

Press Release

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Technical closing report on the EMO Hannover 2013 from 16 to 21 September 2013

EMO Hannover 2013 showcased the production technologies of tomorrow

Intelligent production technologies for raising productivity and optimising resource utilisation

Frankfurt am Main, 28 October 2013. – Under the motto of “Intelligence in Production”, solutions were presented at EMO Hannover 2013 that efficiently integrate new information technologies. The focus here was on innovations that automate, simplify or enhance the efficiency of the work sequences involved. The showcasing of these path-breaking production technologies has created the foundations for maintaining corporate competitiveness against globalised competition. One general trend is the incorporation of styling and operator-friendliness. Emulating the smartphones, numerous machinery control systems now feature a touch-screen. In conjunction with the design of other equipment, this combines to produce an attractive visual appearance.

From a technical viewpoint, numerous solutions are motivated by currently expanding industrial sectors, like the aircraft industry and the energy utilities. The titanium- and nickel-based alloys used, titanium aluminides or carbon-fibre-composite materials require appropriate tools, machinery and machining strategies. The energy

turnaround goes hand in hand with a rising demand for systems designed to use regenerative energies. Efficient machining of the large-dimensioned components required likewise necessitates appropriate equipment. In order to improve efficiency of the production process, new manufacturing technologies like 3D printing are being progressively integrated into ongoing production operations. The spectrum of structures that can be manufactured is thus significantly extended. However, so far there are still limitations to these processes if quality requirements are to be complied with. To enable conventional machining to be performed more efficiently the pieces of equipment concerned are purposefully modified. One example is the use of carbon-fibre composites for structural components of machines or as part of tools. Thanks to their lighter weight, the better damping properties and the higher rigidity of this material, the performative capabilities of the equipment involved, and thus the productivity of the production process, can be enhanced.

Examples are presented below of the trends and issues on which production technology is focusing.

Enhanced operator-friendliness by using innovative information technologies

Many EMO exhibitors showcased solutions that prioritised operator-friendliness. Modelled on smartphone and tablet technologies, concepts were on show that significantly facilitate control of the equipment concerned. With Celos, DMG / Mori Seiki Europe Dübendorf, Switzerland, premiered an operator control level with a touch-screen. The processor behind it can be embedded in the production planning function. In this way, CAD data can be viewed directly, and changed at will. Liebherr-Verzahntechnik GmbH, Kempten, a manufacturer of gear-cutting machines, premiered a new, intuitive system for operator control and for simplified make-ready of its machines. Touch-based operator control and plausibility checks, plus direct graphical depiction of the tools selected by the operator, enable makeready times to be shortened and errors during makeready to be avoided.

Complete machining of workpieces for enhanced productivity

The aim here is to perform several different machining operations on a single machine, so that the change-over times are reduced and accuracy levels improved. WFL Millturn Technologies GmbH & Co. KG from Linz, Austria, presented a machine that enables its users to execute not only turning, milling and drilling operations, but also deep-drilling, grinding and honing. In addition, metrological technologies can be used for taking in-process measurements. In addition, a capability has been integrated for internal turning of large drilling depths as a new process, making for a shorter path and a higher surface quality of the boreholes created.

For rotary transfer machines, too, complete machining is the watchword. Mikron SA from Agno, Switzerland, presented a rotary transfer machine with twelve stations, in the shape of the NRG-50. Three machining units can be integrated at each station. A total of 30 units can be in operation simultaneously; the maximum number of tools is 96. 6-side machining creates a complete-machining capability. Thanks to the modularised construction, the machine can be adapted to suit different series-production requirements.

Another example for the integration of several machining operations on a single machine comes from MAG IAS GmbH in Göppingen. In the shape of the Specht 600 Duo, a CNC machine featuring a double spindle and integrated honing technology was showcased, designed in particular for machining motors. So far, in most cases dedicated machines are using for honing operations.

Flexibility for large machines

The issue of flexibility is becoming progressively more crucial for large machines as well. The aim here is to reduce makeready times, avoid reclamping the tools, and automate the work sequences involved. For machining boreholes with relatively large diameters using the BTA (Boring and Trepanning Association) process, a deep-drilling procedure for creating boreholes with a large length-to-diameter ratio, or a combined peeling and burnishing process, not much optimisation has been

accomplished so far. In order to speed up the change-over process, Ecoroll AG from Celle premiered what it says is the first quick-change interface for this category. In this concept, the tool is moved into the device without rotation and clamped by turning it 40°. Compared to conventional BTA and ejector threads, this innovative interface enables the tool change-over routine to be automated. This is particularly useful when several different processes, like drilling, peeling and burnishing cannot be performed in combination.

