Development of Sintered Parts for Variable Valve Timing Unit

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Abstract

Variable valve timing unit, which is able to decrease environmental load and improve fuel economy is loaded onto many automobiles recently. This unit consists mainly of sprocket, housing and rotor. These parts are requested different properties according to environment. We produce sintered parts for variable valve timing unit by selecting compact, sinter process and special treatment according to demanded properties.
In this paper, demanded properties of sintered parts for variable valve timing unit and adopted technique to satisfy them are presented.

Keywords : VVT, Sinter, Gas nitride, Face compressibility, Wear resistant

1. Introduction

In recent years, Automobiles are demanded to satisfy high performance and low fuel consumption holding safety and environment. Therefore, Automobiles which carry VVT unit are increased. Engine combustion state is improved by adjustment of the opening-and-closing timing of intake and exhaust valve, and low fuel consumption, a high output, and low emission were attained simultaneously.

VVT unit consist of rotor, housing, pulley and vane part etc. Their parts are demanded different property according to use. Sintered parts are used for VVT parts by the flexibility of alloy design, the possibility of Near-Net-Shape and mass production.

We conducted various examination to decide material and treatment of sintered parts for VVT parts. Experiment results and discussion that carried out to evaluate various properties demanded for rotor, housing and sprocket presented.

2. Experimental Procedure

Experimental materials are selected according to demanded property.

Atomized or sponge iron powder, atomized or electrolytic copper powder and carbon powder were mixed with zinc-stearate on FH12 or FH16. Atomized alloy powder and carbon were mixed with zinc-stearate on FH655. They were compacted at 500MPa-700Mpa and sintered at 1373-1423K. Compacts sizes are O.D.35×I.D.25×h5 for resistant wear measurement and 60×10×5 for resistant wear and mechanical strength measurement.

Face compression strength was measured by Yunker –type test system. Face compression strength is measured for the value of load which caves the face of specimen 2 micrometer. This test was carried out to evaluate face strength for rotor.

Resistant wear was evaluated by block on ring test. This test was carried out by combination of rotor ring and stability block. It is similarity that rotor ring is rotor and stability block is housing.

Tooth strength was evaluated by tooth strength test. This test was carried out by produced part and load part. It is similarity that produced part is sprocket and load part is roller

Hardness measurement of face and inside of test piece was carried out to evaluate mechanical property and resistant wear. And optical microscope and scanning electron microscope (SEM) was carried out to confirm condition.

3. Results and discussion

Figure 1 shows face compression strength of the sintered materials which carried out by Yunker type test system. Face compression strength increases as density increases. Compared with raw sintered materials, that of FH655 is the highest value of the three sintered materials. Face compression strength of materials increases as hard and density is higher. That of FH12 materials treated carburizing quench is higher than that of FH655. We selected FH12 materials treated carburizing quench considering face compression strength and cost mainly

Figure 2 shows volume of wear by block-on-ring test. Ring was produced by only FH12 treated carburizing quench. Blocks were produced changing material and heat treatment. Volume of wear of raw materials, which are FH16 and FH655 is lager than that of FH16 materials treated steam or gas nitride. That of raw material of FH16 is about 5 times larger than that of FH16 treated gas nitriding. Wear resistance is affected on face condition. Gas nitriding treatment is the most effective method of face treatment to decrease volume of wear.

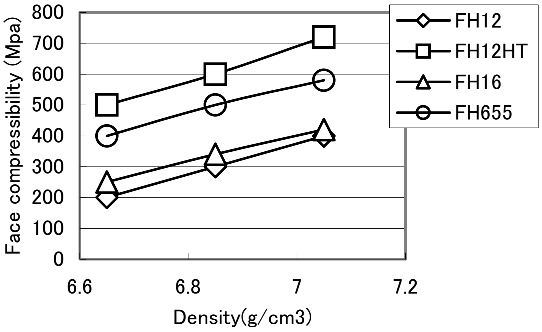

Fig. 1. Face compression strength.

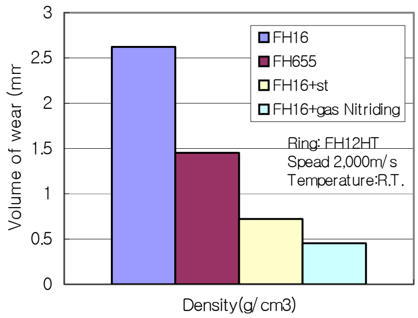

Fig. 2. Volume of wear.

4. Conclusion

(1) We developed and produced the sintered parts for VVT unit.
(2) We selected FH12 materials treated carburizing quench considering face compression strength and cost mainly.
(3) Gas nitriding treatment is the most effective method of face treatment to decrease volume of wear.
(4) This nitriding layer decreases adhesive wear between rotor and housing
(5) The sintered parts which produced by high density compact and induction quench are accepted for high tooth strength, high hardness and high face compressibility
(6) We can choice material and process according to property and cost for VVT unit.

5. References

1) A.Fujiki, Y.Maekawa, Ysugaya and T.Shibano: “Development of Warm Compacted Sprocket for Engine”J.JPN.SOC.Powder Metallurgy vol.51,No.7
2) A.Yamamoto:”Theory and calculation of tightened screw “ P.90 Yokendo
M.Sakai:SAE technical paper series(2000)395
3)K.Kawase, Y.Ishii, K.Morimoto and K.Orito: Abstract of Autumn Meeting of Japan Society of Powder and Powder Metallurgy(2001)129