

Environmentally Friendly P/M Parts and Process for Automotive Applications

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P/M parts can be made without machining and with alloy design, so they have been used in automobiles. This paper describes the environmentally friendly P/M process and parts for automotive applications.

Key Words: Powder Metallurgy, automotive, fuel efficiency, low exhaust gases, net-shape manufacturing

1. INTRODUCTION

P/M parts can be made without machining and with alloy design, so they have been used in automobiles. This paper describes the environmentally friendly P/M process and parts for automotive applications. In this paper four case studies are examined.

Case study 1

Process itself is conventional process, however the applied parts are environmentally friendly parts

Case study 2

Parts their self are conventional parts, however the applied process is environmentally friendly process.

Case study 3

Both parts and process are environmentally friendly.

Case study 4

Study of high copper content ferrous alloy waste recycling system using P/M process.

Especially Case 4 is presented detail in C1-072.

2. CASE STUDIES

2.1 Case study 1

Process itself is conventional process, however the applied parts are environmentally friendly parts. For example, some P/M parts are installed in engine valve timing and/or lift variable system, which are VTC (Valve Timing Control), VVT and VTEC system. Fitting an engine with any of these system reduce the fuel consumed and gases emitted [1]-[3]. The process and materials of making these parts are conventional. The material is usually Fe-Cu-C and simple press and sintering is applied. Sometime heat treatment is needed to achieve the anti-wear characteristics.

Fig.1 shows the outer figure of VTC and inner vane of VTC. Both parts are made by P/M process.

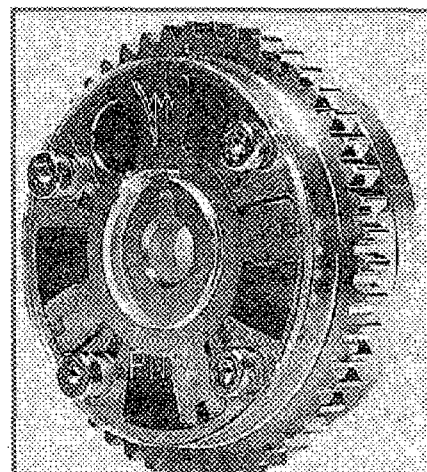


Fig1 VTC Sprocket and Vane made by P/M
(by courtesy of HITACHI UNISIA Co. , Ltd.)

2.2 Case study 2

Parts their self are conventional parts, however the applied process is environmentally friendly process.

There are several examples.

1) Engine sprockets, which is eliminated machining

Fig. 2 shows this sample, the sprocket is idler sprocket which was used to be machined from some performed sprocket, however sinter-joining technology is developed we can eliminate the machining of under-cut portion. Fig.4 shows also some under-cut shaped sprocket. This sprocket is made by under-cut forming technology with special die and tools using CNC (Computer numerical control) press.

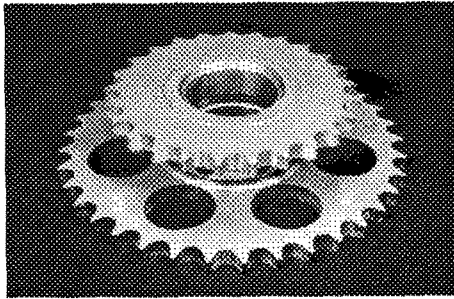


Fig 2 Sinter-joined Idler sprocket which is eliminated machining

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2) Engine sprockets, which is eliminated heat treatment and/or special alloy

Fig.3 shows roller chain sprocket , for MPI(Multi Point Injection=Non-Direct Injection) gasoline engine, Which eliminate heat treatment and/or special alloy with warm compaction process. The first parts were made of Fe-Cu-C with heat treatment. Next parts adopted Fe-Ni-Mo-Cu-C and eliminated heat treatment. Newest parts adopt warm compaction and eliminate heat treatment and special alloy. Iron powder is compacted at 130°C (403K) and achieve high density. It means good mechanical properties. Fig 4 shows the apparatus of warm compaction.

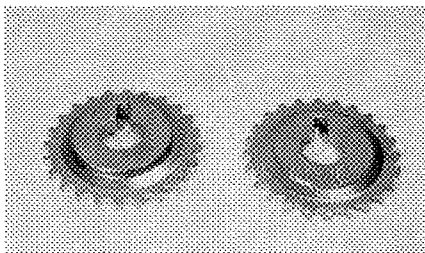
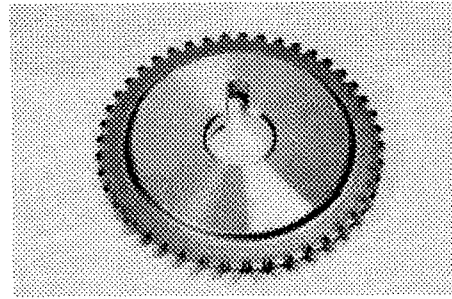


Fig3 Warm-compacted P/M roller-chain system sprocket for MPI engines

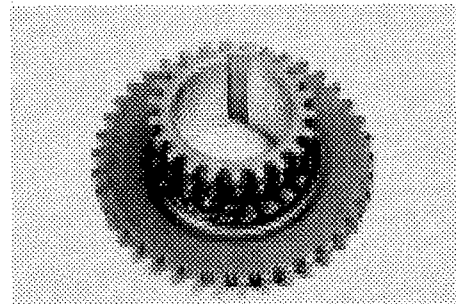
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2.3 Case study 3

Both parts and process are environmentally friendly. For example DIG (Direct Injection Gasoline) engines silent chain sprocket made by warm compaction and high temperature sintering. DIG engines can achieve high fuel efficiency and low exhaust gases. However the wear conditions are severe and this case silent chain system accelerate the wear. So, the wrought steel with machined teeth is common in this application, the authors developed the combined process of warm compaction and high temperature sintering. We also developed best material for this applications. That is Fe-1.5mass%Mo-2mass%Ni-C material. Fig 7shows the developed sprockets.



a) Cam sprocket



b) Crank sprocket

Fig4 Warm-compacted and high temperature sintered P/M silent-chain system sprocket for DIG engines

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2.4 Case study 4

Study of high copper content ferrous alloy waste recycling system using P/M process.

(Detail of this study is reported in C1-08-014)

For the purpose of utilizing copper-rich scrap iron as have been dumped or used for die casting a new powder metallurgical developed by NIMS. The process was high-pressure atomization and consolidation below the copper melting point. It is shown that the cooper rich scrap iron could be reproduced into a material with higher performance than before recycling by the newly developed process.

References

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