

POWDER

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NEWS



Providing optimum support to advance P/M in China

Höganäs (China) Ltd and its Tech Centre is helping to develop P/M in China by giving technical and educational support to both domestic P/M companies and foreign companies entering the Chinese market.

“We aim to be the leader in technology and innovation in a growing P/M market,” says Sydney Luk, Vice-President of Höganäs (China) Ltd. “The Shanghai Tech Centre meets the development requirements of US and European companies making the transition to the Chinese market, as well as the increasingly sophisticated needs of the fast-developing Chinese P/M industry.”

Höganäs (China) Ltd, a Shanghai-based subsidiary of Höganäs AB in Sweden, has operated in China since the early 1990s and is the market leader by sales of high-quality iron powder.

A new approach is being introduced to support Chinese P/M component manufacturers. “Simply imposing practices from the rest of the world doesn’t really work in the

long-term,” notes Sydney. “It’s a case of not only introducing our technology, but exploring and combining local technology to find the best way to help the Chinese P/M industry.”

The company is continuing to invest in pre-mix and annealing production capacity. “Demand for more sophisticated customer-specific mixes is growing,” comments Sydney. “We have a main mixing station and a station focusing on Starmix®.”

Ensuring high quality of the mixes is a top priority, and a 5 S programme for quality assurance has been implemented for all areas of the company.

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PROMOTING P/M INDUSTRY DEVELOPMENT IN CHINA

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Technical support resources

The Tech Centre, opened in 2005, is the third Höganäs Tech Centre with resources mirroring those in Höganäs, Sweden, and Stony Creek in the US.

“At the heart of the Tech Centre is the metallography lab,” says Sydney. With resources such as a scanning electron microscope (SEM), automatic sample preparation equipment, light optical microscope and micro hardness tester, the lab is equipped for Customer Service Investigations to help with production problems.

Regarding the physical testing side, Sydney states: “We will soon add fatigue strength testing equipment to our physical testing facilities in order to offer a comprehensive range of key performance tests.”

An important resource at the Tech Centre is the advanced P/M processing facilities available for product development and production support. These facilities include a hydraulic press and a belt sintering furnace for tests in pilot production scale.

Spreading P/M knowledge

Education is a vital element in supporting development of the Chinese P/M market.

A P/M School is organised by the Tech Centre twice a year. “There is a shortage of trained engineers in this field and we are helping companies to meet that need,” says Sydney. A separate Metallography School, also arranged twice a year, is aimed at experienced engineers from international key customers and has proved very popular since it was introduced in 2005.

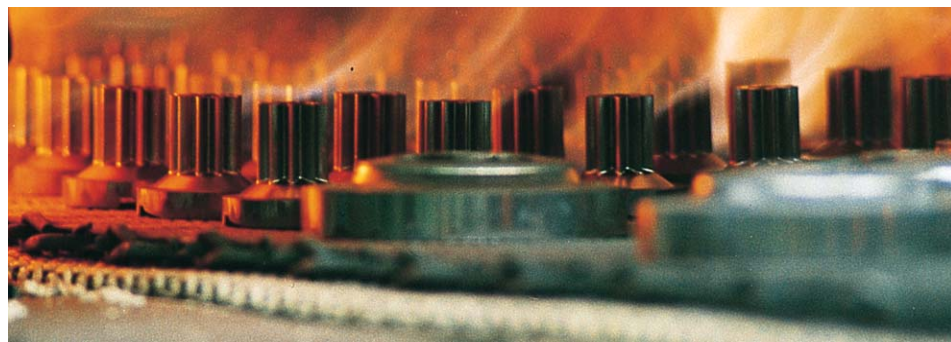


The Tech Centre staff at Höganäs(China) Ltd. (From left) Nelson Guo, Sandy Cai, Yu Yang, Louise Chen, Sydney Luk, Mike Wu and Patrick Lee

The Tech Centre will launch a new educational concept this year, reveals Sydney: “Our Schools are open to various companies, but some companies want their own tailored courses. So, we will offer education modules, which means we will go to the customer’s plant and provide the required training on a specific area of P/M processing.”

BIG POTENTIAL for sinter hardening in China

Sinter hardening is set to become an increasingly attractive process for the Chinese P/M industry, due to trends such as the rising price of alloying materials and growing demand for high-performance parts.



In many markets, P/M component manufacturers are increasingly using sinter hardening to gain benefits such as good hardening effects, cost savings, better dimensional control and more environmentally-friendly processing.

Sinter hardening is not yet widely established in the Chinese market, but several trends are making sinter hardening a more competitive processing alternative. This is the key message of **Sinter Hardening – A Big Market and Technology Potential in China** – a presentation at PM Asia 2007 by Dr. Yang Yu, head of the Höganäs China Tech Centre in Shanghai.

