

Paving the way for PM gear technology

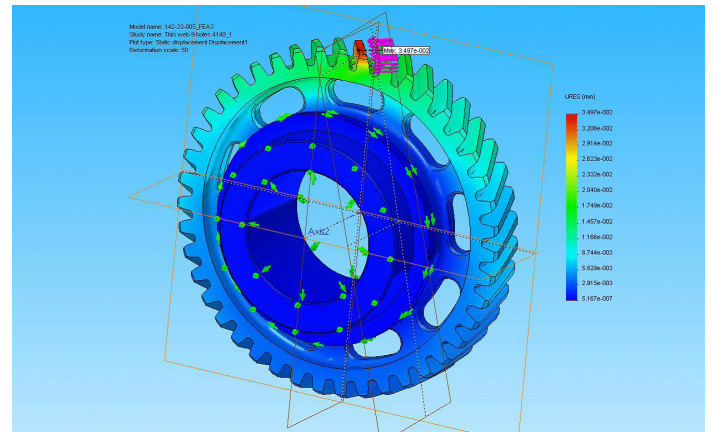
Current gear technology trends are opening up new opportunities for PM to challenge traditional manufacturing processes. As a partner in many ongoing PM gear development projects, Höganäs is pushing the limits of PM solutions.

PM technology has proven to be a highly competitive alternative to conventional manufacturing technologies in the pursuit of more cost-efficient and weight-saving components for vehicles and other applications. One still largely untapped automotive application of PM is manual gearboxes and higher load-carrying gears. However, recent trends in transmission technology mean the competitiveness of PM technology is set to rise.

”There are two major trends emerging within gearbox technology,” says Dr. Anders Flodin, a gear expert at Höganäs. “Firstly, gearbox designs are equipped with more gears, as it allows the engine to be run at a more optimum rpm, in turn resulting in reduced fuel consumption or improved torque. More gears will put still more emphasis on weight and cost reductions and these are the two major benefits of PM technology. Secondly, technological advances have resulted in more diversified gearbox designs. New types of semi-automatic and automated manual transmissions are starting to emerge – types that PM technology is very suitable for.”

Offering complete gear solutions

Astaloy Mo and Astaloy 85 Mo are the standard PM materials mainly used for gear applications, due to their robustness during processing and hardening operations. Using these materials, customers can be assured of a certain high level of component



Weight-optimised PM gear

performance. However, PM remains a rather unfamiliar technology to many gearbox manufacturers. By closely collaborating with partners, Höganäs is able to better promote PM technology and to provide complete ready-to-test gear solutions to the market. Newly developed leaner alloyed PM materials for better sinterhardening or traditional heat treatment response, will further optimise the cost-performance ratio for PM gear solutions.

”Our material expertise and long experience from gear technology enables us to translate specific customer performance requirements into the most technically and commercially feasible powder solution and to manufacture gear prototypes from blanks of the required quality”, states Anders. ”The PoP Centre plays an important role as it is used for pressing and sintering smart preform blanks. Our partner SwePart Transmission AB provides further hardening and finishing, allowing the blanks to be used for prototype testing, pre-series, or final gears. This enables Höganäs to provide complete gear solutions to the market, from material choice and engineering support to PM gears ready for assembly. We can offer gears that draw on the benefits of PM – low price and lightweight design – as well as the high tolerances of machined gears”

A comprehensive range of development activities

The key to successfully developing new PM gear applications is interaction between application performance knowledge, design aspects, processing conditions and powder materials.

”We strongly believe in the future of load-carrying PM gears,” continues Anders. ”That is why we are putting a lot resources and efforts into PM gear development. The PoP Centre is the platform where Höganäs and our partners can join forces to further innovate and grow the business”.

”We have ongoing development projects focusing on gear design, for instance optimisation of the gear flank as well as the entire gear in order to minimise weight and improve running behaviour. On projects concerning design and testing, we collaborate with the Laboratory for Machine Tools and Production Engineering (WZL) of Aachen University”.

Höganäs is involved in a host of activities to develop the processes necessary for competitive PM gears; working on innovative PM gear manufacturing concepts with partners such as Penn State University, advancing surface rolling in a number of collaborations, and partnering Japanese tool and equipment supplier Nissei on surface densification projects.

”Another key development area is helical PM gear compaction involving our partners Dorst Technologies from Germany, and PM tool and adaptor expert Alvier AG PM Technology from Switzerland. Their competencies, together with the new real-life simulation capability of the CNC compaction press at the PoP Centre, are all very important for this area. Improving the interaction of our advanced metal powder and lubrication concepts, with PM tooling and compaction aspects, allows us to further push the limits of PM gear technology,” emphasises Anders.

Two test cars on the road

A lot of work is currently ongoing in promoting Hipaloy™, a unique new Cr-alloyed powder concept that allows high-end densities in single press and single sintering technology of up to 7.5 g/cc. This material offers great potential for gears due to the high density and very good response to surface densification via gear rolling. Collection of further pitting and wear data is underway, but the concept has already been tested and confirmed for gear manufacturing programs by various customers for high-performance engine sprockets as well as manual gearbox synchronization and automatic transmission applications.

”To prove the concept of high load-carrying gears, we bought

a Smart car and disassembled the transmission,” says Anders. ”We were then able to manufacture replicas and to exchange the original gears in the car. The gearbox contains 8 of our PM gears, the maximum amount of exchangeable gears in that specific design, all of which have been pressed and sintered in order to achieve the highest possible density. The test car is available as a free rental to all our employees and has already been used for more than 45,000 kilometres without causing any observed critical wear. An advanced logging system makes it possible to track the gear load and run time, enabling us to properly evaluate the performance.”

Another recent project for PM conversion was the fourth set of gears in a Mitsubishi EVO 9 (Group N car), which is used in the Swedish National Rally. ”Using Hot Isostatic Pressing (HIP), we have managed to remove all pores and oxides from the material to manufacture gear wheels that have been very satisfactory for the driver, Ramona Karlsson. The next step is to use sintered PM gears made from our Hipaloy material to prove



Anders Flodin and the "Power of Powder" test car

that our basic gears work just as well for such demanding tasks”, concludes Anders.

Future gear activities

Höganäs will present two papers about its gear development activities at the International Conference on Gears in Garching (near Munich) on October 4 - 6. In the following week, Höganäs will be submitting joint papers with WZL and Nissei at the Powder Metallurgy World Congress & Exhibition in Florence. Anders will be driving the Smart car to both events, and by the time of the Florence congress, its mileage will exceed 60,000 km.