

Upgrading Your Toolbox

Manufacturers Focus on Tool Design, Material, Coating, Machine Tool Options and Cutting Parameters

Matthew Jaster, Senior Editor

First, the to-do list: Cutting tools need to reduce overall costs, increase tool life and regularly maintain the highest levels of productivity. Many of these requirements need to come from a customizable solution; one that is typically developed hand-in-hand with the customer from start to finish. This involves everything from tool design and cutting parameters to the material and coating options available. Here's a roundup of some of the cutting tool trends, technologies and challenges in the industry in 2017:

Gleason Q&A

Kurt Switzer, senior product development engineer at Gleason Cutting Tools, recently spoke with *Gear Technology* on some of the trends regarding materials, tools, coatings and machine tool developments.

GT: What are some of the most recent innovations in cutting tool materials in 2017?

Switzer: MC90 is still the most recent commercial addition to the gear cutting tool market. Due to the trend toward increasing stock removal rates, there is a corresponding effort towards developing materials with the required red (or hot) hardness.

GT: What are the benefits for gear applications and why does the performance of the material depend greatly on how the material is produced?

Switzer: Because of the highly alloyed nature of [MC90] and other high performance materials (e.g. ASP2048, ASP2052, ASP2060), they can only be made by particle metalurgy processes. Conventional ingot casting results in excessive segregation preventing hot working of the ingot into a usable bar. Materials like vanadium enhanced M35 are about the highest alloy materials still used in gear cutting that can be

made by conventional casting.

GT: Anything interesting happening in tool coatings today?

Switzer: Balzers introduced Balinit Altensa coating a couple years ago. While this coating is designed to perform well in high stock removal rate applications (high heat), its performance benefit to cost has prevented it from gaining popularity in the United States. Testing of this coating continues though, and it still may find some use in high speed gear cutting. Since the advent of TiAlN coatings on the cutting tool scene in the 1990s, the main driving force for new tool coatings has been towards increased stability at high temperatures. New cutting tool coatings now boast oxidation thresholds in the neighborhood of 1200C, which makes them ideal for dry cutting and aggressive stock removal rates even when cutting wet.

GT: How have these coatings evolved in recent years?

Switzer: Cutting tool coating technology tends to evolve rather slowly. There are three very popular coating chemistries still in use, TiN, TiAlN and AlCrN, but the technology behind these coatings was commercialized in the early 1980's. Aluminum Chromium Nitride based coatings now dominate the gear cutting tool market, although there are indications its rapid growth is starting to plateau. There are few coatings which might make bring significant changes to this market (e.g. CBN or α -Al₂O₃), but perhaps fortunately for tool manufacturers, the technical barriers to their application have yet to be overcome.

GT: What role is IIoT (Industrial Internet of Things) playing in optimizing the cutting tool market today?

Switzer: Big data and especially its analysis will play a major role in optimization of tools and their opti-



Gleason stick blades.

mum use in daily production. Short-term, we see more opportunity in optimizing the actual use of tools, the optimum point of reworking or sharpening tools to avoid unnecessary tool life loss. In the long run, data studies may affect the use of materials and coatings with specific applications, learning more as systems provide more correlated data.

GT: Is there anything Gleason is going to promote in these areas at Gear Expo this year?

Switzer: Gleason will present the complete array of its gear manufacturing tools, including latest systems for bevel gear cutting, latest hob, shaper cutters, Power Skiving tools with state-of-the-art materials and wear coatings. We will also show solutions for the optimization of customers' tools and tool life management.

For more information:

Gleason Corporation
Phone: (585) 473-1000
www.gleason.com

Event Spotlight: AGMA Steel for Gear Applications

In a recent conversation with AGMA President Matt Croson, he discussed a new AGMA course this fall that will examine some of the emerging alloys and materials that gear engineers will be able to adopt in the future. "AGMA's Steel for Gear Applications," provides detailed information to make use of steel properties in a system solution and understand the potential that different steel options can offer for various applications. Students will explore the how the production of the steel can affect the performance of the material and also the final component and system. The course will be facilitated by Lily Kamjou, a senior specialist in Ovako's Industry Solutions Development department. It is an advanced level course and qualifies for those individuals pursuing the Advanced Gear Engineering Certificate.

