

# POWDER

**SPECIAL ISSUE**  
 PM2004, WORLD CONGRESS  
 OCTOBER 17-21, VIENNA

## NEWS



### Surface densification IN FOCUS AT PM 2004

*The latest results from the EU-funded HIGHDENS project on surface densification of P/M gears will be presented at the Vienna congress.*

Surface densification will be high on the agenda at the PM2004 Powder Metallurgy World Congress & Exhibition. The technique, which can selectively densify highly-loaded regions of P/M components, is seen as a means to reach the high mechanical requirements demanded for automotive gears.

The four-year HIGHDENS project aims to identify and demonstrate steps in the viable industrial production of surface-densified high-performance gears. Officially titled "Application of High Density PM Gears for Automotive Gearboxes by Densification of the Surface Layer", the project is funded by the European Union as part of its Competitiveness and Sustainable Growth Program.

With the project due to end next year, there is a growing stream of research results and no less than three technical papers on surface densification will be presented in Vienna by HIGHDENS consortium members. The project consortium consists of powder producer Höganäs AB, two component producers (Sinterstahl GmbH and m. G. mini Gears S.p.A), two automotive makers

(Fiat and Renault) and the Laboratory of Machine Tools and Production Engineering (WZL), Aachen University.

Sven Bengtsson of the Höganäs AB R&D team coordinates the HIGHDENS project: "This project has spread knowledge on surface densification throughout Europe and I hope that interest will be further increased at PM2004, which is a good international platform for showing the latest research on this technology. We also hope that more companies will move from interest to action and start benefiting from using this method."

"The consortium's latest research results are very positive," says Sven. "These findings demonstrate that the materials and processes exist to enable the cost-effective manufacturing of surface-densified, high-performance gears."

Höganäs AB will also present two surface densification-related technical papers – one in conjunction with truck maker, Scania, the other on stress distribution calculations – as part of the Group's program of 14 presentations at PM2004.

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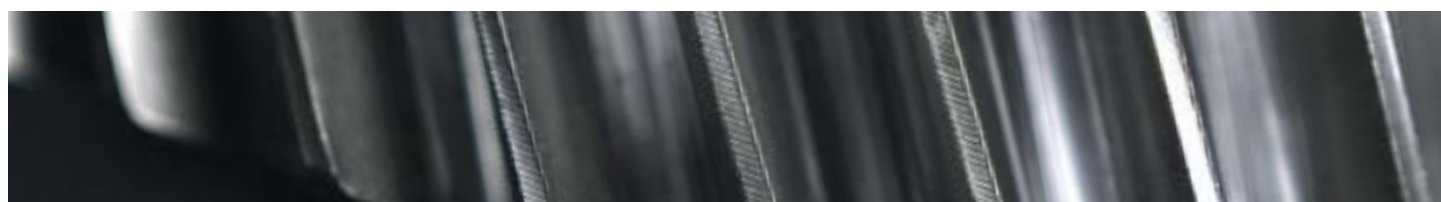
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# Surface densification

## ADVANCES IN EUROPE



*The HIGHDENS project is providing the knowledge to transform surface densification from a promising process into a competitive applied technology.*

Surface densification by transverse rolling is regarded as one of the most promising technologies to improve the mechanical strength of P/M parts, particularly highly loaded gears, to solid steel levels.

The EU concluded that surface densification was a method worth examining as a means to improve the competitiveness of the European automotive and gear industry and provided funding for the four-year HIGHDENS project, which began in 2000. This project, officially called "Application of High Density PM Gears for Automotive Gearboxes by Densification of the Surface Layer" seeks to identify and demonstrate critical process steps and parameters for the mass production of surface-densified P/M gears.

Project coordinator Sven Bengtsson of Höganäs AB says: "The project has helped to put surface densification on the map in



PM gear (left) and conventional helical gear (right) with inner spline used as a fixed gear in a standard gear box.

Europe and increase confidence in the technology. Consortium members have worked hard to make advances and the project's long-term emphasis will lead to a technology that is available and competitive."

Members of the HIGHDENS consortium (see box) will present three papers at PM2004.

### Fatigue strength confirmed

*Application Requirements and Material Selection of Surface Densified PM Gears for Automotive Gearboxes* presents material assessment and selection for a surface densified P/M gear, namely the 5<sup>th</sup> fixed gear of a Renault automobile gearbox.

