PAPER REF: 4784

DRY SLIDING WEAR BEHAVIOR OF CRYOGENIC TREATED GEARS MANUFACTURED BY POWDER METALLURGY

Vahid Abouei Mehrizi[1(*)], Mohammad Talafi Noghani[2], Nassim Sharafi[3], Amin Moradi[4]
[1]Departemant of Engineering, Payame Noor University, Iran
[2] Department of Engineering, I. K. university, Iran
[3] Department of industrial Technology, K. N. Toosi university, Iran
[4] Department of Engineering, I. K. university, Iran
[(*)]*Email:* abouei@iust.ac.ir

ABSTRACT

To determine the effect of cryogenic treatment on the microstructure and dry sliding wear behavior of PM Steels Pre-alloyed with Cr-Mo ,water atomized iron powder (Astaloy CrM®) was mixed with different amount of graphite to produce specimens with ./6 , 1 and 1/5% C. The mixed powders were cold pressed at 600 MPa and sintered at 1120 ℃ for 30 min under pure 90%N_2-10%H_2 gas atmosphere. Cooling rate of sintered specimens was 1 $℃/s$. Then, a cryogenic treatment was done on all specimens. To prevent of martensitic brittleness, a tempering process was established after cryogenic treatment. Wear tests were carried out on the tempered specimens under dry sliding conditions using a pin-on-disk type machine at constant load and speed. It was seen that hardness and wear strength in specimen with 1/5% C were higher than other specimens.

Keywords: tribology, cryogenic treatment, powder metallurgy.

INTRODUCTION

It has been observed that the effect of manufacturing conditions on fatigue and wear properties of Fe-1.75 Ni-1.5 Cu-0.5 Mo-0.6 C sintered steel. Their results showed that the wear and fatigue resistance were increased by decreasing porosity level and by heat treatment. Wang and Danninger investigated the wear behavior of Mo alloyed sintered steels and showed that the wear rate increased under quenching and tempering conditions in comparison to as-sintering condition.

It has also been confirmed that for improving the properties of Fe-1.75 Ni-1.5 Cu-0.5 Mo-0.6 C steel a cryogenic treatment applied to PM specimens. Cryogenic treatment of steel consists of exposing the ferrous material to subzero temperatures to either impart or enhance specific conditions or properties of the material. Increased strength, greater dimensional or micro structural stability, improved wear resistance, and relief of residual stress are among the benefits of the cold treatment of steel [5].

RESULTS AND CONCLUSIONS

In this study, water atomized iron powder (Astaloy CrM®, Hoeganaes Sweden), designated by MPIF as FL-5305 will be investigated. This grade is typically utilized in manufacturing of high performance components by means of sinter hardening. See table 1 for the chemical compositions and process parameters of different specimens. Fig. 1 shows diagram of macrohardness value of the specimens after sintering and cold treating. The mass loss variations against hardness for rapid cold specimens are plotted in Fig. 2.

Table1 - Chemical composition of the steels.

Material code	Cr	Mo	O	Fe	%C after sintering	Process parameters
AS1	3	./5	./15	Bal	./6	As sintered, cooling rate=1$^\circ C/s$
AS2	3	./5	./15	Bal	1	As sintered, cooling rate=1$^\circ C/s$
AS3	3	./5	./15	Bal	1.5	As sintered, cooling rate=1$^\circ C/s$
AC1	3	./5	./15	Bal	./6	As sintered, cold treat and tempered
AC2	3	./5	./15	Bal	1	As sintered, cold treat and tempered
AC3	3	./5	./15	Bal	1.5	As sintered, cold treat and tempered

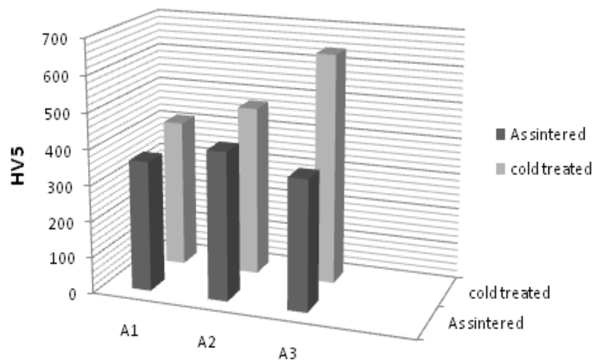

Fig. 1 - Macrohardness diagram

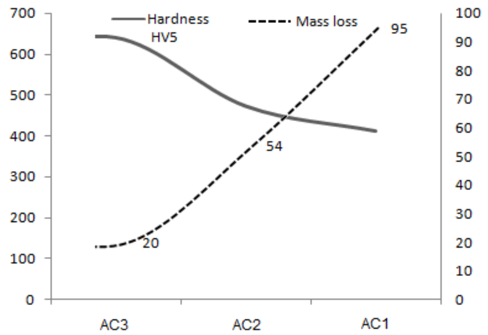

Fig. 2 - Loss mass against hardness diagram

At the sliding distance of 1000 m, the highest and lowest wear rates were obtained in the AC1 and AC3 specimens, respectively.nAC3 specimen had highest Macrohardness value among all specimens. Cold treated specimens had three types of wear mechanism consist of oxidational, delamination and abrasive.

REFERENCES

[1]-Sudhakar KV, Sampathkumaran P,Dwarakadasa ES. Dry sliding wear in high density Fe–2%Ni based P/M alloys. Wear 2000;242:207–12.

[2]-Wang J, Danninger H. Dry sliding wear behavior of molybdenum alloyed sintered steels. Wear 1998;222:49–56.

[3]-Khorsand H, Yoozbashizade H, Habibi SM, Janghorban K, Nangir A, Reihani SMS. The role of heat treatment on wear behavior of powder metallurgy low alloy steels. Mater Des 2002;23:667–70.

[4]-Wang J, Danninger H. Dry sliding wear behavior of molybdenum alloyed sintered steels. Wear 1998;222:49–56.

[5]-ASM metals handbook,Vol 7.pp 487-488.