For more information:

AGMA
Phone: (703) 684-0211
www.agma.org

Material Spotlight: Ovako's IQ-Steel

Steel components are increasingly required to withstand high, multi-directional loads and the purity of new generation IQ-Steel from Ovako is further developed to meet the stress demands of today's high performance parts. It not only has dramatically increased fatigue strength in all directions, but can also help customers to achieve lighter, stronger, more efficient and compact component designs.

IQ-Steel is one of Ovako's new attribute brands and is an isotropic, ultra clean steel with properties that match remelted steel. The pure and highly consistent qualities of the steel are achieved without the complex processes inherent in remelted steels which add considerably towards energy consumption and material price.

Unlike standard grades that are shown to incur time and money costs for the customer, cleaner high-performance steel grades by Ovako can ensure both quality and continuity of production. They are ideal for gears, camshafts and other steel parts.

"We increasingly hear from customers in the marine, energy, transmission,

engine, light and heavy vehicle and wind power sectors that standard engineering steels are just not suitable for tougher jobs. The problem with conventional steels is they are produced in a process where inclusions are stretched and elongate in the rolling direction," said Göran Nyström, head of group marketing and technology at Ovako.

"With superior properties in all directions, IQ-Steel can upgrade the performance of a gear in a transmission, a high pressure diesel injector or a safety

critical component that is subjected to high and complex loading. The pure and highly consistent steel quality is ideal for extreme pressures and temperatures where cracking or defects are simply not an option," Nyström said.

"This is why some of the world's most demanding original equipment manufacturers (OEMs) and forging shops are using our IQ-Steel grades to handle the strain of higher and more complex loads," he added.

Comparisons of the fatigue strength

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of IQ-Steel and conventional steel found that Ovako grades can obtain around 900 MPa in fatigue limit both in the longitudinal and transverse directions, compared to 400 to 500 MPa in conventional steels.

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Star SU and Samputensili Q&A

John O'Neil, engineering manager-gear tools, at Star SU and Dr.-Ing. Deniz Sari, gear technology manager at Samputensili Cutting Tools, recently spoke with *Gear Technology* on some of the trends regarding materials, tools, coatings and machine tool developments.

GT: What are some of the most recent innovations in cutting tool materials in 2017?

Sari: Most of the recent effort has been centered on the optimization of the gear tooth manufacturing system. This involves the tool design, material, coating, machine tool options and cutting parameters that best suit the goals of the customer and unique demands of the application. The latest developments in cutting tool materials include heat resistant properties for use at higher cutting speeds.

O'Neil: For existing material technologies, properties like higher wear resistance, enhanced thermal stability and conductivity have evolved significantly. In recent years, the relationship between tool supplier and end user has become more important to find a best fit tool solution for today's produc-

tion demands. To reach this goal, computer simulations and complex analysis methods (3D modeling and chip formation programs, for example), are being used more often.

GT: What are the benefits for gear applications and why does the performance of the material depend greatly on how the material is produced?

O'Neil: Today, gear production demands are tailor-made cutting tools for each gear related to material, geometry and application. To manufacture high performance gear cutting tools out of the newest cutting materials to satisfy these demands, experienced knowledge of cutting tool manufacturing is required.

For example, dry hobbing of an automatic transmission component using a steel hob with AlCrN coating was presented for cost improvement. No cycle time reduction was needed so the application of a carbide substrate should yield significant tool life savings. To be cost effective the carbide hob would have to make 2× the number of parts per use and 1.5× the number of uses. A test was initiated using a carbide hob with AlCrN coating. The final result with the latest AlCrN advancements is 7.5 × parts per use and 1.5 × number of uses. Sample photo of edge wear after 12 reconditionings. Coating wear is ~0.123 mm and edge wear is ~0.051 mm.

GT: Anything interesting happening in tool coatings today?

