

Grinding Mechanism and Case Study on Double-Disc Grinding of Ferrous Sintered Material

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Abstract

The sintered parts are mainly used for automobile industry, and a part of air conditioners. In automobile industry, the application range of sintered parts is very broad and use for a driving and a lubricating system. And air conditioner uses them for compressor. Grinding of compressor and pump parts is very difficult these days, because these parts use High hardness materials and require high precision grinding. Tool life has to be extended to decrease production cost. We analyzed processing mechanism and developed new grinding wheels for Double Disk Grinding. And, we introduce new truing technology that improved tool-life and precision.

Keyword: Chip form, Double Disk Grinding, Wear resistance, Electro-Discharge Truing

1. Introduction

Sintered alloy parts are broadly used as components for compressors and oil pumps. Compressor and oil pump components demand high-precision flatness, parallelism, and high-quality processing.

In recent years, in conjunction with the introduction of environmental countermeasure technologies, the efficiency of air conditioners and pumps has been advanced, and the demand for high-precision processing of their component parts is increasing. Moreover, with the objective of reducing manufacturing cost, the improvement of tool life is becoming an important concern.

One method of making these requirements a reality is Double Disk Grinding. D.D.G is able to the grind the end face of a work piece at one time; so many production factories use it and get higher flatness and parallelism.

We studied the D.D.G and conducted analysis on the processing mechanism of sintered parts. We succeeded in developing a wheel that has excellent grinding characteristics.

We report on the development of a new technology that realizes higher quality precision processing and longer tool life.

2. Processing Mechanism

An investigation was conducted on the wheel wear form of the double-disc grinding process used for oil pump components made of Ferrous Sintered Alloys (Equivalent to SMF-4040).

The processing conditions were as shown in Table 1, and the conditions of the wheel abrasive grain layer and the form of the

chips obtained at the time of processing are shown in Fig. 1.

As is clearly shown in Fig. 1, the dulling of the abrasive grains is significant, and at the time of base material processing, it was found that large flow type chips were discharged.

Table 1. Processing Conditions

Equipment	KVD-300 manufactured by Koyo Machine Industries
Wheel	CBN140-60B φ305-75W-3X-50T
Work	Oil Pump Parts Base material equivalent to SMF-4040
Wheel Rotation	1500 min-1
Machining Allowance	0.3 mm / Both Sides
Grinding Speed	0.03 mm/ sec
Spark Out	2 sec.

In relation to the above results, the following two points were concluded for wheels used for double-disc processing of ferrous sintered parts, namely; (1) a bond system having wear resistance against flow type chips is necessary; and (2) selection of abrasive grains that can prevent dulling is important.

3. Development of Bond System Optimization of Abrasive Grains

Based on the knowledge obtained from the investigation of the processing technology, development of a bond system that excels in wear resistance was conducted.

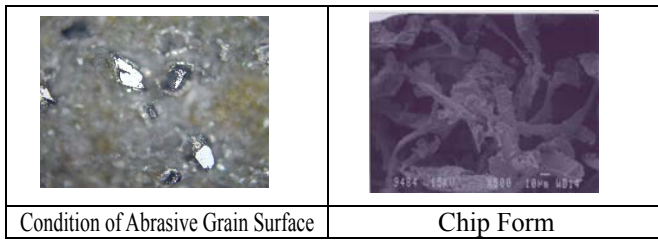


Fig. 1. Condition of Abrasive Grain Surface and Chip Form.

In order to increase wear resistance, comparatively large hard grains were dispersed in the bond, as shown in Fig. 2. Figure 3 shows changes in the wear amount of the wheel when processing was conducted, under the conditions shown in Table 1, using a conventional bond and a new bond.

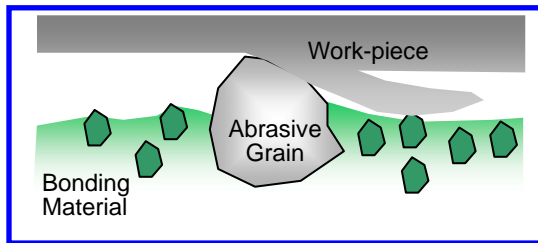


Fig. 2. Outline of Bond System.

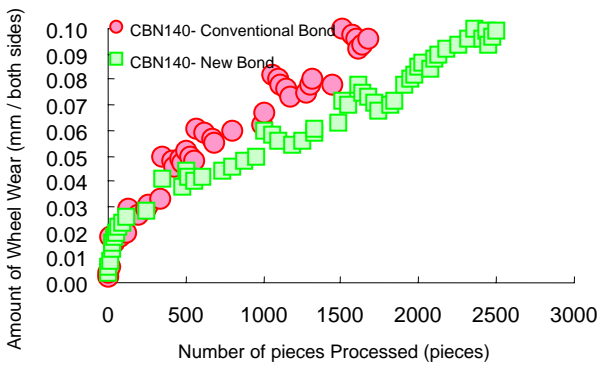


Fig. 3. Changes in Wheel Wear.

As it is clear from Fig. 3, it was found that the new bond excels in wear resistance in the processing where flow type chips are discharged.

Next, with the purpose of preventing dulling of the abrasive grains, the optimization of the abrasive grains was conducted. Since the strength of the abrasive grains greatly influences the dulling of the abrasive grains, tests were conducted by using abrasive grains of higher strength.

In Fig. 4, comparison of the cutting edge of the abrasive grains based on the changes in abrasive grains is shown. Figure 4 shows that high strength abrasive grains have low load during the grinding processing, and they excel in sustaining their cutting edge.

By combining the new bond system and high strength abrasive grains, the dress interval on the production line can be improved by two times. Together with the improvement in the tool life, an improvement in the utilization rate of the equipment was realized.

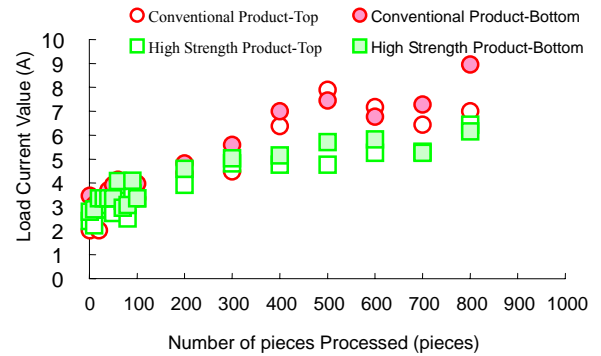


Fig. 4. Comparison of Cutting Edge by Changes in Abrasive Grains.

4. Introduction of New Technology

The recent development clearly demonstrated that the wear resistance of the bond and the strength of the abrasive grain were important.

From the standpoint of wear resistance of the bond, metal bond is ideal, and for the strength of the abrasive grain, diamond is ideal. A double-disc grinder equipped with an electro-discharge truing function made possible processing that is based on a wheel which combines the aforementioned two points.

In the processing of oil pump components made of sintered alloy, by using a diamond metal bond wheel, we were able to achieve a dress interval of over four times that of the CBN resin bond wheel.

5. Summary

- 1) As a result of the mechanism analysis of the double-disc grinding processing of ferrous sintered parts, it was clearly shown that the wear resistance of the bond and the strength of the abrasive grains are important.
- 2) Adding large particle size hard grains to the bond improved the wear resistance.
- 3) Utilizing high strength abrasive grains improved the sustainability of the cutting edge during the processing of ferrous sintered parts.
- 4) The technology developed allows the use of diamond metal bond wheels, which realize a considerable improvement in tool life.