New developments in turning operations

In the case of turning operations, due to the relatively simple kinematics of the process concerned, there are limits to the amount of optimisation achievable. In order to upgrade efficiency nonetheless, new concepts are needed for minimising change-over times. Weiler Werkzeugmaschinen GmbH, Emskirchen, presented a 4-path lathe fitted with automatic cycle control. In this way, the tool slide and the steady rests for supporting the workpiece can be moved independently of each other, enabling a solution to be achieved that assures high precision even for large-size workpieces. The machine is in its standard version constructed with a peak width of 12 m, which can be extended using modularisation up to a length of approx. 30 m. In order to upgrade productivity levels for machining ships' crankshafts, the Weingärtner Maschinenbau GmbH company from Kirchham, Austria, premiered a millturning machine. Thanks to a traversing and swivelling milling head, this model is also able to machine the bearing seats for the connecting rods.

Machine tools with parallel kinematics

At roughly the turn of the millennium, the use of parallel kinematics in production technology was being intensively researched and discussed by reason of its inherent improvement potentials compared to conventional machines with serial kinematics. So far, however, machines featuring parallel kinematics have not been able to meet the high expectations of their users. Willemin-Macodel SA from Delémont, Switzerland, a manufacturer of high-precision components for the watch industry, the medical technology producers and the aerospace sector in particular, exhibited a

new machining centre with parallel kinematics, in the shape of the 701S. The machine's concept is essentially based on delta kinematics driven by three linear motors with play well-nigh eliminated, thus actuating the machine's translatory degrees of freedom. According to the manufacturer, dynamics and accuracy can be significantly improved compared to his serially driven machines, thus reducing the machining time required, by a factor of 5.

Conventional machines from Asia

Conventional lathes and milling machines, which are an absolute necessity for teaching and training organisations in particular, were likewise on show at EMO Hannover. Almost all these machines come from Asian countries, which is why not only the manufacturers themselves are represented but also European companies that import machines from Asia. Kami GmbH from Isernhagen, for example, showcased its machinery portfolio, which is manufactured at Chinese firms. The machines are imported, and customised to suit each purchaser's requirements. Service support is provided directly by Kami.

Following the last EMO Hannover in 2011, there were reports of planned joint ventures between Chinese and German manufacturers. One result was presented by Shenyang Machine Tool Group from Shenyang, China. The Viva Turn horizontal CNC turning centre has been designed for the European market, and developed by German engineers at the development centre of Schiess Tech GmbH in Berlin. The machine is manufactured in China, and according to the vendor provides high-speed machining with good levels of both accuracy and reproducibility.

Dry-machining still a topical issue

Dry-machining continued to be a significant issue at the EMO Hannover 2013. New solutions were spotlighted in different categories. The tool manufacturer botek Präzisionsbohrtechnik from Riederich premiered single-lip deep-drilling tools developed specifically for machining with minimal-quantity lubrication. These high-performance drills are offered in a diameter range of between 2 and 12 mm. Gühring

OHG from Albstadt exhibited a test rig for tools with a minimal-quantity-lubrication feature. In this test rig, particularly, the response time up to the first aerosol exit and up to a constant aerosol flow can be determined. In addition, there is an option for checking how large the oil quantity is and whether this value remains constant over the entire process time. The company offers its customers a corresponding check routine for minimal-quantity-lubrication tools as a service extra.

Starrag AG from Rorschacherberg in Switzerland, and Walter AG from Tübingen showcased their jointly developed solution for cryogenic process cooling. Cooling by means of CO₂ snow offers numerous advantages in terms of coolant feed compared to the previous nitrogen-based cooling. During the feed operation, until it exits from the nozzle near the blade, the CO₂ is at room temperature. This means the concept can be retrofitted to existing machines. Typical applications for cryogenic machining operations include processes that hitherto have been carried out in dry mode, and in which productivity can be increased by using this innovative form of cooling. In addition, extended useful lifetimes are possible when handling difficult-to-machine materials like titanium-based alloys.

