

Competence in composites: Equipped for lightweight construction

The efficient machining of composites and composite materials is currently one of the key topics of manufacturing technology. True to its motto "Key to markets", Messe Stuttgart is also making this a major topic at the upcoming AMB, the international exhibition for metalworking, which takes place from 16 to 20 September 2014 in Stuttgart.

methods required. "The necessary knowledge and production equipment must be established in the company, which requires corresponding investment." However, he warns against the "wrong approach" of a pure material substitution in line with the motto: "We use carbon sometimes instead of steel sheet." If used correctly, however, composites "could have a



Under the heading "Competence in composites", exhibitors display their special skills in this area. Trade fair visitors can find these exhibitors very quickly thanks to a corresponding logo at the trade fair stands and special information in the trade fair guide. Visitors can also obtain information within the framework of the event series of business breakfasts. "Introduction to composites and precision tools" by the Stuttgart Region Economic Development Cooperation, which also dedicates itself to the topic with several presentations.

Presentations introduce the topic

"The increase of composites in production and especially series production is creating a demand for technologies, machines and tools", is how Dr.-Ing. Marco Schneider, Department Director, Lightweight Construction Technologies, at the Fraunhofer Institute for Production Technology and Automation (IPA) in Stuttgart, describes the general direction. Despite near net shape manufacturing, many components made from composites usually require machining. "The transfer from metalworking to machining composites, CFRP (carbon fibre reinforced plastics) or sandwiches is only possible with special measures. This starts with the machine tool, the machining technology, the cooling and lubrication concept, and extends to the tools, the extraction through to the quality control." The broad range of composites also lays down very individual requirements in relation to tools, machines and process parameters. In his presentation within the framework of the business breakfast, on 18 September at 9.30 in the "Regio Lounge" at the East entrance, he will mention the requirements of "Precision tools for machining composites".

Dr. Schneider sees huge possibilities with lightweight materials, which extend beyond the well-known fields of application in the aviation and automotive sectors to many other areas. However, two obstacles are still preventing any breakthrough; firstly, the new way of thinking required in composites, or fibre-based materials, and secondly, the alternative manufacturing and machining

nucleus effect, in order to think in terms of these new materials and the possibilities, apply the new manufacturing methods for other products and thus drive product and production innovation."

Dr. Simon Küppers, Deputy Department Director, Fibre Composite Technology, at the Institute of Textile Technology and Process Engineering (ITV) Denkendorf, who will also deliver a presentation in the "Regio Lounge" on 19 September at 9.30, sees it from a completely different angle. He examines "Fibre composite technology, joining techniques and organic sheeting" from a textile point of view. In order to further reduce the weight, smart functions cannot only be integrated into the components, but directly into the textile and even into the fibre. The resin systems could also assume additional functions. "Weight reduction can also be achieved by system monitoring, i.e. the monitoring of components, because then the safety factors can be reduced with the design", states Dr. Küppers. Another approach he mentions is "tailored fibre placement". Bionic designs and fibre orientations imitate nature and make them useful for technologies. Weaving and braiding technologies, as well as preform technologies, are other ways to make components lighter. "There is thus a strong focus on textile engineering, as it is already familiar with a complete range of efficient methods for meeting requirements from fibre composite technology", states Dr. Küppers with confidence.

Improved process reliability

"The particular challenge in the machining of composites lies in the reliable and efficient machining, particularly the drilling of so-called stack materials", explains Dr. Peter Müller-Hummel, Head of the Business Division Aerospace & Composites, at Mapal Dr. Kress KG in Aalen. To date, sometimes composite materials, made from composites and metal materials such as titanium or aluminium, still have to be bored out in several steps. "In the future these bore holes are to be completed in a single work process." Under no circumstances, however, should this affect the quality. Whereas up to now the bore hole diameter

changes over the service life of the drilling tool, today Mapal can achieve a constant diameter in all stacks by using a new type of technology. Dr. Müller-Hummel: *"With this technology bore holes can be reliably produced in the H8 tolerance range with a process capability index of over 1.4."* Nevertheless, an important prerequisite is that the environment and the machine satisfy this quality standard.