“We want to accelerate acceptance of sinter hardening, as we know it has many benefits for customers,” says Dr Yu. “Sinter hardening is a process that can reduce the amounts of alloying materials used or enable a switch to a less expensive alloying material – chromium – and still achieve the same performance.”

The presentation acts as an introduction to sinter hardening of P/M steels, covering key factors that influence the sinter hardening effect – modifying the base powder and increasing the furnace cooling rate.

A material-comparison case study is used to show the outcome of sinter hardening with the chromium materials: Astaloy CrM[®] and Astaloy CrL[®]. The key findings were:

- Astaloy CrM + 0.4%C achieved a tensile strength above 1000 MPa after sinter hardening.
- The cost for alloying elements in Astaloy CrM and Astaloy CrL is lower than other materials.
- Compared to other sinter hardening materials containing copper, Astaloy CrM provided closer dimensional accuracy.

Sinter hardening was introduced on the Chinese mainland a few years ago and so far only a handful of sinter hardening furnaces are in operation. According to Dr Yu, adoption of sinter hardening is held back by two major factors:

“Firstly, technology within the Chinese P/M industry is not yet as advanced as in areas such as the US, Europe and Japan. Another reason is that sinter hardening requires investment in a new type of furnace.”

Promoting sinter hardening

“At the Tech Centre we are involved in a wide range of activities to promote sinter hardening and assist in the transfer of technology to the local market.

“We work closely with the Chinese P/M industry on the materials and technology for sinter hardening. The Tech Centre prepares samples, runs sintering trials at customers’ plants and provides the practical support required,” explains Dr Yu.

Wider acceptance of sinter hardening is also being driven by market forces, in particular increasing demand for high-performance P/M parts for the automobile industry and power tool sector.

“This growing demand creates enormous potential. The pressure to cut alloying material costs will lead P/M component producers to consider sinter hardening more seriously, so we see a bright future for the process,” says Dr Yu, who adds: “We also expect that among other sinter hardening materials, those alloyed with chromium will be increasingly applied due to their good hardenability, beneficial material cost, good mechanical performance and better dimensional stability.”



THE STRENGTH TO REPLACE WROUGHT STEEL

If you want to compare a high-strength P/M steel and a wrought steel for component design purposes, the MPIF Standard 35 register offers a good objective starting point – Astaloy CrM® and Astaloy CrL® are in the latest edition.

“My presentation at PM Asia 2007 will show examples of how P/M steels can achieve the same ultimate tensile strength, yield strength and fatigue strength as many wrought steels produced by machining, forging or casting,” says Jan Tengzelius of Höganäs AB, who will present **PM Steel Components with the Strength of Wrought Steel**. “However, I also want to emphasize that material standards are in place to make objective comparisons possible.”

“New design concepts open up new opportunities for P/M,” continues Jan, “but to take advantage, designers have to compare techniques. Material standards such as MPIF or ISO make it simple. It’s important that this type of information is available from an independent source and not just material and part suppliers. The measurements and quality criteria are there to make valid comparisons possible and help convince designers that P/M is a viable alternative. The standards can act as a good first step for designers if they are thinking of designing a component in P/M steel.”

Virtually all Höganäs materials are listed in MPIF Standard 35 and two relatively new products for high-strength P/M steels, the chromium-alloyed materials Astaloy CrL® and Astaloy CrM® are now included. Astaloy CrL is coded FL-5208 and Astaloy CrM, FL-5305, in the 2007 edition of MPIF Standard 35, Materials Standards for PM Structural Parts. The ISO standard is currently under revision and the two products will also be present on the new list.

The case histories featured in the presentation compare P/M steels and wrought steel for two potential P/M parts – a planetary gear in a heavy truck gearbox and a heavy-duty latch cone. “Our findings show clearly that with the right design, high-strength P/M steels can be utilized even for heavy loaded components such as gears and latch cones,” states Jan.

Outstanding results

In his presentation, Jan will also comment on new research from Sweden on using Astaloy CrM as an alternative to wrought steel for an injector yoke.

“Although there is a lot of evidence available on the performance and cost benefits of P/M steels, this study produced some outstanding results, highlighting exactly why P/M is a better alternative. It is always interesting to see such excellent figures, especially from an independent study,” says Jan.

Technology, Environment and Economic Evaluation of an Injector Yoke is a study carried out by IVF Industrial Research and Development Corporation, the Swedish engineering industry’s research institute. The industrial partners cooperating in the study were: Volvo Trucks AB, SKF AB, Callo AB and Höganäs AB.

The studied injector yoke type, commonly made in wrought steel, is used to keep the injector nozzle in place in diesel engines. When a sintered injector yoke was produced in Astaloy CrM, the following findings were noted:

- The number of process steps was reduced.
- No separate hardening operation was needed in conjunction with sintering.
- Material savings of 30% were gained by achieving 97% material utilization, rather than the wrought steel part’s 68%.
- Material savings and the simpler process route led to 32% savings in energy.