This paper shows that surface-densified rollers can be successfully manufactured and exhibit excellent fatigue properties. The material Distaloy DC matched the rolling contact fatigue strength of the solid steel reference and has been selected for further tests with gears.

### Required DIN quality achieved

*Evolution of Gear Quality in Helical PM Gears During Processing* studies a surface-densified helical gear for an automotive gear box and compares its properties – microstructure geometry, surface roughness and DIN quality – with the conventional wrought steel gear currently used in the gear box.

High geometric quality better than DIN Q7 is usually required for gears in gear box applications. A key conclusion of the paper is that "the quality of selectively densified gears reaches a quality level of DIN Q8, which is comparable to the quality of a shaved conventional gear made from wrought steel."

### Simulation tools developed

*A New Simulation Methodology for PM Surface Densification Process* explains how

finite element modelling can be used to efficiently design optimised gear preforms and rolling tools for surface densification. This approach saves time, as trial and error can be avoided in the process set up.

### Understanding stress distribution

Finite element analysis is also the basis for calculations in a paper from Höganäs AB focusing on surface densification: *Root and Contact Stress Calculations in Surface Densified PM Gears* by Anders Flodin and Linnéa Fordén.

After analysis it is concluded that: "Finite element calculations show surface densification creates a higher maximum root strength compared to non-densified P/M and wrought steel... This means that a higher core density will have a positive impact on the stress state of a densified gear tooth."

### The HIGHDENS project

Together, the six consortium members provide the knowledge base necessary for all steps in the manufacturing chain for surface-densified PM gears. All partners contribute specialist expertise and project roles are broadly divided as follows:

- Höganäs AB supplies the metal powders
- Sinterstahl GmbH (Germany) takes responsibility for pressing and sintering
- m. G. mini Gears S.p.A (Italy) carries out surface densification and heat treatment
- RWTH (Rheinisch-Westfälische Technische Hochschule) Aachen (Germany) carries out penetration calculations and load-carrying capacity tests on gears and rollers
- Fiat (Italy) and Renault (France) make test facilities available and as end-users set the parameter requirements for components.



# P/M GEARS EN ROUTE FOR high performance

*Höganäs AB has been cooperating with Scania, a leading manufacturer of heavy trucks, to test the potential of various P/M manufacturing routes for high-performance gears.*

Warm compaction and surface densification are two performance-enhancing processes that are helping to push P/M technology towards the high strength and fatigue properties required for transmission gears.

The latest research in this area will be presented at PM2004. High-performance Gears, by Sven Bengtsson and Linnéa Fordén of Höganäs AB and Magnus Bergström of Scania, compares the performance of gears produced by three different manufacturing routes – cold compaction, warm compaction and surface densification

Tests were carried out on a 20-tooth, 700-gramme planetary gear used in the hub reduction unit of Scania heavy trucks. Dista-loy AB and Astaloy 85Mo were used



as base materials for the P/M prototype gears, which were tested at the Scania Technical Centre in Södertälje, Sweden.

“The interesting thing from a P/M point of view is that these tests were on a gear for a heavy truck,” says Sven Bengtsson. “This gear is a critical, heavy-duty component subject to heavy stresses, and it shows how far our technology has come that a P/M solution is being tested for such a high-performance application.”

## Closing the gap

Gears for this type of application are normally manufactured by forging a blank, followed by turning, hobbing, shaving, heat-treatment and finally grinding.

“These are large gears, which means a lot of material is machined away before the component is finished,” states Sven. “Material utilization for solid steel is about 50%, while for P/M it approaches 100%. This means that using a net shape process can achieve a cost saving of 30% compared to a solid steel gear. And now P/M is closing the performance gap, especially when using warm compaction and additional process steps such as surface densification.”

Warm compaction, a technique that has been continuously developed since the 1990s, improves density and ensures excellent pore size distribution. Surface densification enhances the fatigue properties of P/M gears, as the density of highly loaded regions can be significantly increased.

Linnéa Fordén says the tests with Scania confirmed the performance-enhancing qualities of warm compaction and surface den-

sification. “With the surface densification route, we achieved a virtually pore-free surface layer along the gear tooth and a surface hardness that was much better than the non-densified materials. It could also be seen that, in comparison with cold compaction, warm compaction elevates tooth root fatigue performance by increasing the density from 7.01 g/cm<sup>3</sup> to 7.44 g/cm<sup>3</sup>.”