The trend is heading towards significantly higher quality, but more durable tools, in order to reduce the price per bore hole. An example of such a tool, which can be seen at the Mapal Stand 5D32 within the framework of the PTW special show in Hall 5, is the Tritan Drill for difficult drilling situations. Mapal promises reliable machining and significantly better performance in comparison to conventional solid carbide drills. Three blades and an aggressively designed, self-centring cross-cutter should lead to maximum position precision upon initial contact with the workpiece - particularly important for difficult boring situations such as drilling through material or entering cross holes. The special sanding pad should keep the cutting pressure and blade temperature low, the point discharges the swarf without friction via three clamping slots.

Martin Heckel, Head of Product Management at LMT Tool Systems GmbH in Oberkochen, sees the aerospace and automotive industries as the trend-setters for composites. But several new industries such as wind energy are now also pushing the use of composites. Depending on the requirement of the component, diverse lightweight materials such as titanium, aluminium, CFRP, glass fibre reinforced plastic, CFRP-metal layered compound structures and honeycomb structures, are also being used, whose reliable machining poses huge challenges. *"What is characteristic of these technologies is that they not only substitute materials, but also demand a separate process chain from the component design to the manufacture of the raw materials and semi-finished products, the shaping through to the realisation of the final contour and surface of the component."* For machining processes an optimal surface quality and high tolerance precision has to be combined with tools boasting an extremely long life. This is why the LMT Group is developing customised solutions for its customers which are specific to the applications and materials.

For instance, at its AMB Stand 1F52 in the L-Bank Forum (Hall 1) LMT showcases the DFC Compression Mill, a drill with a counter-rotating twist and a defined compression point. *"Below this point it has an ascending twist, above it pushes the swarf downwards. In an optimal situation, the pull and push are*

at equilibrium, the laminated workpiece is properly compressed", explains Martin Heckel. For processing so-called "honeycombs", LMT Onsrud developed special slot millers and milling cutters with variable cutting heights and replaceable cutting parts. These structural and inner panels are used in aero-planes. The slot millers can cut the top layer and undercut the honeycomb structure in just one step. Using a PKD 2 tool the top layer and honeycomb structure are then cut. The "One-Shot-Drill" from LMT Belin thus combines three work steps in a single tool. It can drill, ream and bevel stacks made from CFRP and aluminium, in order to prepare them for riveting.

Trainee project: Pedal car with CFRP components

Paul Horn GmbH, Tübingen, have come up with something quite spectacular for AMB. In order to make their own young and talented staff more aware of composites in a more practical manner, the trainees have built a pedal car, a type of modern soapbox. The chassis and the split rear axle are made from CFRP. It can be viewed at the stand of the Horn-Akademie at the East entrance area, Stand No. E2-102. The tools which the trainees used for machining the material are located at the trade fair stand 1116 in the L-Bank Forum (Hall 1). CVD diamond, in particular, plays an important role here as a cutting material. It can be used not only for turning, but also for cutting aluminium alloys, graphite and plastics reinforced with abrasive filling materials. Press Contact Christian Thiele: *"Through the combination of the long service life of the diamond tools and the new Horn chip groove geometry on the CVD diamond cutters, productivity can be increased by up to 35 percent and the machining costs reduced by up to 80 percent."* Horn also developed various cutting inserts with wiper geometry for high-speed cutting for internal and external turning. Significantly longer tool lives are possible with these CVD-based tools. Thiele Stolz: *"For a composite made from PEEK (polyetheretherketone) containing up to 50 percent of carbon fibres, we were able to increase the tool life threefold for a customer in comparison to PKD tools"*.

