What's New and Noteworthy in Powder Metal?

Industry Focuses on Strength, NVH and Heat Treatment in 2017

Matthew Jaster, Senior Editor

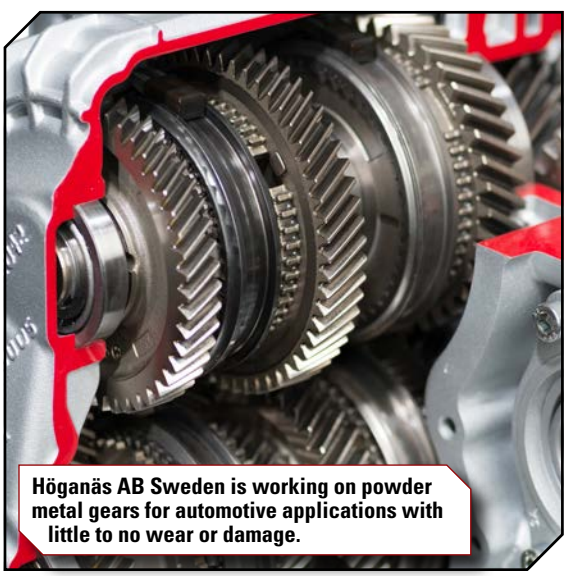
First, the facts: powder metallurgy is a cost-effective method of forming precision net-shape metal components that allows for more efficiently designed products. It saves valuable raw materials through recycling and the elimination of costly secondary-machining. PM competes with wrought steel gears as the technology continues to advance. You'll find PM components in everything from automobile transmissions to aircraft turbine engines, surgical equipment and power tools.

In 2017, strength and safety are two areas of focus in PM gears, particularly in highly-critical applications. The following short articles will address risks, benefits and advancements to PM technology and examine where the industry is today and where it's heading in the future.

Höganäs Improves Rolling Simulation Technology

Höganäs is a key supplier of powder metals, developing new products and technologies in areas like additive manufacturing, brazing, electromagnetic applications, filters, metal injection molding, sintered components and surface coatings. Anders Flodin, business development manager, Eckart Schneider, director of PM components and Thomas Schmidtseifer, manager, market development and customer projects at Höganäs, recently discussed some of the latest PM technology.

Flodin believes that much of the research currently being conducted in PM involves data collection. "A lot of research has been done at the big suppliers. One of the more important factors for the designers is the availability of coherent solid fatigue data," Flodin said. "KISSsoft has this data in its material database and we are working with others to incorporate our material there. Press and tooling has been developed too, helical gear drive systems and faster electromechanical presses."



Höganäs AB Sweden is working on powder metal gears for automotive applications with little to no wear or damage.

One feature that is being heavily investigated by the major players is the NVH aspects of PM gears. "Some of the PM houses are generating data and exploring E-vehicle NVH advantages using PM gears. Also for high-strength gears, there is powder forging for helical gears that has been developed by GKN. Höganäs has developed the HIP process to obtain similar strength levels," Flodin said.

The "green" or eco-friendly benefits of PM remain one of its greatest strengths according to Schneider. "With 5-8 times increase in manufacturing speed, and 95% (or higher) material utilization with no cutting fluids and chip disposal; machine inventory can be reduced and shop floor size cut by 50%. This all helps in reducing the CO_2 footprint and keeps competitiveness and cost efficiency at par or better than current cutting technologies," Schneider said.

Flodin believes the greatest challenge in powder metal is the inertia in the industry. "There are many non-technical barriers that have to be overcome. The growth will probably be exponential, but we are at the beginning of that curve where it is still near horizontal. From a technical aspect Höganäs is working on improving the rolling simulation technology since the OEMs that are working with PM gears are choosing this technology for extra safety and strength. We are also supporting with proof of concept of different technical systems in test vehicles, PM gear design and awareness seminars all over the world, lecturing at expert conferences, bundling tech partner competencies in the POP center," Flodin added.

In the heavyweight battle to compete with steel, PM continues to make significant progress. "We have learned a lot on how to improve heat treatment results as well as distortions so we can match solid steel micro hardness. Regarding strength we are anywhere from 75 to 110% of normal gear steels. It depends on the manufacturing path. PM can be tailored for the strength needed. It is coming to the point where purity of the material is becoming influential," Schneider said.