Using carbon-fibre composites in machine tools and tools

The xperion components GmbH & Co. KG company from Laudenbach showcased tools and machine components made of carbon-fibre composites at the EMO Hannover, exemplified by an optimised grinding disk. The preceding model had a fabric-like structure. The new disk is made of thin, oriented layers, thus further significantly increasing its rigidity. The radial termination is implemented as an annular rigid profile. In the category of turning, a drill rod was presented for internal turning, with which the length-to-diameter ratio has been increased from 3.5 to 4.6 by using carbon-fibre composites. In the category of machine components, carrier components were exhibited with which the weight has been reduced by 25 per cent compared to conventional solutions. In addition, carbon-fibre-composite components exhibit higher rigidity and better damping properties. Thanks to an innovative expansion compensation concept, moreover, a solution was presented for

guideways: these are made of metal on a carbon-fibre composite base, and can expand as necessary when subjected to thermal stress.

At the EMO Hannover, Werkzeugmaschinen & Automation GmbH from Magdeburg exhibited a machine for which the Z-slide was manufactured from carbon-fibre composites. Compared to a slide made of aluminium, the weight has been reduced by 45 per cent. This weight saving can be utilised for a higher dynamic of the linear axes. Besides higher productivity, the energy consumption has simultaneously been reduced.

Machining carbon-fibre composites

Machining plastics is particularly problematic because of the health-hazardous dust produced. The Jakob Lach GmbH & Co. KG company from Hanau presented a PCD continuous-drilling tool for machining carbon-fibre composites, glass-fibre composites or thermosetting plastics fitted with an internal extraction feature. The dust particles containing glass fibres or carbon are, says the vendor, effectively removed from the process, eliminating the risk for humans and the natural environment.

Using laser technologies

The laser technologies offer options for both ablating and depositing material. The Acys Lasertechnik GmbH company from Kornwestheim showcased a process for creating chip-breaker geometries at tools. The chip-breakers are very difficult to produce individually or as small series by conventional methods. With this laser technology, any defined chip groove geometries can be created. In addition, there is an option for rounding off cutting edges with the laser. This process is currently being developed for series production, and could replace conventional processes like abrasive blasting.

In 3D printing technology, material is deposited using lasers. Layer by layer, powder is applied, and melted onto the component concerned by the laser. EOS GmbH from Krailling outlined the possibilities unveiled by this technology in a presentation given

under the aegis of the congress on “New Production Technologies in the Aerospace Industry”. Complex components can be manufactured whose structure cannot be produced by metal-cutting. It is predicted that in future around 50 per cent of a turbine’s components will be additively manufactured, with projected weight savings of 450 kg in a turbine weighing 2,700 kg.

The laser is also used for supporting conventional machining processes. The Fraunhofer IPT from Aachen and the tool manufacturer Rineck Maschinenbau GmbH from Marienfeld presented a milling tool in which the material concerned is warmed up directly in front of the blade using a laser. Thermal softening of the material reduces the process forces required for subsequent milling of silicon nitride ceramics by 90 per cent, and for machining the nickel-based alloy Inconel 718 by up to 60 per cent. A realtime control system is used to synchronise the laser irradiation with the tool engagement, so that only the material being machined is softened, and the possibility of damage to the rest of the material can be ruled out.

Improving the characteristics of bearing surfaces

The Supfina Grieshaber GmbH & Co. KG company from Wolfach presented an innovative finishing process for improving the antifrictional and bearing characteristics of surfaces. This process features not only rotational workpiece movement and an oscillating tool movement in the axial direction, but also an oscillation of the tool in a radial direction. This creates not a full-coverage cross-hatched pattern, but a structured surface, featuring occasional recesses, in which oil can collect. This piezo-aided structural finishing offers an opportunity to replace the laser honing previously used.

Enhanced metrological efficiency

The topic of “Intelligence in Production” is also reflected in the new metrological solutions presented. The Mitutoyo Deutschland GmbH company from Neuss unveiled a compactly dimensioned 3D coordinate measuring machine called “Mach-3A 653”, which can be integrated as a station in concatenated lines. It detects incorrectly

machined workpieces as rejects at an early stage. Corrective action can then be initiated. With their traversing speeds of 1,212 mm/s, the machines are significantly superior to conventional coordinate measuring models, and are compactly dimensioned. The accuracy for length measurements is extremely tight, at 2.5 µm.