Mechanical engineers with new concepts

Not only the tool manufacturers are needed when it comes to machining fibre-reinforced composites, but the machine tool manufacturers also have to be more inventive. The Italian manufacturer Jobs S.P.A, Piacenza, boasts over 30 years of experience with such machines. The "Speeder" line is a range of milling centres with a mobile portal and was designed especially for machining composites in the aerospace and automotive industries. Antonio Dordoni, Vice President, Sales, Marketing and Service: *"The Speeder line consists of two basic versions with a similar structure,*



but different power outputs up to 22 kW and speeds up to 60 m/min. These can be adapted to the specific requirements of the customer." For the developers, it is a matter of low operating costs and easy maintenance. "We also looked for technical solutions, which correspond to the eco design and the environment-friendliness of the "Green Vision" of Jobs." The high portal machines are suitable for medium and large dimensions. They have high dynamics and high operating volumes. Important when machining fibre-reinforced materials: A high-performance extraction system and an enclosed cabin, which guarantee the safety of the operator, but also easy accessibility. The Speeder machines can be viewed in Hall 5 at Stand 5A11.

For the automotive industry

The Swiss company Otto Suhner with a German subsidiary located in Bad Säckingen, also adapted itself to the special requirements of machining composites. These materials are increasingly used in automotive manufacture for rooftops, body parts, inner panels, switches and operating elements, states Dieter Herzog, Head of Automation. And in aircraft construction the "almost exclusively used aluminium is being replaced with stacks, multilayer materials of diverse materials". It is precisely these layered materials which are placing the highest demands on the respective drilling and cutting tools when machining and on the machining industry. Herzog: "In order to achieve optimal machining results, very different cutting parameters have to be used. The change should ideally take place automatically, the spindle speed and the infeed must be able to be adapted to the next material independent of each other for every transition." This is why Suhner developed hand-operated two-axle CNC riveting machines especially for the aviation industry, which satisfy these requirements. Stationary drilling machines, which are currently in the testing phase, are brand new. Similar requirements can also be seen in the automotive industry with automotive components manufactured from CFRP. Herzog: "Suhner provides suitable machining units precisely for these tasks, which are used for large, bulky workpieces, as they can work from different directions at the same time." Herzog mentions a special machine as an example, which can perform 33 boring operations simultaneously in less than 2.5 seconds with 33 spindles. Otto Suhner showcases its products for machining such materials in Hall 3, Stand 3C76.

Xperion Components GmbH & Co. KG in Laudenbach specialised less on the machining of composites and more on their use in machine tools. At its Stand E2-206 in the East entrance area, it presents CFRP components which are exposed to high accelerations.

"Low weight and the adjustable, if required very high specific stiffness, coupled with a low, also definable thermal expansion, are the valuable material properties that CFRP offers vis-a-vis steel and which bring the user significant added value", states President Thomas Henß. For instance, the X-Girder, a rectangular CFRP girder with mounted guide rails in thermostable design, enables a 20-fold speed increase without compromising on quality in comparison to steel. The problem: CFRP is almost thermo-stable, steel expands during heat exposure. A fixed connection would cause warping at fluctuating working temperatures and thus jeopardise the repeat accuracy. Thomas Henß: "With a patented mounting solution, we have managed to allow an axial expansion of the guide rail and thus remove any concerns regarding repeat accuracy."



Not to be missed

More than 90,000 visitors and around 1,300 exhibitors are expected to attend AMB 2014 from 16 to 20 September 2014. Exhibitors will present innovations and further developments from the metal cutting and precision tool industry, as well as chucking tools, CAD, CAM, CAE, software, grinding machines, handling of workpieces and tools, and measuring systems on a gross exhibition area of more than 105,000 square metres. AMB 2014 will be backed by the promotional supporters, i.e. the VDMA Precision Tools Association, the VDMA Software Association and the Association of German Machine Tool Manufacturers (VDW).

AMB

International exhibition for metal working
Messe Stuttgart - Deutschland
Dates: 16-20 September 2014

Schedule:

Tuesday to Friday from 09.00 am to 06.00 pm
Saturday from 09.00 am to 05.00 pm

www.messe-stuttgart.de/amb/