The automotive industry is one area that continues to reap the benefits of PM advancements. "This industry sees the opportunity as long as there are cost benefits and minimal risk. For example, a few big OEMs have recently announced they will use PM gears in their transmissions," added Schneider.

While the PM industry is growing, Schmidtseifer said the major activity is taking place in China. "Although internal combustion engines will be the dominant power source until 2030, there will con-

tinue to be faster implementation of hybrid and electrification strategies," he said.

For pure electrification, the drives become significantly simpler. New players will enter the arena since less value will be in the transmission and entry barriers will be lowered. "Developing and making a 7-speed dual clutch transmission, however, requires a lot of special know-how and deep pockets, something only a few have," Schmidtseifer said.

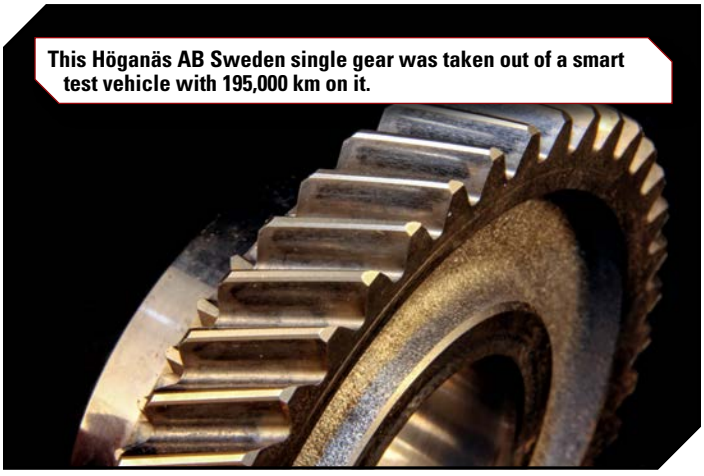
Höganäs AB has a track record of having implemented and tested PM gears in multiple demo car transmissions. This includes PM gears in a SMART car, a high-performance rally car, an electric vehicle and a 320 Nm popular European 6-speed manual transmission passenger car. The company has hands-on experience and supporting data for several successful applications of PM gear technology.

By understanding modern transmission designs and their application performance requirements, the Höganäs team can help clients analyze specific gear load scenarios. They can assist in optimizing the component's macro and micro design modification needs. They can also help choose the best suitable manufacturing processes and material solutions and ensure a proper heat treatment result.

They encourage industry professionals to utilize the extensive tech partner network in their application- and process development center where they can support everything from technical feasibility analysis, to design optimization, prototyping and off-tool sampling for PM gear testing and validation purposes.

Capstan Atlantic Examines PM Evolution

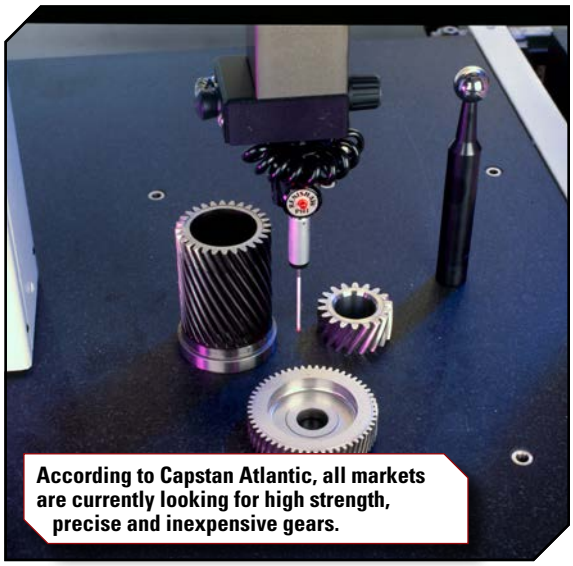
Capstan Atlantic is a producer of precision powdered metal gears, sprockets and complex structural components. The company combines advanced gear engineering with proprietary processing techniques to meet the most demanding applications. Capstan's roll densification process and high density single press technology (HD4) allows Capstan to achieve original gear design tolerances, reduced wear and noise characteristics while maintaining a competitive cost advantage. *Gear Technology* recently caught up with said Richard Slattery, vice president, engineering at Capstan, to dis-



This Höganäs AB Sweden single gear was taken out of a smart test vehicle with 195,000 km on it.

cuss trends, technologies and future considerations in the powder metal (PM) industry.

