins



Fig. 4 WAFIOS BMF 60 busbar bending area