Carl Zeiss Industrielle Messtechnik GmbH from Oberkochen presented an X-ray-based process able to detect internal defects like blow-holes at the blank. With the aid of the associated software, the areas to be machined can already be digitally ablated, so that only the material quality in the relevant areas is taken into consideration.

Alicona Imaging GmbH from Graz, Austria, unveiled an optical microscope with which steep flanks of up to 80° can also be imaged. The systems featuring “Infinite Focus” are based on a focus variation. With the associated software, the actual form shown can be compared to a setpoint contour. In addition, there is an option for measuring peak-to-valley heights or determining cutting-edge rounding phenomena.

Jenoptik Industrial Metrology Germany GmbH from Schwenningen showcased a measuring unit for determining roundness and diameter of the bearings at crankshafts. The unit scores heavily not least in terms of its motorised adjustment, which takes the measuring head to its optimum position for measuring. This is particularly necessary when the grinding disk is so worn that a correction is required.

Etalon AG in Brunswick premiered an innovative length measuring system for absolute measurements, in the shape of its Absolute Multiline Technology. The system is based on an adapted interferometric process, and can handle up to 100 independent measuring channels. Each channel has a range of up to 20 m, with a measuring uncertainty of 0.5 µm/m. Possible applications include monitoring production lines, monitoring or determining the geometrical shape of machines and of vibrations or thermal drift.

CAD/CAM

In times of shorter product life-cycles and higher variant diversity, the importance of CAD/CAM systems is growing. Automatic path generation on the basis of CAD drawings is meanwhile the state of the art for 5-axis milling. InterCAM-Deutschland GmbH from Bad Lippspringe has transferred the dynamic path generation customary for milling to the turning operation as well. Under the term of “dynamic lathe”, the turning tool is effectively utilised by taking due account of the blade’s shape. In this way, the cutting values can be significantly improved and the tool’s useful lifetime increased by up to 300 per cent.

“Intelligence in Production” also shows up in new developments for the field of CAD/CAM. Modern, operator-friendly user interfaces, for example, are featured in the new hyperCAD-S from Open Mind Technologies AG in Wessling. By incorporating ergonomic criteria, the wishes of CAM users can be responsively accommodated. The trend towards significantly user-friendlier interfaces is generally discernible among exhibitors in this field.

Expansion of tool management

Classical tool management, in which the tool manufacturer supplies a production line with tools, is meanwhile the customary standard procedure. At the EMO Hannover, the tool manufacturers are expanding their range of services by also designing the process involved. Because of shorter product life-cycles, the machining company often does not have the time to run its lines in or optimise them. Walter AG from Tübingen will accordingly on request handle the entire process design work. The “Multiply” concept subsumes not only tool supply and inventory management, but also component-specific cost analyses. The process here is meticulously analysed, and designed to ensure the lowest costs per good component.

Under the name of “Novo”, the Kennametal Europe GmbH company from Neuhausen, Switzerland, premiered a software package that helps the customer in autonomously designing his machining process. On the basis of a workpiece drawing

and the machine's connection dimensions, the software recommends various tools that are required for the machining process concerned. Taking due additional account of the quality stipulations, moreover, cutting values are outputted. The data are based on empirical values, and grouped together in a "machining cloud".

Enhanced efficiency for tools

In times of rising prices for hard metals, more effective use of hard-metal indexable inserts is essential. Numerous tool manufacturers unveiled solutions in which the inserts feature a higher number of blades. Iscar Germany GmbH from Ettlingen presented five-blade inserts from its "PentaCut" product family for groove turning and thread turning. In this way, the hard-metal cutting material is efficaciously used. The "X4" system from Seco Tooling GmbH in Düsseldorf has a four-blade insert. Though this tool possesses one blade fewer, thanks to the symmetrical configuration it can continue to be used without any problems if a blade breaks. Ingersoll Werkzeuge GmbH from Haiger unveiled, under the designation of "Gold Max 8", an eight-blade indexable insert for milling. The tool has been designed for milling cutters with tangential installation. The maximum cut depth is 8.7 mm.