"PM has evolved on a technical level to rival the precision and strength of wrought steel gears at a fraction of the price. Material systems, process methods and innovative metrology enable this advancement," said Slattery.



According to Capstan Atlantic, all markets are currently looking for high strength, precise and inexpensive gears.

According to Slattery, gear tooth qualification achieved via pressurized gear rolling (in oil) against specifically engineered roll dies enable custom involute forms for noise reduction, precise gear crowning, combined with selective densification to improve fatigue properties. PM is also a "green" technology using >90% recycled raw materials. Additionally PM is a net shape process with near zero scrap.

Similar to other manufacturing processes, cost is the biggest challenge in the PM industry despite being an economically attractive process against most other manufacturing methods.

"An additional focus has been on maintaining dimensional precision on hardened gears, without the need for a post hardening grind operation. This is achieved through the development of low, or no, distortion hardening methods," Slattery added.

Slattery has witnessed the strength and hardness of PM gears improving in recent years.

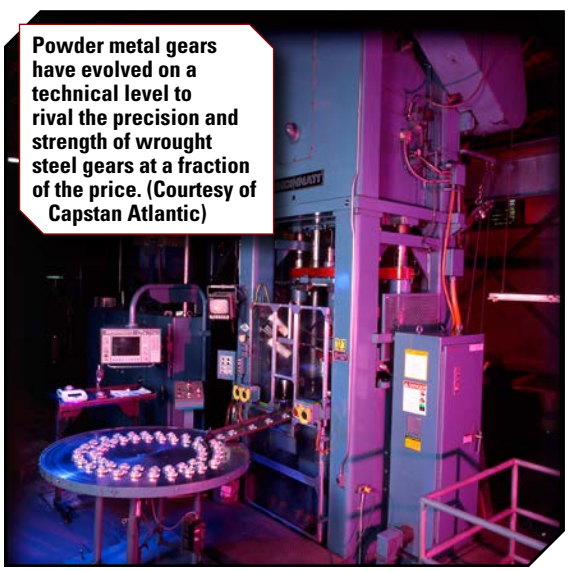
"PM gear strength has evolved significantly over the years, whether it be through the use of chrome-steel alloys, single press high dense technologies, or tooth flank densification to minimize contact fatigue issues (fretting). Bending fatigue strength has improved dramatically by achieving high (>7.4 g/cm^3) core density with high tonnage part compaction, and minimum levels of organics (powder lubricants, etc..) in the raw material," Slattery said.

The PM game in 2017 revolves around all market segments looking for high strength, precise and inexpensive gears. Slattery believes powder metallurgy component manufacturing is the best means to this end.

In the future, Slattery sees precision low cost gears and pulleys for electronically powered gear trains.

And all the talk of additive manufacturing in recent years has had an impact on the PM industry.

"Additive manufacturing for the purpose of rapid prototyping is compressing the development timeline," Slattery said. "I find this technology fascinating, and I'm excited to see where this technology takes PM in the future."



Powder metal gears have evolved on a technical level to rival the precision and strength of wrought steel gears at a fraction of the price. (Courtesy of Capstan Atlantic)

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PM Industry News

HERE'S SOME OF THE LATEST PM-RELATED NEWS AND EVENTS FROM 2017:

Powder Metal MPIF Elects New Officers

John F. Sweet, PMT, president & CEO, FMS Corporation, Minneapolis, MN, has been elected as the 29th president of the Metal Powder Industries Federation (MPIF), succeeding Patrick J. McGeehan, Ametek Inc., Eighty Four, Pa. His two-year term will take effect at the conclusion of the Federation's annual Powder Metallurgy (PM) Management Summit and 73rd Annual MPIF Business Meeting, October 21–24, 2017, in Naples, Fla.

One of the Federation's six associations will also instate a new president following the Summit. Dax Whitehouse, NetShape Technologies, Floyds Knobs, IN, has been elected president of the Powder Metallurgy Parts Association (PMPA). Meanwhile, Dean Howard, PMT, North American Höganäs, Hollsopple, Pa., was re-elected to serve a second term as president of the Metal Powder Producers Association (MPPA), while Thomas Houck, Carpenter Technology, Tanner, Ala., will serve a second term as president of the Metal Injection Molding Association (MIMA).

