

# Spin City

## Grinding Wheel Technology Focuses on Speed, Efficiency and Time Savings

Matthew Jaster, Senior Editor

### **Gear grinding is all in the details—surface quality, cycle times, lower costs, quicker results, less energy consumption, etc.**

Gear producers want to make product faster, quicker and more efficiently than ever before. This means the grinding wheel needs to meet and exceed customer expectations with each and every turn. Thanks to a heavy dose of grinding conversation during and after IMTS 2018, we're able to provide the latest trends, technologies, challenges and future considerations for grinding wheels in the gear market.

### **The Need for High-Speed**

It's no surprise that speed tops the list when it comes to grinding wheel technology. Faster grinding times produce more parts which results in a much more efficient machining operation.

"The gear industry is looking for higher-quality, more precise wheels that can grind very fast and provide the best surface finishing capabilities on the market," said Amandine Martin, worldwide gear platform leader, Norton | Saint-Gobain.

TJ Boudreau, category manager for high volume production at Weiler Abrasives, said grinding wheel technology starts and ends with addressing the specific needs of each customer.

"If you can develop a grinding wheel that cuts faster and can be easily utilized on existing equipment, this is much more valuable to your customer. You can produce more parts per hour, reduce dress and save production time," said Boudreau.

On the machine tool side, Andreas Mehr, grinding and shaping technology developer, at Liebherr, said gear customers are seeking out the following key capabilities: They want High Q-Prime (metal removal rate) for fast grinding times with a low risk of grinding burn. In combination with a fine surface

roughness ( $R_z < 3\mu\text{m}$ ) and good profile form deviation ( $ffa > 2\mu\text{m}$ ). They also want good tool life with a high number of parts per dressing.

"They want constant cutting and wear behavior over the shift-length and usable diameter range. The experience from us and our customers shows that when the worm diameter gets small the performance of the wheel sometimes gets bad," Mehr added.

Regarding cylindrical gear technology, Martin Boelter, COO, Klingelnberg, cites high-speed and high-feed rates as well as an extremely open structure of grinding wheels in combination with innovative grit material that allows for high stock removal without the risk of grinding burn.

### **Meeting Efficiency and Productivity Demands**

In order to make better gears, machining efficiency and productivity improvements are necessary to remain competitive in the gear market.

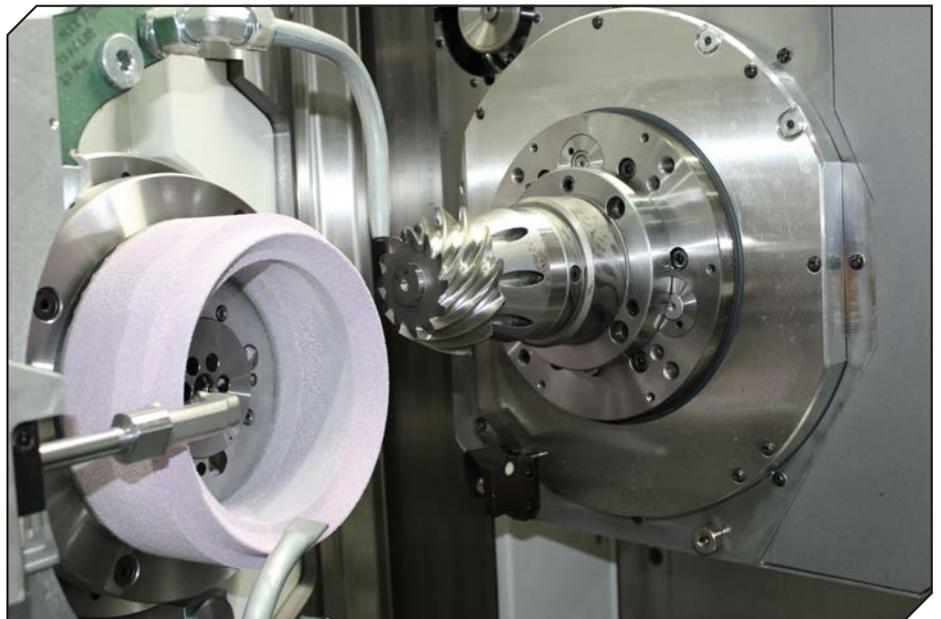
Understanding the metallurgy of the latest gear materials will play a huge role

in meeting these demands now and in the future, according to Boudreau.