Scania, the world’s third-largest producer of heavy trucks, develops and manufactures vehicles with a gross weight of more than 16 tonnes. “We have cooperated with Scania for many years on various projects such as warm compaction for synchroniser rings,” says Sven. “The company is very open to new ideas and active in the hunt for new and better materials and processes. Our cooperation with Scania is slightly unusual as they are an end user rather than a component maker. Cooperation with end users gives us a very good insight on their component performance requirements, and helps us to adapt powders and processes to meet those needs.”

## Focus on high-performance gears

Höganäs AB is committed to widening applications for P/M gears. Transmission gears for automotive applications is a prioritized R&D area. Extensive resources are being directed to examine both the materials and manufacturing routes that have the potential to reach the required properties. Höganäs AB became involved in surface densification in the early 1980s and the technique has been intensively developed since the mid-90s.



# Microstructure MAKES OR BREAKS P/M MATERIALS

*Analysing microstructure is the key to understanding the fatigue performance of P/M materials. The inside story on the microstructure of robust diffusion-bonded powders will be revealed at PM2004.*

The quest for high fatigue performance in the P/M industry requires a deep understanding of materials' microstructure. In 2001 Höganäs AB started a major project to map the microstructure and fatigue performance of its materials. The result is a unique knowledge bank based on the work of the Fatigue Research Team, a group of four that works exclusively on fatigue-related research.

At PM2003, the Fatigue Research Team presented its findings on chromium materials. This year, two of the team, Luigi Alzati and Anders Bergmark, will present microstructural insight on diffusion-bonded materials in a paper entitled *Diffusion Alloyed Powders with High Fatigue Performance in the As-Sintered State*.

This paper examines the relation between microstructure and fatigue performance in three diffusion-alloyed powders and a pre-alloyed powder, Astaloy Mo. The same processing route was used for all materials – sintering at 1120° C and cooling at 0.8° C/sec – enabling the effect of carbon addition to be examined as an isolated parameter.

"We have carefully analysed the strengthening mechanism of the diffusion-bonded materials," says Anders Bergmark. "We

focused on microstructural characteristics and found that the strengthening mechanism lies in a well-designed good distribution of alloying elements and the heterogeneity of the microstructure."

When copper is used as an alloying element in diffusion-bonded materials, as in Distaloy AE and HP, it melts during sintering, establishing a network in the microstructure that completely surrounds the base powder particles. With the addition of carbon, this network forms even stronger microstructures.

"We found that the higher the carbon level, the higher the percentage of robust martensite in the network," says Anders. "So we can conclude that you should increase the carbon content if you are looking for enhanced fatigue performance using Distaloy AE and HP."

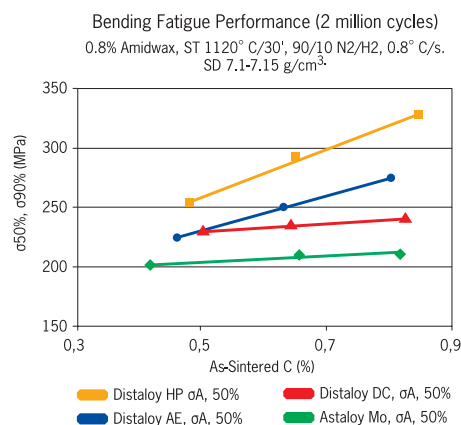
Fractographic analysis revealed a different fracture mechanism in diffusion-bonded materials compared with Astaloy Mo. "The Astaloy material shows crack initiation related to porosity and sinterneck failures, whereas in diffusion-bonded materials fatigue cracks start in the base particles. Diffusion bonding makes the materials stronger and less sensitive to porosity," says Luigi Alzati.

Anders and Luigi have been on the fatigue research team since the start, and were involved in the initial building up of a laboratory and methodology optimised for studying microstructure and fatigue behaviour in P/M materials.

"The most important general discovery so far is that we have established the strong link between microstructure and fatigue performance," explains Luigi. "Before this project, the focus in fatigue study was mostly on

porosity and alloying elements, but we now see that microstructure plays a major role."

"Through looking at microstructure, we can understand exactly what makes Höganäs AB powders so good," adds Anders. "And now that we have built up our knowledge bank on microstructure and fatigue, we can use it as a basis to improve existing products and move on to develop new materials, especially for high performance applications."