Sweet has worked for FMS Corporation for 27 years, sustaining a family tradition as a third-generation entrepreneur. He most recently served as president of the Powder Metallurgy Parts Association and has served the association and MPIF actively for many years. Sweet received MPIF's Distinguished Service to Powder Metallurgy Award earlier this year during POWDERMET2017—Las Vegas. He has been a member of APMI International for 29 years, is a certified Level I Powder Metallurgy Technologist, and serves on the APMI Board of Directors.

Sweet has also been an elected trust-

ee of the Center for Powder Metallurgy Technology. He was a co-op student in the R&D Laboratory of Hoeganaes Corporation for 3 years and earned his BS in materials engineering from Drexel University. Sweet is also a member of Alpha Sigma Mu Professional Honor Society for Excellence in Materials Engineering. In his local community, he has been serving on the Elder Board of the Redeemer Bible Church for the last ten years. (*www.mpif.org*)

New Industry Talent Attends PM Short Course

The annual Basic Powder Metallurgy (PM) Short Course recently pressed out another batch of students. This year's course, held August 14–16, received excellent feedback from attendees, with over 93% stating that they would recommend the course to others.

This year there was a broader range of attendees than reported in 2016. The largest represented industry segment was still engineering (33%); however, quality control and testing, and sales employees made up 19% and 20% of the audience, respectively. Production (12%), other (12% — mostly R&D), and management (5%) rounded out the short course attendees.

The Basic PM Short Course is a vital educational tool for the entire industry. Each speaker is an expert in their field and provides invaluable knowledge. Combined, the speakers have an incredible total of over 450 years of relative in-industry experience. The course is specifically designed for those who want to expand their knowledge of PM; enhance their opportunities to advance; and for those who are looking to deepen their understanding in the specialized area of PM. (*www.mpif.org/Meetings/basic-short-course.asp*)

GKN Expands Global Footprint, Wins PM Material Awards

The acquisition of Tozmetal Ticaret Ve Sanayi AS (Tozmetal) was completed in June 2017. The powder metal part manufacturer based in Turkey will expand the global footprint of GKN Sinter Metals, the world's largest manufacturer of sintered components which now comprises production locations in 10 countries and over 7,000 employees.

Tozmetal focuses much of its output on hydraulic pump components for European automotive customers. At a celebratory event, employees of Tozmetal were welcomed by Wolfram Messner, president, Global Small Segment Operations.

During the event, Messner said: "Tozmetal is an excellent fit and provides increased access to new customers in the Middle East region. I am delighted to announce that Hüsnü Özdüral, who for years has been managing and growing the company successfully, will continue to lead the plant. We will work closely

with the local team to make the site a strong platform to help grow our business and support our customers in the region," Messner added.

GKN Sinter Metals has received two Grand Prize Design Excellence Awards from the Metal Powder Industries Federation (MPIF). The awards were in the Automotive Transmission category and the Automotive Chassis category.

The MPIF Design Excellence Awards recognize companies who use the flexibility of Powder Metallurgy (PM) materials to push new designs and concepts into a progressive industry. GKN accepted the awards at the annual PowderMet Conference in Las Vegas, Nevada.

In the Automotive Transmission category, GKN Sinter Metals' planetary carrier assembly for Ford Motor Company's 10-speed transmission won the Grand Prize. The sinter-brazed copper-steel assembly is comprised of a cage and a flanged hub, and features a novel twist-lock geometry as a bearing retainer.

The twist-lock retainer allows the flanged hub to only require a simple turning operation for functionality. The technology's design reduced the stress by over 50 percent, resulting in a PM product that outperforms in a competitive process and cost.

GKN's copper-steel output pulley for Nidec Automotive Motor Americas won the Grand Prize in the Automotive Chassis category. The pulley includes a compacted, net-shape groove for an electric reclining mechanism in a mini-van rear seat application, significantly reducing cost.

The part's unique groove was designed for PM production, providing full functionality as a net-shaped product. The application required a small footprint design with lightweight parts, resulting in the success of the compacted technology of the output pulley.

MPIF recognized eight products across the industry at the conference for elite awards, and GKN is the only company in 2017 to win two Grand Prize awards. MPIF is an international federation with a mission to advance PM and particulate materials.

"GKN is pleased to receive two awards in 2017 and recognizes MPIF's role in promoting the PM industry," said Alan Taylor, Vice President Lightweight Technology, GKN Sinter Metals. "The two winning parts detail the breadth of design opportunities when using PM and provided our customers' exceptional value when compared to other metal working processes." (*www.gkn.com*)

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