Noritake Proposal

Featured Products and Technology

03

Cylindrical Grinding Resin Wheels Capable of High Efficiency Carbide Grinding

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The market for carbide tools is expanding, requiring high efficiency in the diamond wheels that grind them.
However, as the durability of carbide materials continues to improve, grinding them becomes more and more challenging.
Noritake has developed the BWC series of resin bond wheels, which enables high efficiency grinding of carbide tools by enhancing the grain holding strength and grain protrusion.

Resinoid Bonded Wheel for Carbide Cylindrical Grinding

BWC Series

[Scope of Application and Expected Benefits]

Metallic material		Non-metallic material		Other
Ferrous material	Non-ferrous material (Al, etc.)	Inorganic material (glass, ceramics)	Organic material (rubber, plastic)	Advanced material
	●			

Shorter cycle time	Improved tool life	Improved machining quality	Improved workability	Environmental consideration
●				

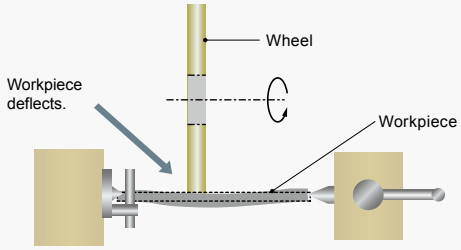
Problems with Carbide Cylindrical Grinding

Carbide is an alloy of tungsten carbide (WC) and cobalt (Co) mixed and sintered. Because Carbide maintains high hardness even at high temperatures, it is used in cutting tools, dies, and other areas where wear resistance is required.

Each carbide tool needs to be ground into a specific shape to suit its intended purpose. However, as stated above, it is difficult to grind because of its hardness. In recent years, very fine powder of tungsten carbide has been used as raw material to achieve harder and stronger carbide, and since this hardness makes it difficult to grind, the hardest grain, Diamond, is commonly used.

In cylindrical grinding of carbide using traditional diamond wheels, the cutting ability of the wheel is insufficient when grinding an elongated workpiece such as a drill or an end mill, and the workpiece deflects. Therefore, the cut depth and speed are adjusted, creating conditions where the the grinding efficiency is lowered (Fig. 1). In addition, the diamond grains will wear as grinding continues, and will protrude from the bond less and less. Then, the bond comes in contact with the workpiece and the worn grains won't bite into the workpiece. Therefore, the grinding efficiency needs to be lowered again to grind the workpiece without deflection.

Fig. 1 Problems with Carbide Cylindrical Grinding



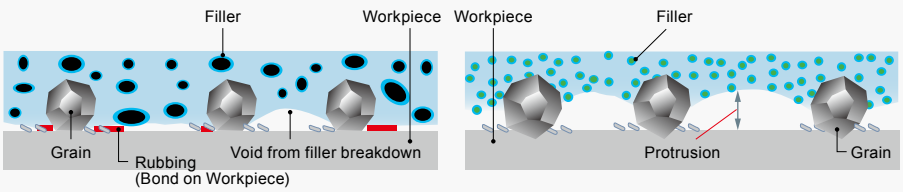
When the grains protrude less, they can't bite into the workpiece.

Micro-Bond Structure Enabling High Efficiency Grinding

In order to maintain cutting ability, promoting high grain protrusion through controlled bond wear is necessary. In other words, it is essential to promote grain protrusion, allow dull grains to drop out, and reveal fresh, sharp grains on the wheel surface through even bond wear. Since diamond tools generally have long dress intervals, in grinding ferrous materials, for example, grinding chips remove bond and facilitate cutting edge renewal. However, since carbide is harder and more brittle than ferrous materials, the layer of chips generated in grinding is more shallow. This means less bond is removed, which causes less grain protrusion, keeps dull grains from dropping out, and keeps fresh grains from being exposed, resulting in poor cutting ability. One way to improve bond wear is to soften the bond by adding a solid lubricant or something similar. However, in traditional wheels, this weakens the grain holding strength too much, causing grains to drop out prematurely, rendering stable grinding conditions impossible. In traditional wheels, bonds with higher grain holding strength tend to be hard and less wearable, making it difficult to achieve both improvement on grain holding strength and grain protrusion. To cope with this difficult problem, Noritake focused on the bond structure.

Traditional wheel structure relies on grinding chips to wear the bond down (Fig. 2(a)). However, there are large bits of filler* existing in traditional wheels which keep the chips from wearing the bond. In addition, whenever the filler grains break down they leave large voids and bond wear proceeds unevenly. As a result, the protrusion of the grain becomes uneven and the cutting ability decreases when the workpiece makes contact with the bond. Noritake developed the new resin BWC series in which fine fillers are adopted to retain grain and make the bond system easier to

Fig. 2 Grinding Wheel Structure and Grinding Mechanism



Bond wear is not uniform, and bond rubs against workpiece.

(a) Traditional wheel

Maintains high protrusion due to controlled bond wear.

(b) BWC series

remove, even with small chips. The use of fine fillers while using bond with high grain holding strength promotes controlled bond wear* (Fig. 2(b)). This allows us to maintain high grain protrusion, enabling high efficiency grinding.