## Focus on diffusion-bonded materials

Höganäs AB introduced diffusion-bonded powders between the 1970s and 1990s, and the products has been marketed globally over the years with great success. Ten different grades, offering a range of distinctive properties, are made in Höganäs, Sweden.

In general, the family is characterized by high strength, in particular high fatigue strength. Diffusion-bonded materials are also a very robust product group delivering good characteristics even in less than perfect processing conditions.





# Testing on the cutting edge

*Höganäs AB and Sandvik Coromant have continued their successful testing partnership to determine the optimised machining data and cutting tools for a chromium-alloyed P/M material (Astaloy CrM®) in bainitic state.*

Even though P/M is a net shape or near net shape process, machining is necessary in some applications to reach the final tolerances. P/M materials are sometimes considered difficult to machine, but high productivity and low cost levels can be achieved for a specific material by choosing the right combination of tool material, insert geometry, optimised cutting data and additives.

Höganäs AB, the world's largest metal powder producer, and Sandvik Coromant, the global leader in manufacturing and supplying tools and techniques for machining, work together to provide guidelines for machinability of components based on Höganäs AB P/M materials.

The partnership began in the mid-1990s with tests to identify machining parameters for a number of Höganäs AB base powders. These findings are collected in the Höganäs AB *Handbook for Sintered Components No 5, Machining Guidelines*.

Over the years, the companies have tested around 25 base powders and variants. The most recent tests were on the chromium material, bainitic Astaloy CrM®, which is the subject of a paper for PM2004: *Machining of High Strength PM Steels* by Olof Andersson and Sigurd Berg (Höganäs AB) and Hans Thordenberg (Sandvik Coromant).

Co-author of the paper, Applications Engineer, Hans Thordenberg has worked at Sandvik Coromant for 30 years. He carried out the machining tests on Astaloy CrM® at the R&D and product design facilities of Sandvik Coromant in Sandviken, Sweden.

The paper considers the influence of insert grades and geometries, additives and cutting data when machining test bars made from three different Astaloy CrM® powder mixes.

One of the paper's conclusions is that: "Three times higher productivity and tool life is achieved by MnS compared to a variant without additive." Three times higher productivity was also achieved with MnX in comparison with the non-additive variant.

"When we started the tests, we followed our previous experience that dry machining was the best method to use on P/M materials," says Hans Thordenberg. "However, Astaloy CrM® exhibited different behaviour and we found that for controlled wear it was better to machine with cutting fluid."

"Another interesting aspect of testing Astaloy CrM® was discovering the great effect of additives," continues Hans. "Without additives, the dominant wear characteristics were build up edge and smearing, but when additives were used these phenomena disappeared. The additives MnS and MnX made a great difference to performance."

## A partnership that benefits customers

"We want to be able to tell customers how to carry out secondary operations in the most cost-effective way. We can do some machining tests in-house, but if we want to test at the highest professional level it is best to work with the expert in this field, and that is Sandvik Coromant. Some customers who are interested in using Astaloy CrM® perhaps think it's difficult to machine, but in this paper for PM2004 we have shown that there is an optimised solution. We are very pleased to be able to cooperate with Sandvik Coromant and look forward to working with them on new materials in the future."

Olof Andersson,  
Development Engineer, Höganäs AB

"Our ambition is to be a partner in reducing manufacturing costs by delivering productivity, reliability and security – increasing our customers' competitiveness. Cooperation with Höganäs AB works very well and helps us to learn a lot more about P/M materials, and that in turn helps us to improve our products. We want to stay at the forefront of our field and that means being prepared to provide products for materials we believe will be popular in the future. By testing Astaloy CrM®, we now have the required knowledge and parameters to guide our customers, so they can machine this material at the lowest possible cost and with highest productivity."

Hans Thordenberg,  
Applications Engineer, Sandvik Coromant

# ELECTRIFYING PROSPECTS FOR SMC



*When automotive electrical systems shift to a higher voltage, SMC technology will be well placed to provide motor designs optimised for new electrified subsystems.*

A large number of SMC-based electric motors and machines are in production around the world. Soft Magnetic Composite (SMC) technology is now an established source of commercial solutions.

