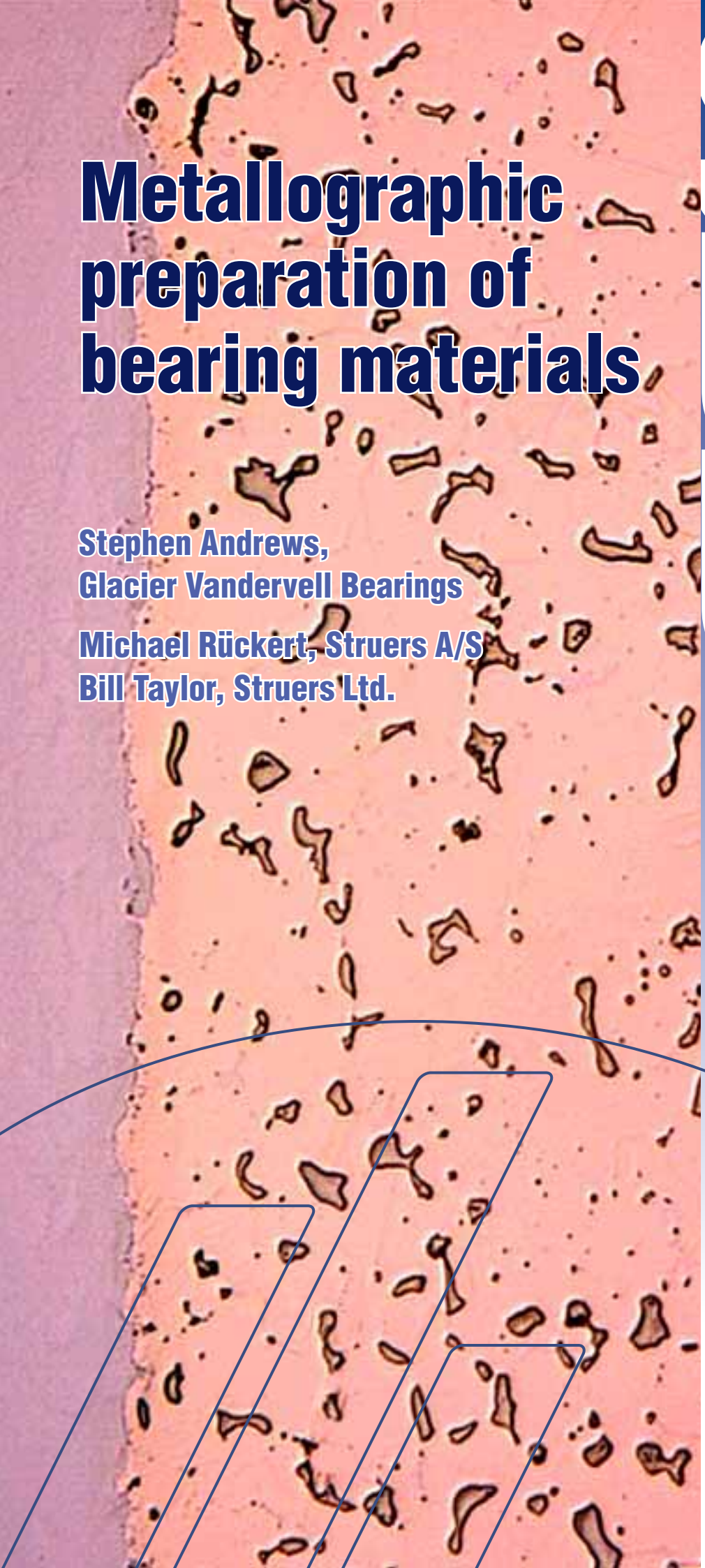

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SB10

Metallographic preparation of bearing materials

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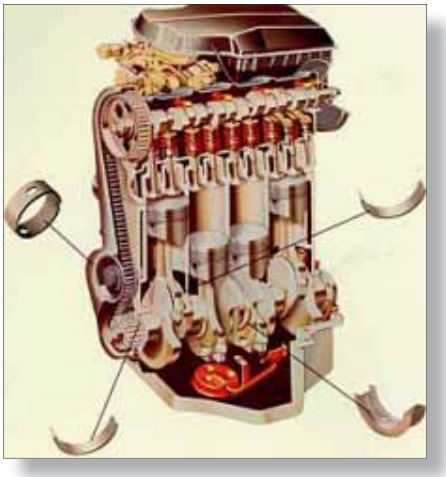
Introduction

Glacier Vandervell Bearings in Kilmarnock, Scotland, UK is a leading manufacturer of bearing materials for the automotive industry.
The present facility in Kilmarnock was opened in 1947, and today employs about 500 people and has been part of the Dana Corporation since the end of 1998.

The Kilmarnock factory specialises in the development and manufacture of Aluminium and Copper based bi-metals which are fabricated into bearings, bushings and thrust washers. The aluminium based bearing materials are produced in 10 different alloys, ranging from relatively simple AlSnCu alloys to more complex AlSnSiNiCuMnV alloys. The choice of a specific alloy will be dictated by the properties required to withstand the operating conditions within the many different engine types, capacities and performance levels.