Another concept for even better utilisation of a tool's blades was premiered by ZCC Cutting Tools Europe GmbH from Düsseldorf under the name of "Simply Coloured". Here, the colour of the insert's borehole designates the application class. In addition, the individual blades are colour-coded to indicate the cutting material concerned. In this way, the machine's operator can easily recognise which cutting material is involved and which blade has already been in use. Hitherto, the blades on indexable inserts were often not used up completely, since it could not always be detected which blades had been in use.

Clamping technology

A flexible production operation demands application-responsive clamping systems. One problem frequently encountered in this context is change-over of the devices

concerned. The Schunk GmbH & Co. KG Spann- und Greiftechnik company from Lauffen/Neckar presented a quick-change chuck for lathes. If a broad spectrum of different diameters has to be handled on a particular lathe, a complete replacement of the chuck is often necessary which can take up to one hour. The innovative chuck, which features a flex-cone, can be fitted in a matter of seconds. The concentricity lies at about 0.01 mm. Under the name of "TOPlus mini", Hainbuch GmbH from Marbach presented a chuck for machining rotationally symmetrical components. Thanks to full-area clamping, the total clamping force required can be reduced. The manufacturer also offers the TOPlus variants with sensor technology that detects the clamping force in the process and adjusts it to suit the loadings encountered.

Conference on "New production technologies in the aerospace sector"

Under the aegis of the conference on "New production technologies in the aerospace sector", perspectives and challenges in this specific sector were mapped out. MTU Aero Engines AG from Munich and Premium Aerotec GmbH from Varel showcased aircraft requirements for the years ahead. There are several programmes awaiting approval for the engines, so that by 2020 an increase of 100 per cent is being predicted. The higher efficiencies being demanded necessitate replacement of the materials used hitherto. The use of titanium aluminides as a material for turbine blades is an important step forward in this context, one that entails major challenges in metal-cutting technology. In regard to the material mix, there is an ongoing shift towards carbon-fibre composites and titanium-based alloys. In the A350, more than 2,000 components are made of carbon-fibre composites (Duromer), more than 3,000 parts of carbon-fibre composites (Thermoplast) and more than 600 parts made of titanium. These materials likewise pose stringent requirements for the design of the metal-cutting operation. In the case of titanium-based alloys, the choice of blade materials is usually restricted to hard-metal tools, resulting in low cutting values.

The tool manufacturer Kennametal Inc. from Latrobe (USA) reports good empirical results with CVD-coated diamond as a cutting material. In comparison to hard

metals, the cutting speed has been increased from 65 m/min to 300 m/min. In the case of carbon-fibre-composite materials, drilling operations are particularly difficult, since the drilling result is characterised by delamination and fraying. Mapal Präzisionswerkzeuge Dr. Kress KG from Aalen unveiled tools designed specifically for these drilling operations: they focus on dry-machining when drilling composites made of CFCs and titanium.

Specialist congress on “More Intelligence in Production”

Under the aegis of the specialist congress on “More Intelligence in Production”, the vision of “Industry 4.0” was addressed in detail. Besides the modern-day information technologies, new production technologies were addressed in general. Siemens AG from Munich emphasised in its presentation how a production line can be optimised by using a “Virtual Reality”. In the example, the output of a press line was increased by a simulation, and simultaneously its energy consumption cut by 40 per cent. Robert Bosch GmbH from Stuttgart primarily spotlighted its in-house production system. For implementing a pull principle, in particular, this system constitutes an important instrument. In its presentation, Audi AG from Ingolstadt focused primarily on the issue of efficiency. A “Production Strategy 2020” has been drawn up, designed to upgrade the efficiency of its production operations. By 2018, for example, the energy requirement and the CO₂ consumption are to be reduced by 25 per cent. Successful measures are being communicated worldwide and implemented inside the company.

Summary

At the EMO Hannover 2013, numerous solutions were presented in response to the to the latest social and commercial trends. Integrating modern-day information technologies into machine tools makes them more attractive and above all easier for the operator to control. In addition, revamped styling repeatedly emphasised how important a machine’s visual appearance has become as a sales argument. On the technological side, machines, tools and machine components have been developed that upgrade the productivity and efficiency of machining processes. Solutions were

unveiled here in particular for growing sectors of industry like aviation or the energy sector, contributing towards cost-efficient manufacture of the requisite components.

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