Sintering Processing of Compressor Flanges

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Abstract

To manufacture a flange for a compressor with a relief groove by using powder metallurgy in order to prevent deformation to the compressor in operation, powder material for the flange is charged into a mold; an ablative member having a melting point lower than that of the powder material is positioned at a place where a relief groove is to be formed; the flange is formed by compressing the powder material and the ablative member; and the formed flange is sintered at a temperature between the melting point of the powder material and the ablative member so as to melt and remove the ablative member. It made according to the new method has more excellent strength and airtight property than the conventional one. It is analyzed that the ablative member is melted and penetrated into the flange structure during the sintering process, which results in improvement of the airtight property and increase of the strength.

Keywords : Sintering, Compressor, Wear resistance, Sealing property

1. Introduction

Considering precision, high performance and cost competitiveness, powder metallurgy is generally used to manufacture top and bottom flanges supporting the rotary axis of compressors used in air-conditioners and refrigerators. Figure 1 is a compressor model, and Figure 2 shows a relief groove formed in a compressor flange. Relief grooves are either cut or molded using powder metallurgy. The first method requires higher production cost due to an additional processing step of having to machine cut a relief groove. With the latter method, on the other hand, not only a separate mold in the groove form is needed but also the molded area, ie., the relief groove area, is weak to easily cause groove damage, lowering productivity. Furthermore, the basic property of flange, ie., complete sealing, can not be guaranteed in flanges manufactured with the above two methods because the relief groove area is bound to be weak.

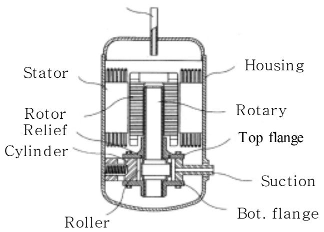


Fig. 1. A compressor model

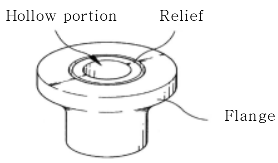


Fig. 2. Flange

This study was conducted to shape the relief groove area using a simple and effective method of sintering without machine processing or using a mold. An ablative member or a mixture of ablative members, having the melting point lower than that of the metal powder used to form the flange, was placed in the shape of a ring around the hollow portion of the flange at the time of powder compression and removed by sintering. In addition, we are planning to apply this sintering method in manufacturing other sintering products.

2. Experimental and Results

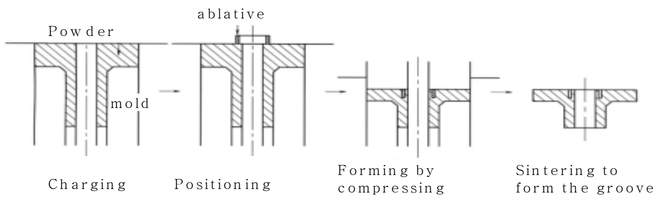


Fig. 3. Flange manufacturing

Figure 3 shows the process flow of compressor flanges.

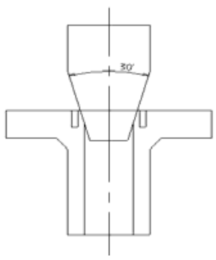
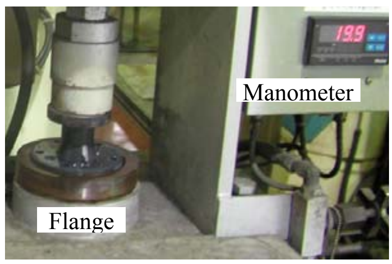


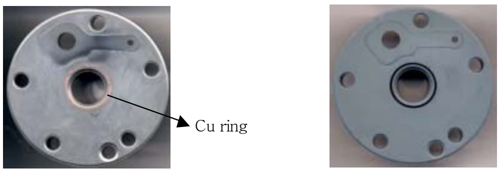
Fig. 4. Breaking Strength Test



Picture 1. Sealing Test

The microstructure was observed under an optical microscope. Hardness was measured on the surface of relief groove using a Rockwell hardness tester. Breaking strength at the relief groove was evaluated with a universal testing machine using the taper jig shown in Figure 4. The sealing test was done as shown in Picture 1 by attaching the jig to the flange by supplying 20kg/㎠ of nitrogen gas.