"SMC materials are basically pure iron powder particles coated with a very thin electrically insulated layer," explains Lars Hultman of Höganäs AB. "One of the main advantages is 3D-properties; the materials are isotropic and can carry magnetic flux equally well in all directions. Combining these materials with the 3D-shaping capability of the P/M compaction process has opened up new possibilities in the design and manufacturing of electromagnetic machines and other devices."

#### Successful applications

Recent SMC applications include an electric bike, produced by US company WaveCrest Laboratories, that has an SMC-based direct drive DC motor located in the rear wheel hub. And in Japan, Twinbird Corporation has developed a sterling cooler suitable for portable freezers that contains a linear motor with SMC stator parts.

SMC is already established in automotive applications. An outstanding commercial example is the rotor for the Aisin Seiki PM

BLDC ABS-motor, a solution that reduced motor length by 36% and weight by 17%. Other SMC automotive applications include:

- Pulse transformers for ignition systems (Delphi Corp)
- Linear actuators for diesel fuel injectors (Robert Bosch & Denso)
- Power steering torque sensor (Fine Sinter)
- TFM-Direct Drive for buses (Voith Turbo)

Today's automobiles contain up to 50-100 electrical motors and the use of electromagnetic devices in vehicles is increasing. Adoption of SMC solutions in automotive applications is likely to be dramatically accelerated by a future shift from the 14 Volt electrical system to a 42, or even higher, bus voltage, which will enable the electrification of many more vehicle subsystems.

A paper for PM2004: *Existing and Future Automotive Applications for Soft Magnetic Composites* by Lars Hultman examines the prospective role of SMC in new electromagnetic technologies and devices.

The main conclusion is that SMC technology is well placed to meet future demands for automotive electrical motors. SMC materials' isotropic nature and 3D-shaping potential provide the design flexibility to deliver improved higher-efficiency motors such as PM BLDC, as well as new concepts such as Claw Pole and TFM (Transverse Flux Machine).

#### New compaction method

The advantages of a new compaction method – controlled die temperature compaction –

are highlighted in a PM 2004 paper entitled *Production Aspects of SMC Components* by Zhou Ye, Lars Hultman and Lisa Kjellén of Höganäs AB.

This paper looks at the effects of production parameters such as compaction methods, heat treatment, lubricant content and tool die temperature on the magnetic properties of SMC parts.

Controlled die temperature compaction, in which the tooling (not the powder) is moderately heated up to approx. 60° C, was compared with existing compaction methods. It was found that the new method generally enhances the material properties at the same time as it decreases lubrication needs, which opens up possibilities for reaching even higher densities.

"Our results show that controlled die temperature compaction is an easy and effective way to significantly improve the material properties of SMC materials," says Lars Hultman.

#### Focus on SMC technology

Höganäs AB launched the first SMC materials in 1993 and has been the leading R&D force in this specialized field ever since. The Group is driving SMC technology forward through technical development of materials and processes for new components. Cooperation with end users is considered an essential element in advancing SMC technology. The Höganäs Group is currently involved in more than 40 projects with manufacturers of electrical machines, primarily motor producers.

# SPONGE IRON POWDERS ARE STILL GOING STRONG

*Sponge iron powders still have an important role in today's P/M industry and offer distinct advantages, particularly for component producers looking for fine tolerances in medium-strength applications.*

Höganäs AB has manufactured sponge iron powders for almost 100 years and remains the world's largest producer. Initially supplied to Swedish steel makers, the company's sponge iron powders were used in the compacting and sintering developments of the 1930s to establish the basis for today's P/M industry. Other iron powder production methods such as water atomization were developed in the 1950s, but sponge iron powders remain highly relevant to modern needs.

"The success of water-atomized powders should not obscure the fact that sponge iron powders are still popular and offer a range of excellent benefits. These products are well-proven with properties that in certain cases make them a better choice for medium-strength applications than atomized powders," says Mats Larsson of Höganäs AB, who answered our key questions on sponge iron powders.

**Does particle shape have an effect?** Sponge iron particles have a spongy internal structure (see figure 1), while water-atomized particles have very little internal porosity. The irregular shape and porous interior of sponge iron powder particles gives it a better green strength after compacting than powders with a regular particle shape. High green strength makes components easier to handle and gives high edge strength.

**What is considered a good all-round sponge iron powder?**

The benefits of particle shape on high green strength can be clearly seen in NC100.24, one of the most widely used grades in the manufacturing of sintered parts, especially structural parts where high green strength after pressing is an important quality.