Injector yoke made by forging (left) and PM (right)

Making high-performance P/M gears a reality

How close is the P/M industry to breaking into the enormous market for high-performance gears? A presentation at PM Asia 2007 reports on the P/M materials and processes that can deliver the necessary performance.

Progress in developing high-performance P/M gears is important for the Chinese market, according to Sydney Luk, Vice-President of Höganäs (China) Ltd: "There are a lot of opportunities for making gears in China. We anticipate that a great percentage of our future growth will come from high-performance P/M gears."

The presentation **Opportunities for High Performance PM Gears in Automotive Applications**, by Ulf Engström, Sven Bengtsson, Linnea Fordén, Pernilla Johansson and Senad Dizdar of Höganäs AB, will be given by Sydney Luk at PM Asia 2007.

"At this stage we are addressing the density and precision issues that must be solved before we can fully exploit growth opportunities in this area," explains Sydney. "This presentation shows just how far we have progressed in terms of developing the high-density materials and processes, such as surface densification, that can make high-performance P/M gears achievable."

The presentation covers potential applications in automotive, compares the costs of machining against P/M solutions, and outlines the P/M gear production route. Two case studies are also considered that highlight competitive fatigue performance from the surface densification process, which

introduces a high-density layer around the gear tooth, increasing the load bearing capacity of the component.

"If the P/M industry is to keep growing, we need to find ways of maintaining the net shape advantage of P/M, while increasing performance," states Sydney. Selective densification techniques are being developed that have the potential to fulfil automotive gears' high-performance requirements.

The long list of possible applications includes transmission gears in manual gearboxes, planetary, ring and sun gears for automatic gearboxes, engine balancer shaft drive gears and sprockets and gears for valve timing systems.

Transmission gears require high geometrical requirements, DIN 7-8, and high mechanical performance, especially fatigue performance such as tooth root bending, rolling contact and pitting.

Impressive case studies

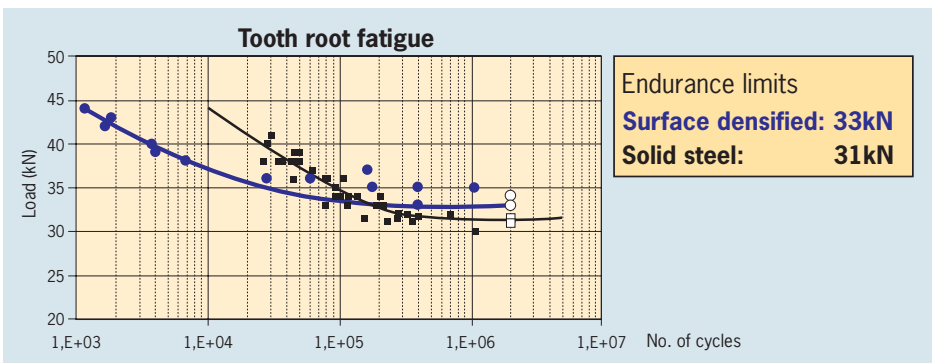
The two case studies in the presentation examine the fatigue performance of two surface-densified P/M gears made from Astaloy® 85 Mo (FL4400) with 0.2% C.

In the first case study, a helical

transmission gear – 5th gear of a transmission in a Volvo car – is studied. Tooth root fatigue testing showed the surface densified gear reached an endurance limit of 94% of the solid steel reference gear used in actual production. A planetary spur gear for a gearbox in a Scania heavy truck is the subject of the second case study. The endurance limit for the surface densified gear in tooth root fatigue testing was an impressive 33kN, compared to 31 kN for the solid steel gear.

Sydney feels the case studies show the true potential of P/M materials and processes in gear production: "It is shown that surface densification by rolling is a cost-effective process to improve geometry and mechanical properties of P/M gears and that pre-alloyed base powders such as Astaloy 85 Mo with a low amount of graphite is an ideal material for surface densified and case hardened P/M gears."

Importantly, surface densification can now deliver P/M gears that match the performance of wrought steel gears. "From these two case studies we can conclude that the tooth root fatigue performance of surface densified P/M gears is comparable to solid steel," concludes Sydney.



TECHNICAL PRESENTATIONS AT PM ASIA 2007, SHANGHAI, APRIL 2-4

Monday

April 2

Sinter Hardening- A Big Market and Technology Potential in China

Höganäs (China) Co Ltd
Yang Yu

Tuesday

April 3

PM Steel Components with the Strength of Wrought Steel

Höganäs AB
Jan Tengzelius

Wednesday

April 4

Opportunities for High Performance PM Gears in Automotive Applications

Höganäs AB: Ulf Engström,
Sven Bengtsson, Linnea Fordén,
Pernilla Johansson, Senad Dizdar

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