"The marketplace is advancing so quickly that many customers are working with materials that are harder to grind. Some customers have no idea where to start. Our job is to make sure our grinding wheels are doing what they were asked to do in the first place," said Boudreau. "Tooling can be a tremendous expense for gear manufacturers and we want our wheel technology to provide the greatest efficiency gains."

High metal removal rates are achieved due to fast cycle times as well as the increased stability of the grinding wheels today, according to Dr. Rolf Schalaster, head of competence center grinding technology at Klingelnberg.

"Klingelnberg machines enable a good performance for deep grinding (from solid). Deep grinding enables high flexibility in the gear design (tool profile). This strategy can be seen as an alternative to blade grinding, coating and setting up the cutter head for a cutting process," Schalaster said.



Xtrium bevel gear grinding wheel from Norton | Saint-Gobain.

## Grinding Challenges

Mehr at Liebherr cites several challenges that need to be met in grinding today saying that the increased quality requirements and NVH behavior, especially for E-Drive are some of the greatest challenges. There is also a clear tendency for more topological modifications on gears and asymmetric tooth profiles.

“Here Liebherr is already well positioned due to the latest software developments like, GER (Generated End Relief) and generating grinding of asymmetrics,” he said.

For collision critical gears, Mehr said you need worms with a small outside diameter (< 120 mm) in combination with a length of 200 mm and a bore of 40 mm. These wheel dimensions are a technical challenge to manufacturing.

“Especially on these small worms the requirement on a homogenous wheel structure and constant hardness is very high. Both characteristics are a ‘must-have’ for a successful generating grinding process,” Mehr said.

Boelter agreed that the electrification of the drivetrain will require higher precision and lower tolerances. This will also increase the requirements for tooth waviness and noise characteristics.

Many of today’s challenges are simply a result of opposing requirements, according to Boelter.

“Customers want high precision as well as high productivity, special tool modifications, superfine surface finishes and increased load carrying capacity and noise requirements,” he said. “Many of these requirements contradict each other.”

## Dual Design

With so much emphasis on multifunctional machining, several machine tools can take advantage of wheels today that handle multiple operations.

Norton | Saint-Gobain featured a new dual-worm wheel design during IMTS 2018 that enables two operations in one grinding wheel, substantially saving time and cost. Norton Xtrimium Dual-Worm grinding wheels feature a unique design with a high-performance vitrified bond section for grinding and a fine-grit resin section for polishing the gear teeth, enabling one wheel to perform what traditionally required two wheels.

Substantial savings in wheel costs and productivity via the elimination of wheel swapping can be achieved with the Norton design. In addition, improved surface finishes of Rz = 1.0 mm and Rpk = 0.05 mm, and reduced harmonics (noise) are realized. The Norton Xtrimium Dual-Worm Grinding wheels can also be adapted to existing machines.

“Our customers are seeking solutions where grinding parameters can be met for higher accuracy and improved surface finishes,” Martin said. “This is

where Norton Xtrimium can offer an advantage in quality.”

Boudreau also believes the gear market is following general metalworking by combining as many operations as possible into a single machine.

“Grinding and polishing in one operation. This is what’s happening in the gear industry. Weiler is currently developing this for a customer’s honing operation,” he said.