**Is compressibility an issue?**

The porous structure of sponge iron powders means they generally offer lower compressibility than atomized powders. However,

there are sponge iron powders with good compressibility. SC100.26 has been optimized to provide the best compressibility of all Höganäs AB sponge iron powders. It combines good compressibility with high green strength (see figure 2), which makes it a good alternative to the atomized AHC100.29.

**Do these powders have any special applications?**

Yes, high green strength at low densities makes sponge iron powder uniquely suitable for self-lubricating bearings. One of our powders, MH80.23, has been especially designed to match the requirements for this application with a particle size that creates an optimal pore structure.

**How pure is sponge iron powder?**

All our sponge iron powders for the P/M industry are produced in Höganäs from virgin material rather than scrap metal. Using virgin material means a lower level of metallic impurities and this ensures greater consistency in the powder's chemical composition.

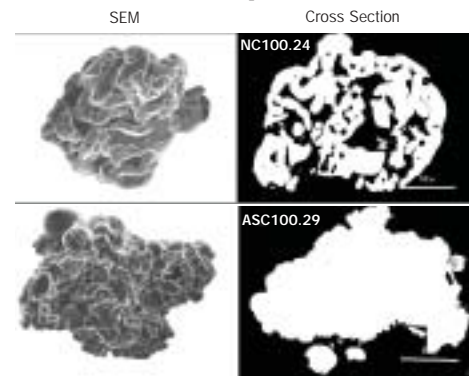
**Why are these products relevant to today's needs?**

One aspect of sponge iron powders that has become more important to component producers is small dimensional scatter (see figure 3). There is a clear trend towards finer tolerances for components and one of the important factors is having a base material that provides lower scatter. Our experience is that you can achieve lower scatter with sponge iron than certain atomized powders.

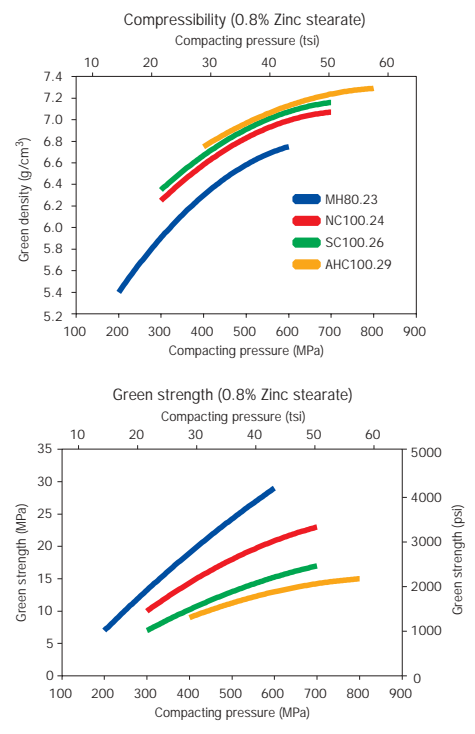
**When is sponge iron a better powder choice than water-atomized?**

For self-lubricating bearings and low-density applications, sponge iron powders are the recognized choice, whereas water-atomized powders are best for high-strength components. In the medium-strength segment, which includes structural parts such as belt pulleys, there is an overlap where you can choose either an atomized or sponge iron powder. In many cases it's better to select a sponge iron powder because the lower dimensional scatter gives you access to the finer tolerances that are required today.

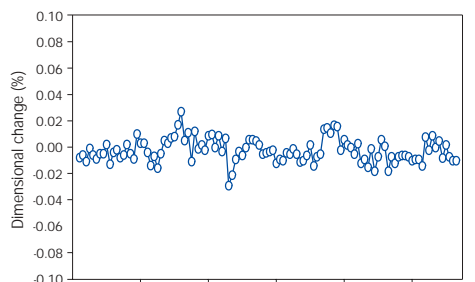
**Figure 1.** External particle shape and internal particle structure of sponge iron powder (NC100.24) and water atomized iron powder (ASC100.29)



**Figure 2.** Compressibility and green strength of iron powder grades mixed with 0.8% zinc stearate



**Figure 3.** Dimensional change of lots produced over a period of one year of a Starmix containing SC100.26+1.8% Cu+0.6% Graphite+Lubricant