Production

The two different bearing materials are produced in different ways.

Copper Lead alloys
For the CuPb alloys the raw materials are mixed, melted and processed by spray atomisation to produce a powder. An integral part of the quality control process at this stage is to check the chemistry, particle size and shape of this powder mix prior to the sintering operation. In the initial stages of what is a continuous process, this powder is dispersed onto a ground steel strip material and sintered at temperatures between 700 – 800 °C. After slow cooling the material is then rolled to the required thickness and formed into coils.

In the final stage of the process, the coil undergoes heat treatment. It is at this stage that samples are removed for quality control.

Subsequent operations on the coil involve cutting, shaping and machining processes to provide the finished bearing.

Aluminium Tin Alloys
The AlSn alloys are produced in a different way. An alloy of a specific composition is produced in the molten state. This molten alloy is then continuously cast into strip material which is then coiled. This coiled strip material is subsequently roll bonded onto a steel substrate with a pure aluminium foil intermediate layer.

It is at this stage that the coiled bimetal is heat treated. Before the finished coils of either material are taken through the rest of the production process, samples are taken for quality control. In addition to mechanical testing, product metallography is an integral part of the quality control process.

Metallography
Test coupons are punched out of the bimetallic strip and sent to the lab. Several of the coupons are hot mounted together in a bakelite mounting material. After hot mounting the mounted samples are trimmed on a Struers Labotom cut-off machine using a 33TRE cut-off wheel. This removes any cold work damage produced by the coupon punching operation. The mount size is 30 mm. Only CuPb or AlSn samples are mounted together.

Up until two years ago, production control samples had largely been prepared manually using several grits of SiC paper. This proved to be time consuming, expensive, and it was difficult to obtain a consistent quality of polish. At that time a number of sections were sub-

mitted to Struers Ltd. Laboratory to establish whether a more effective method in terms of cost, consistency, and reproducibility could be developed.

Working in conjunction with Laboratory staff from Glacier Vandervell, a semi-automatic method which satisfied all the customers' criteria in terms of the quality of specimen preparation was developed.
The requirements for the final polished sections are listed below:

Copper Lead

- High quality general polish
- Minimal relief between bearing layer and steel backing to facilitate assessment of the bond integrity.
- Fully developed and polished islands of Lead to ensure consistency of comparative analysis with standards.

Step	PG	FG 1	FG 2	DP	OP
Surface	MD-Piano	MD-Piano	MD-Largo	MD-Mol	MD-Chem
Abrasive	Diamond	Diamond	DiaPro Allegro/Largo	DiaPro Mol	OP-S
Grit/grain size	600	1200			
Lubricant	water	water			
Speed [rpm]	300	300	150	150	150
Force [N]	30	30	30	30	30
Time [min]	2	2	6	6	3

Table 1

Aluminium Tin

- High quality general polish.
- Minimal relief between bearing layer, intermediate foil and steel backing in order to facilitate assessment of the bond integrity.
- Also to ensure consistent comparative analysis of type, size and distribution of different phases present in the range of alloys.

The preparation of the production control mounts is now carried out on 2 TegraSystems; one consisting of a TegraPol-11 with a TegraForce-1 and a TegraDoser-5, and the other consisting of a TegraPol-11 with a TegraForce-1 and a TegraDoser-1 for dosing of diamond products.

For the preparation of the specimens on the TegraSystem, the old traditional methods have been replaced by one semi-automatic method. An outline of this method is provided in Table 1.

Since commissioning the TegraSystem, the preparation has changed considerably when compared with the method previously used.

Mr. Stephen Andrews, the Laboratory Manager at Glacier Vandervell explains:-
"Traditionally we ground all specimens using 3 steps of SiC-paper, grit size 600, 1200 and 2400, and a new sheet of paper was used for every specimen to ensure that the grinding conditions were always the same.
As we are preparing 100 – 120 specimens a week, we used considerable amounts of SiC grinding paper. Since installing the TegraSystem, and making use of MD-Piano and MD-Largo, we have found that with each disc having a working life of approximately 3 weeks there is a considerable cost saving when compared with the amount of SiC paper that would be required.

The new semi- automatic method allows both CuPb and AlSn bearing materials to be prepared not only using the same method, but also together in one preparation process.
As 6 different CuPb and 10 different AlSn bearing materials are produced, using only 1 preparation method saves both cost and time.

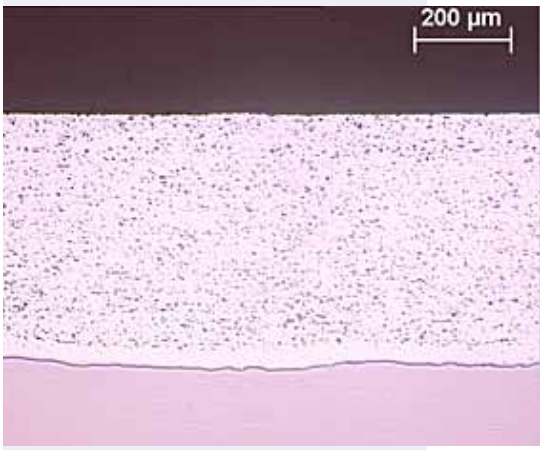
Analysis

After the metallographic specimen preparation the different bearing materials are examined. For the CuPb bearing materials the following features are evaluated:

- Lining porosity
- Lead grain size
- Degree of sinter
- Residual particles
- Bond to base material

The AlSn bearing materials are checked for:

- Lining porosity
- Degree of lining directionality
- Tin stringers
- Alloy foil bond integrity
- Steel foil bond integrity



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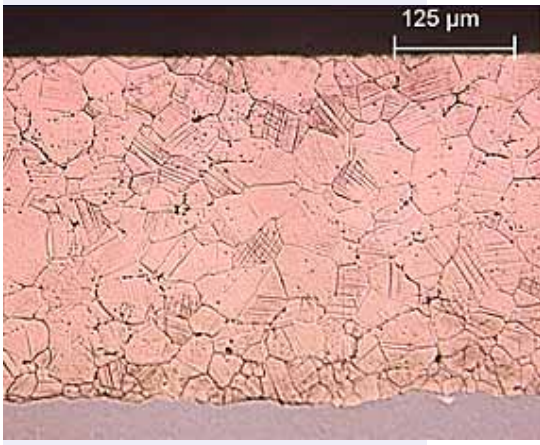

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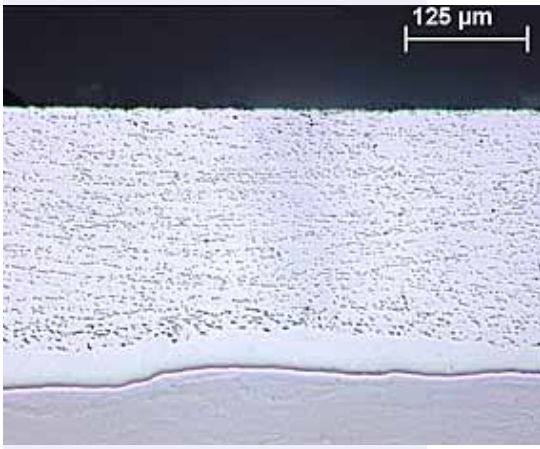

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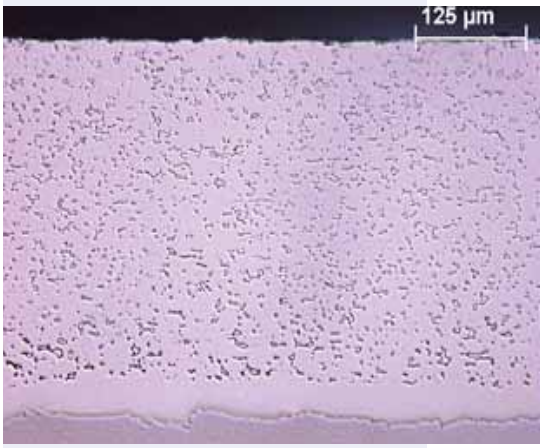
The above features are quantified through comparison with established standards developed by Glacier Vandervell.

Apart from the preparation advantages of the TegraSystem also the user-friendliness of the system was mentioned. Laura Watson, lab technician/metallographer at Glacier Vandervell says: "The in-built automation now available makes it possible to leave the preparation unattended and carry out other tasks."

Conclusion

The metallographic preparation of bearing materials is an important step in ensuring consistent quality of the production. Since the TegraSystem has been set up at Glacier Vandervell the number of preparation methods for the production control has been limited to one method only.
Optimization of the preparation method has at the same time resulted in more uniform preparation results while also providing substantial consumable savings.



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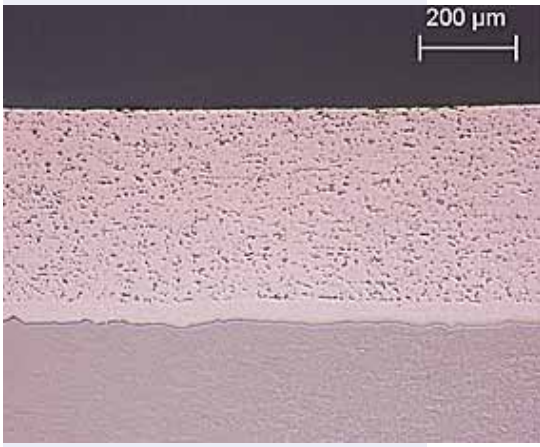

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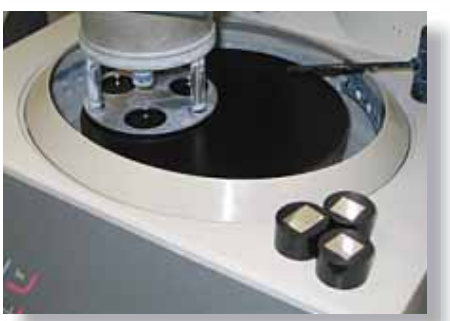
Laura Watson at Glacier Vandervell preparing specimens

The Prepamatic has been installed 15 years ago and is still used for the preparation of demanding customer requests



Three specimens can be prepared at the same time

A variety of prepared specimens, ready for archiving