O'Neil: New developments in the AlCrN-Family of coatings to

increase gear cutting productivity and tool life. Wear resistance, oxidation temperature and thermal conductivity have all been enhanced. For existing coating technologies, the properties like higher wear resistance, enhanced thermal stability and conductivity.

GT: How will these coatings evolve in the future?

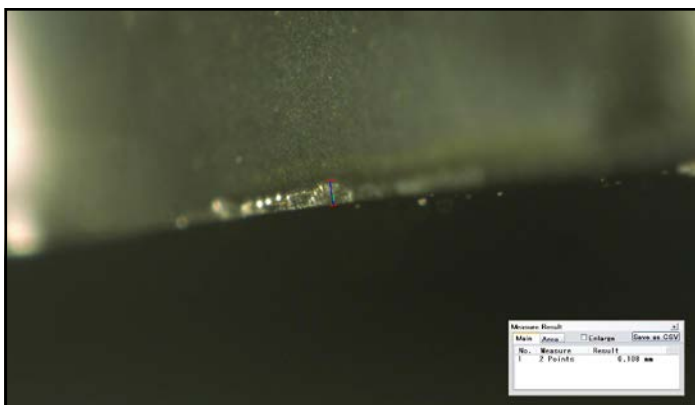
O'Neil: In the next 5–10 years we expect the incremental improvements of current technologies to continue. For example, since the introduction of the AlCrN coating, there have been several incremental improvements on this technology base, each resulting in tool life improvement of 30% in some cases. In other cases coating advancements have allowed for tool base material changes to a less expensive grade without affecting performance.

GT: How significant is the custom cutting tool market today?

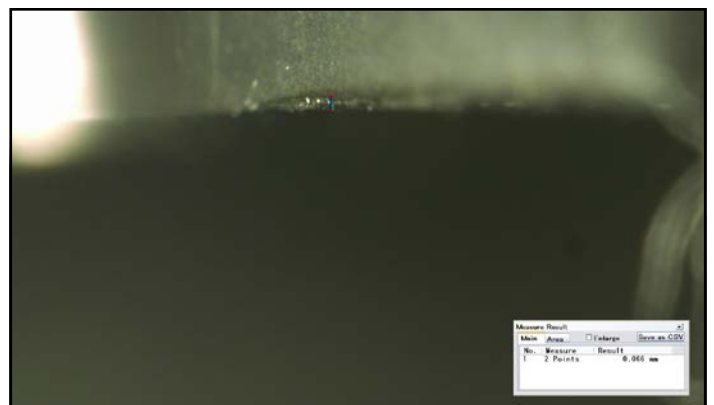
O'Neil: Due to the wide range of influences on the gear cutting process, a standard cutting tool cannot satisfy the market demands like custom designed gear tools are doing today. Offering the market, a dedicated custom tool solution should be the gear tool suppliers standard. A custom hob design may have modifications to the generating diameter to enhance the strength of the tooth tip for example.

GT: What role is IIoT (Industrial Internet of Things) playing in optimizing the cutting tool market today?

O'Neil: An increased number of sensors and improved data analyzing



Sample photo of edge wear after 12 reconditionings. Coating wear is ~0.123mm and edge wear is ~0.051mm



Evolution of AlCrN coating, flank wear reduction in this case was 39%. Photos are of lower left flank of a dry cutting hob.

leads to a better understanding and choice of cutting parameters in gear cutting processes. With this improved process understanding, the tool supplier can choose the best tool solution regarding design, cutting material and cutting parameters to improve productivity and tool life. A further process knowledge combined with an advanced process monitoring will also help to avoid excessive tool wear and provides indicators for an on-time tool replacement.

GT: What role is software playing in this area?

Sari: While new cutting materials offer advantages to customers they present challenges to the application itself. New software and sensor analysis is required to ensure a stable process and utilization of the entire tool potential. Tool design and cutting parameter analysis software such as *SpartaPRO*, developed by WZL at Aachen University, is used to insure the process parameters are ideal for the tool material and coating.