# TECHNICAL PRESENTATIONS

AT THE PM2004 WORLD CONGRESS, VIENNA, OCTOBER 18-21

Monday October 18	Tuesday October 19	Wednesday October 20	Thursday October 21
<p><b>A Comparison of Methods of Reaching High Green Densities using Elevated Temperatures</b></p> <p>North American Höganäs, Inc. <i>David Milligan</i> <i>Paul Hofecker</i> <i>Ulf Engström</i></p> <p>Höganäs AB <i>Mats Larsson</i></p> <hr/> <p><b>Performance and Capabilities of Powder Mixes during Warm Compaction</b></p> <p>Höganäs AB <i>Hilmar Vidarsson</i> <i>Björn Johansson</i> <i>Per Knutsson</i></p> <hr/> <p><b>P O S T E R</b></p> <p><b>Processing Conditions for High Strength PM Steels Alloyed with Chromium</b></p> <p>Höganäs AB <i>Sigurd Berg</i> <i>Barbara Maroli</i></p>	<p><b>Improved Tolerances by Optimized Powder Mixes</b></p> <p>Höganäs AB <i>Mats Larsson</i> <i>Daniel Edman</i></p> <hr/> <p><b>Influence of Secondary Operations on Mechanical Properties of Low Alloyed Sintered Steel</b></p> <p>Höganäs Japan KK <i>Kanno Koki</i> <i>Yoshinobu Takeda</i></p> <p>Höganäs AB <i>Anders Bergmark</i> <i>Luigi Alzati</i> <i>Björn Lindqvist</i></p> <p>Fine Sinter Co. Ltd <i>Yoshihasa Ueda</i></p> <p>Kanto Yakin Kogyo Co. Ltd <i>Kiichi Kanada</i></p> <p>Trento University <i>Andrea Zandonati</i></p> <hr/> <p><b>Lubricant Distribution on Compacts and Tool Walls after PM Compaction</b></p> <p>Chalmers University <i>Erik Hjortsberg</i> <i>Lars Nyborg</i></p> <p>Höganäs AB <i>Hilmar Vidarsson</i></p> <hr/> <p><b>P O S T E R</b></p> <p><b>Diffusion Alloyed Powders with High Fatigue Performance in the As-sintered State</b></p> <p>Höganäs AB <i>Luigi Alzati</i> <i>Anders Bergmark</i></p>	<p><b>Machining of High Strength PM Steels</b></p> <p>Höganäs AB <i>Olof Andersson</i> <i>Sigurd Berg</i></p> <p>AB Sandvik Coromant <i>Hans Thordenberg</i></p> <hr/> <p><b>Evolution of Gear Quality in Helical P/M Gears during Processing</b></p> <p>Sinterstahl GmbH <i>Lorenz Sigl</i> <i>Günter Rau</i></p> <p>miniGears S.p.A <i>Pierluigi Zingale</i></p> <p>Renault France <i>Didier Caudebec</i></p> <p>Höganäs AB <i>Sven Bengtsson</i></p> <hr/> <p><b>High Performance Gears</b></p> <p>Höganäs AB <i>Linnéa Fordén</i> <i>Sven Bengtsson</i></p> <p>Scania C.V <i>Magnus Bergström</i></p>	<p><b>Root and Contact Stress Calculations in Surface Densified PM Gears</b></p> <p>Höganäs AB <i>Linnéa Fordén</i> <i>Anders Flodin</i></p> <hr/> <p><b>Application Requirements and Material Selection of Surface Densified P/M Gears for Automotive Gearboxes</b></p> <p>Höganäs AB <i>Sven Bengtsson</i></p> <p>Renault France <i>Didier Caudebec</i></p> <p>WZL, RWTH-Aachen <i>Frank Wattenberg</i></p> <p>Centro Ricerche FIAT <i>Massimo Asti</i></p> <p>miniGears <i>Pierluigi Zingale</i></p> <p>Sinterstahl GmbH, Füssen <i>Günter Rau</i></p> <hr/> <p><b>Production Aspects of SMC Components</b></p> <p>Höganäs AB <i>Lars Hultman</i> <i>Ye Zhou</i> <i>Lisa Kjellén</i></p> <hr/> <p><b>P O S T E R</b></p> <p><b>Existing and Future Automotive Applications for Soft Magnetic Composites</b></p> <p>Höganäs AB <i>Lars Hultman</i></p>
<p>For daily update of presentations visit <a href="http://www.hoganas.com">www.hoganas.com</a></p>			

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