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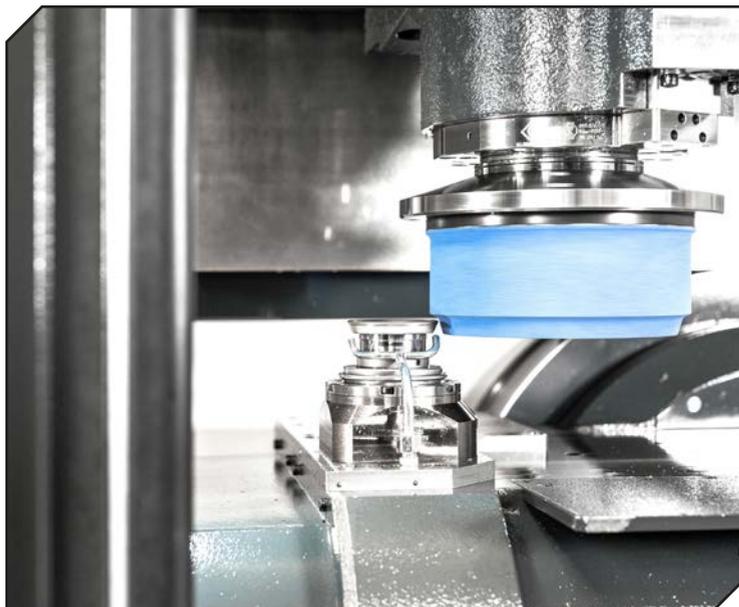
With dual wheel designs and new gear materials, companies offering grinding wheels have to go above and beyond just selling consumables to a job shop or OEM.

“Our goal is obviously to meet the long-term needs of our customers with a full line of technology and a full line of application engineers who can come in and streamline the process,” said Joshua Fairley, product engineer, bonded abrasives at Norton | Saint-Gobain. “This starts with the service and support team. It’s about getting the full value out of the entire grinding operation.”

Adds Jim Gaffney, senior product manager at Norton | Saint-Gobain. “I’m proud to say our organization is always expanding capabilities through capital investments and hiring a tremendous amount of grinding talent around the world to serve our diverse global customer base.”

This is one of the number one critical needs that Boudreau hears from the gear industry in general.

“Service and support is always a



Many of today’s grinding challenges are a result of opposing requirements, according to Martin Boeltner, Klingelberg COO.

challenge in this industry. It’s pivotal that you get the product out in a timely fashion and your response time is efficient when the customer needs a problem solved. When Weiler acquired SwatyComet it was an easy transition

because both organizations shared a common focus on service and support,” Boudreau said.



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## Global Competency

Gaffney discussed the company's global impact in grinding during IMTS 2018. "Strong wheels that sustain higher speeds need dimensional integrity for optimal success," Gaffney said. "Norton | Saint-Gobain has made significant enhancements to our global technology centers including locations in Germany, Spain, India and North America. We share research and knowledge across these centers, working hand-in-hand with OEMs to build better relationships along the way."

"Following this successful in-house collaborative approach, we start with the grains and then add the speed and grinding dynamics needed to maximize efficiency," Gaffney said. "We're actually the first company to introduce a shaped grain to the market, over 20-years ago. Many companies source grains instead of developing them internally."

## Mix & Match Tech

SwatyComet, headquartered in Maribor, Slovenia, dates back to 1879 and has a long tradition of providing high quality abrasive products. Now as a part of Weiler, the organization started in aerospace applications in North America and is ready to focus its efforts in gear manufacturing.

Weiler has decades of experience with its bond technology. While many of the larger companies develop their own grain technology, Weiler has partnerships with different vendors in the industry.

"We can look at all these different abrasive technologies and identify which one works best with our bond technology," said Boudreau. "This gives us the ability to create unique pairings from different abrasive manufacturers into our grinding wheels. We can also determine what the most cost effective solution is available for our customer's application."

## Smarter Wheels

On the focus within Industry 4.0 one additional feature of grinding wheels is the automatic data transfer of the tool information like module, no. of starts, pressure angle, allowable cutting speed, etc. into the grinding machine. "Maybe the solution is an integrated RFQ chip or data matrix code printed on the wheel. Both are a real challenge on vitrified bonded wheels, due to the surface structure and manufacturing process of the wheels. The wheel manufacture should seek a smart solution," Mehr said.

Norton | Saint-Gobain has recently been investigating this challenge and is looking to work closely with customers



Weiler has decades of bond technology experience allowing them to mix and match pairings from different abrasive manufacturers.