GT: Is there anything Star SU and Samp is going to promote in these areas at Gear Expo this year?

O'Neil: The newest technologies for materials and coating for gear cutting tools, including carbide hobs and Scudding cutters coated with Oerlikon Balzer's BALANIT ALTENSA coating, the high-speed coating solution that realizes productivity gains and efficiency.

We are also featuring the FFG Modul H 200 vertical hobbing machine. The H80/100/160/200 series is the latest version of our hobbing machine line for small applications, specially engineered for automotive. These machines have been designed for dry cutting operations in particular, although using oil or emulsion is possible. Now this machine is available with an optional extended radial travel, incorporating the working range of the H80 up to the H200.

For more information:
 Star SU
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www.star-su.com

Product Spotlight: LMT Fette

The reprocessing of precision tools significantly lengthens a tool's life cycle and reduces production costs. Depending on the degree of wear, a gear hob can be reprocessed 15 to 20 times. Professional reprocessing at the LMT Fette service center returns the tool to a new condition. As a tool producer, LMT Fette offers all reprocessing steps for gear hobs from a single source: Deburring, regrinding, cutting edge preparation and recoating in manufacturer's quality.

LMT Tools offers customers an individual pick-up and return service. This is done by its own service employees. They collect tools directly from customers and deliver them again after they have been reprocessed.

"Our service employees are experts with technical know-how and can answer questions directly on site," says Christian Johns, who is responsible for the gear cutting tool service segment, while explaining the benefit of personal customer contact.

For additional flexibility, LMT Tools provides its customers with service

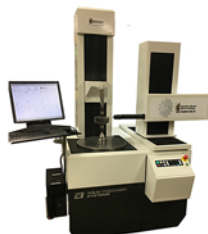
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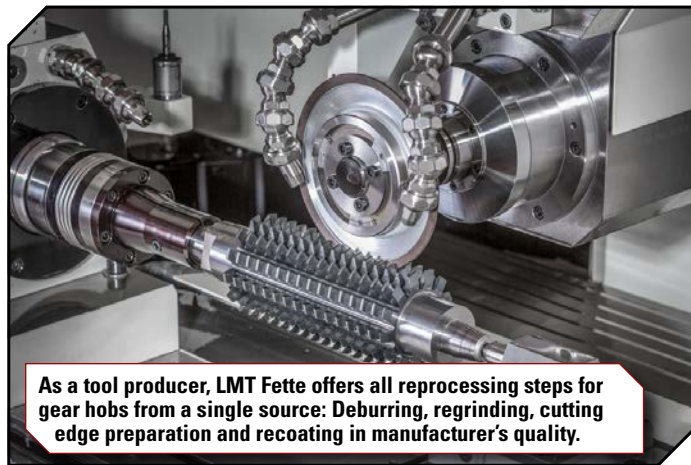
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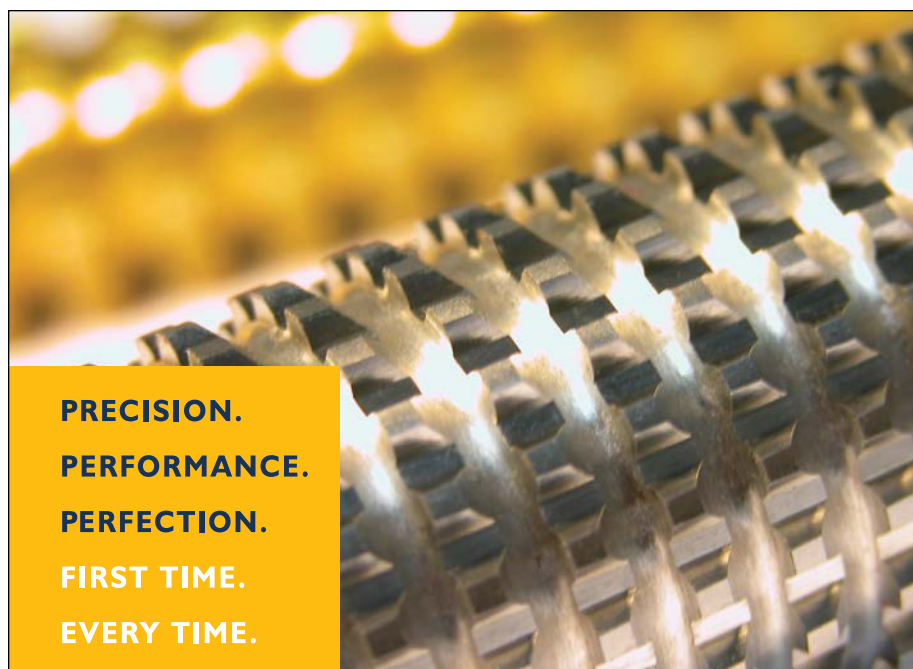
boxes. These boxes are equipped with suitable packaging material and a UPS label for direct shipping to the reprocessing location.