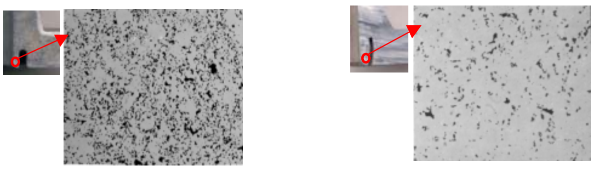
Picture 2 shows a green part and a completed flange. A copper ring, ie., the ablative member used in this study, is inserted in the flange formed at the left.



Green Part Completed flange

Picture 2. Products made using the new method

A processing step is omitted during flange manufacturing with the sintering method used in this study so that manufacturing cost can be cut by at least 10%. Sealing property is also increased significantly due to the sealing effect of the ablative member having a low melting point sealing the porous areas. Picture 3 shows the degree of porosity seen in flanges prepared by cutting and with the new method. Porosity was decreased by more than 50% with the new method.



Flange prepared by cutting Flange prepared with the new method

Picture 3. Pore distributions in flanges

Wear resistance and strength at the relief groove area are very important in that they induce flange deformation when the rotary axis, ie., the core of compressor driving force, changes. They cause decreased compressor performance and noise since melting bonding and abrasion occurs at the rotational roller and the oil film is destroyed at the relief groove area. Table 1 shows hardness and strength in the flanges prepared with the conventional cutting method and new method. Hardness is not significantly different but strength is increased by more than 20% at the functional area, ie., the relief groove, in the flange prepared with the conventional method compared with that prepared with the new method. We believe that the steam layer formed on the flange surface affected the final hardness, and strength was increased due to decreased pores due to the invasion of the ablative member into pores.

Table 2 shows the sealing property seen in the flanges prepared with the conventional method and new method.

One of the important properties in flanges, ie., sealing property, also is increased significantly with the new method due to the invasion of ablative member into pores.

Table 1. Hardness and breaking strength in flanges manufactured

	Conventional method (Cutting)	New method
Hardness (HRB)	85 ~ 90	83 ~ 88
Breaking strength (kgf)	500	600

Table 2. Sealing property shown in flanges manufactured

	Sealing
Conventional method (Cutting)	Decreased gas pressure after 3 min
New method	No decrease in gas pressure for 5 min

3. Summary

The new method proposed in this study to manufacture compressor flanges offer several benefits over the conventional methods. With this method, there is no need to build a separate mold to form the relief groove since the existing mold can be used without modification. There is no need to mechanically process a relief groove after the flange is formed. But an ablative member is simply placed where the relief groove is to be formed at the time of pressure forming and removed by sintering. Thus, we can increase production and cut cost. In addition, metals used as ablative members with low melting points can infiltrate into the flange itself during sintering, increasing strength, sealing property, and quality in the resulting compressor flange.

4. References

[1] J. K. Park, “Method for Manufacturing Flange for Compressor”, patent Literature Data, 2001.

[2] S. T. Choi, “Effects of Powder Size on Microstructure and Mechanical Properties of Sintered Fe Alloys”, 2000.

[3] M. S. Lane, “Modern Development in Powder Metallurgy”. 1984.

[4] Douglas Godfrey and Richard L. Courtney, “SAE Technical Paper Series”, 1971.

[5] F. V. Lenel, “Powder Metallurgy(MPIF)”, 1980.

[6] Leander F. Pease, William G. West, “Fundamentals of Powder Metallurgy”. 2002.

[7] “Powder Metallurgy Design Manual, 3rd Edition”, Metal Powder Industries Federation, 1998.