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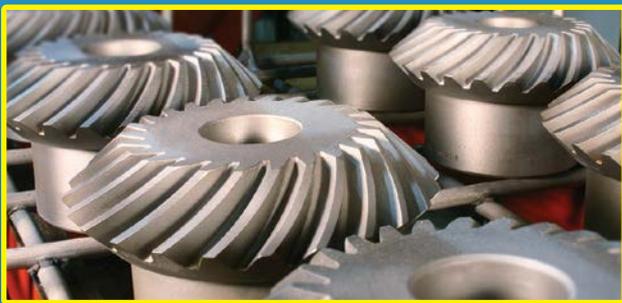
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on projects related to smart tags. They are working to integrate RFID tags with grinding wheels for better identification and inventory management.

Also recently launched, the new Norton 4Sight system is a Process Monitoring and Diagnostic System which can remotely monitor machine operations and the grinding process allowing customers to collect real-time data to monitor process performance and optimize productivity.

### The Future for Grinding Wheels

In Mehr's opinion, a further grinding time reduction will not happen in the next 3–5 years. "Actually, the new abrasives like 3M Cubitron II or Norton Quantum are already developed. Also the bonding systems are designed for these abrasives. The trend for a finer surface roughness will lead to use of finer grain sizes in the finishing cut. To be still powerful in the roughing cut the demand on segmented grinding worms (with a roughing and finishing zone) will increase. A further focus should be on the Industry 4.0 topics like the gear data exchange format for the communication between the machine and the tool," Mehr said.

Further advance of abrasive grit and compound material will allow higher stock removal rates. Compound technology will increase mechanical strength of grinding wheels allowing higher cutting speeds and benefitting productivity. In generating grinding there will be more applications with combination of different grinding wheel sections for conventional roughing



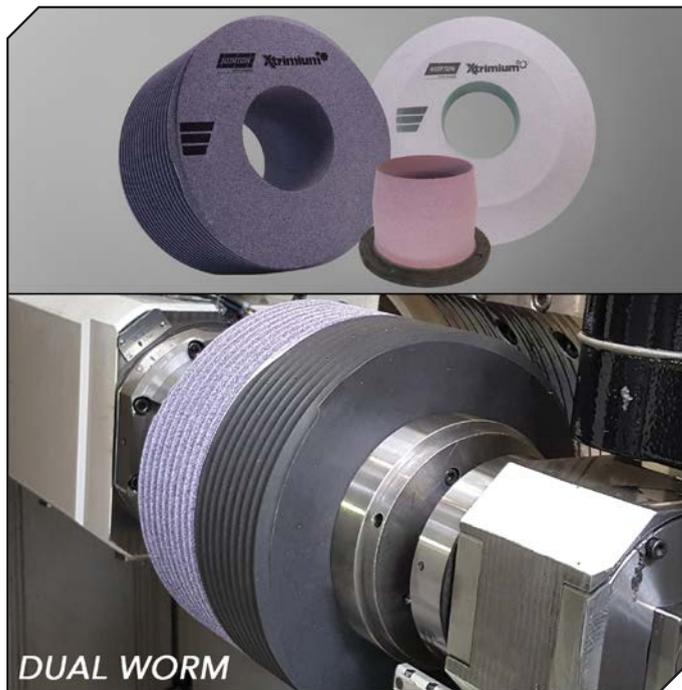
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and polish grinding.

For Schalaster at Klingelberg, the basic trend will remain the same: grinding wheels that will increase productivity and provide better surface finish and increased tool life up to the physical limits of the equipment. "The costly control of heat treating to achieve constant stock and spacing for gear grinding may also be reduced due to the increased performance of the grinding process," he added.

Boudreau brings the topic of speed back into the conversation when looking into the crystal ball.

"A few years ago machines were grinding at 40 meters-per-second, than 50 and 60 and 80 will eventually be the norm," Boudreau said. "I'm sure we'll find our way to 100-120 meters-per-second for the surface speed of wheels down the road." 



Substantial savings in wheel costs and productivity via the elimination of wheel swapping can be achieved with the Norton | Saint-Gobain design.

**For more information:**

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