To document the entire life cycle, there is an accompanying card for each tool. The grind amounts and the respective reprocessing date are documented on this card. This way, the customer can track constant tool performance and keep stock to a minimum.

Furthermore, LMT Tools also does a wear assessment. Wear is determined precisely and individually for each tool. Finally, only the necessary amount of material is removed with each grinding operation. "This way our reprocessing experts achieve the maximum number of tool uses from the predefined tool life," explained Johns.



As a tool producer, LMT Fette offers all reprocessing steps for gear hobs from a single source: Deburring, regrinding, cutting edge preparation and recoating in manufacturer's quality.



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Market Forecast: Cutting Tools

February U.S. cutting tool consumption totaled \$174.98 million according to the U.S. Cutting Tool Institute (USCTI) and AMT – The Association For Manufacturing Technology. This total, as reported by companies participating in the Cutting Tool Market Report (CTMR) collaboration, was up 1.1% from January's \$173.05 million and up 0.6% when compared with the total of \$173.88 million reported for February 2016. With a year-to-date total of \$348.02 million, 2017 is up 4.5% when compared with 2016.

These numbers and all data in this report are based on the totals reported by the companies participating in the CTMR program. The totals here represent the majority of the U.S. market for cutting tools.

"There is a feeling of optimism in the air that is backed up by the positive growth the cutting tool market data shows after the first 2 months of the year," says Steve Stokay, president of USCTI. "Manufacturing continues to be a hot topic and continues to have a seat at the table in the new Trump administration. The strong dollar will continue to challenge our ability to export but with the US automotive and aerospace markets remaining steady, it should provide a firm foundation for growth as the other industrial sectors rebound from a weak 2016. This should bode well for cutting tool manufacturers."

Scott Hazelton, managing director of economics and country risk at

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IHS Markit adds that “The economy is enjoying improved business and consumer confidence, resulting in strong momentum in employment growth and single family housing as well as a rebound in nondefense capital spending, including the important energy sector. Consumption of cutting tools is forecasted to respond with increasing growth over the year. Acceleration of growth in 2018 is expected as tax reform and infrastructure investment will enhance the investment outlook.”

For more information:

AMT
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Industry Spotlight: Oerlikon Balzers

Oerlikon Balzers, the coating specialists from Liechtenstein, have commissioned their new Customer Center for the North Germany region in Bielefeld, after relocating from the previous site in Spenge. The new site in Bielefeld will allow Oerlikon Balzers to combine the services offered at their existing sites in Spenge, Herford and Hildesheim. “In the last few days we have transferred all coating systems and equipment from Spenge to Bielefeld. The relocation went well, and we have already restarted production. All staff from Spenge will continue to be employed at Bielefeld, and we are all looking forward to the new premises,” says Hendrik Alfter, CEO of Oerlikon Balzers Germany. The second stage will see the site at Herford integrated into the new Customer Center by the end of summer 2017. The full production capacity of the site at Bielefeld will be reached in early 2018 after the site at Hildesheim is relocated. The aim of the new Customer Center is for Oerlikon Balzers to expand its range of individualized solutions and to optimize processes and internal workflows so that it can respond to customers’ wishes with even greater flexibility.

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