High Efficiency Carbide Grinding with the New Resin BWC Series

This section introduces the results of two tests which were conducted with new resin BWC series achieving high efficiency cylindrical carbide grinding.

Test (1) Cylindrical Plunge Grinding (application example: carbide tool shanks)

Wheels with poor cutting ability have a high power consumption value(high grinding force) and tend to deflect the workpiece, making it impossible to increase the feed rate. The new resin BWC series can be used without deflecting the workpiece even at a feed rate of about 2.3 times higher than that of traditional wheels (Table 1 and Fig.4). Since more stability and higher cutting ability are achieved, even when the grinding efficiency (feed rate) is increased, the load applied to the workpiece is small, allowing grinding without deflection which enables shorter cycle time.

Test (2) Cylindrical Traverse Grinding (application example: carbide roll)

The cutting depth can be increased by 1.5 times and the feed rate can be doubled compared to traditional wheels, leading to a substantial improvement in grinding efficiency (Table 2 and Fig. 5). As a result, the BWC series can triple the productivity of traditional wheels.

Table 1 Test Conditions (Cylindrical Plunge Grinding)

Grinding machine		Cylindrical grinding machine
Application		Cylindrical plunge grinding
Stock removal		0.5 mm
Feed rate		0.3 mm/min
Grinding wheel	**Specification**	SDC140B
	Size	φ350 × T30 mm
Workpiece	**Item**	Carbide tool shank
	Size	φ20 × L120 mm

Table 2 Test Conditions (Cylindrical Traverse Grinding)

Grinding machine		Cylindrical grinding machine
Application		Cylindrical traverse grinding
Stock removal		5 mm × L1500 mm
Cutting depth		0.014 mm/pass
Traverse speed		0.6 m/min
Grinding wheel	**Specification**	SDC140B
	Size	φ350 × T20 mm
Workpiece	**Item**	Carbide Roll
	Size	φ150 × L1500 mm

Fig. 4 Test results (Cylindrical Plunge Grinding)

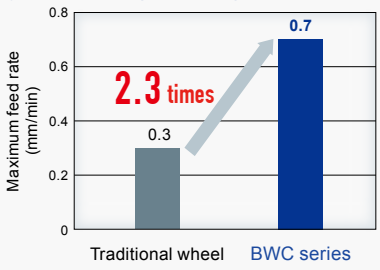
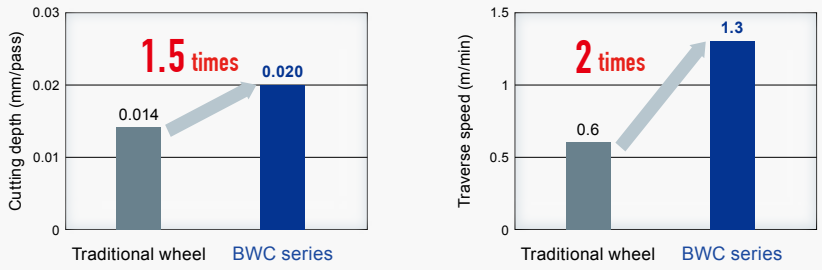


Fig. 5 Test results(Cylindrical Traverse Grinding)



The specialty of the BWC series is excellent cutting ability of carbide, but depending on the circumstances, durability may take priority. We designed the BWC series to meet the needs of a wide range of customer demands.

Durability type ←		→ Cutting ability type
BWC	BWC1	BWC2

Exploring High Efficiency Grinding

In this article, Noritake introduced the new resin-bonded BWC series, which enables high efficiency grinding with less deflection of the workpiece, for carbide cylindrical grinding. We expect that the research and development of carbide materials for improved tool life will continue to be actively pursued, creating increasingly harder materials. For this reason, we believe that requirements for high efficiency grinding will increase even further. In order to respond to such demands, Noritake will continue to develop grinding wheels for even higher grinding efficiency.

[Notes]

* Controlled Bond Wear: During grinding, the bond of the grinding wheel is scraped by the grinding chips. Bond types which are more easily scraped are described as having high self-dressing ability
* Filler: Materials added to the grinding wheel matrix to control the properties of the grinding wheel. Fillers don't have cutting edges like abrasive grains, but the characteristics of the wheel can be controlled by adjusting their type, size, amount used, etc.

Q Is the BWC series available with CBN grains?

A A CBN grain with a BWC series bond is not recommended. The chips generated when grinding steel, which CBN is most commonly used on, are different than chips generated by carbide grinding, which BWC was designed for, so it's unlikely there would be any advantage.

Q Is the BWC series capable of grinding carbide and steel simultaneously?

A If the ratio of carbide portion is below 80%, due to the reason described in the previous question, there may be problems such as large wear or not enough cutting ability.

Q I'm looking for a wheel that has high corner shape retention, is the BWC-series suitable?

A No. Since the bond is designed to wear down the BWC series is not recommended where corner shape retention is a necessity. For grinding that emphasizes on corner shape retention, we propose other optimal products. Please consult with Noritake representative.

Q & A