



Realizing Even Higher Efficiency with Porous Vitrified Ceramic Grinding Wheels

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There is a great need for high efficiency in conventional grinding wheels, it is currently difficult to maintain both high-precision and high-efficiency simultaneously.

The newly developed "CZ wheel" uses a proprietary grain and homogeneous-structured bond system to maintain cutting ability and surface roughness for longer, increased efficiency.

Porous Vitrified Ceramic wheels for High Efficiency Grinding

CZ Wheel

[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
●	●	●	●	



Market Trend toward High-Efficiency and Selective Use of Grinding Wheels

Vitrified grinding wheels are widely used for high-precision grinding. Recently, the demand for high-efficiency has led to increased use of Diamond/CBN wheels, enabling automated and unmanned grinding. However, the grinding machines and conditions that Diamond/CBN wheels can be used are severely limited. For this reason, there is still great demand for high efficiency conventional grinding wheels (conventional wheels), which have relatively fewer restrictions with grinding conditions and machine compatibility.

In order to meet the need for high efficiency in conventional wheels, Noritake has developed products such as Life King^[1] and CX wheels. But we are now undertaking the development of even higher efficiency grinding wheels, and have succeeded in commercializing the CZ wheel, a new vitrified ceramic porous wheel.

Workplace Difficulties and Breakthroughs Associated with Higher Efficiency

At the machining site, accuracy and shape (dimensions) of the workpiece are most important. Therefore, it is common practice to adjust the cutting rate of the grinding wheel and dressing conditions. Even where higher efficiency is sought, technicians may try to shorten machining times by increasing depth of cut and cutting speed. However, it can be inferred that this increases the grinding load which causes the wheel to exceed target surface roughness, and creates grinding burn, which lowers the machining surface quality of the workpiece, therefore preventing increases in efficiency.

To solve such problems, CZ wheels are made with a high cutting ability to lower process load and maintain surface roughness.

CZ Wheel Capabilities

In order to verify the performance of the CZ wheel, a surface grinding test (Table 1, Fig. 1) and a cylindrical grinding test (Table 2, Fig. 2) were conducted under relatively high grinding efficiency test conditions.

In surface grinding, the CZ wheel is 10% lower in power consumption value and 40% lower in wheel wear than the traditional CX wheel, so along with improved cutting ability, this also indicates extended wheel life. Additionally, surface roughness of the CZ wheel shows a lower (smoother) value than that of the CX wheel. Usually, grinding wheels with high cutting ability tend to have shorter wheel life and are prone to surface roughness problems, but CZ wheels have shown improved cutting ability and surface roughness, which makes it an excellent wheel for high efficiency grinding.

Additionally, the cylindrical grinding results show that compared to the traditional CX wheel, the CZ wheel is 10% lower

[Wheel]	
Dimensions	φ176 × T14 × φ76.2mm
Specification	CX-V104P (CX wheel)
	CZ-V700P (CZ wheel)
[Dressing conditions]	
Dresser	0. 8LL Single-Point Dresser
Dressing Lead	0.1 mm/r.o.w.
Cut Depth	10μm/pass
[Grinding condition]	
Grinding Method	Surface Grinding
Workpiece Material	SUS304(JIS)/304(AISI)/X5CrNi1810(DIN)(HRB 90)
Workpiece Dimensions	Length: 100mm, Thickness: 10mm
Wheel Speed	33.3m/s
Table Feedrate	0.33m/s
Grinding Efficiency	3.3mm ³ /mm·s
Spark-Out	None
Coolant	Water-soluble: SEC-700(×50)

Table 1 Test conditions (Surface grinding)

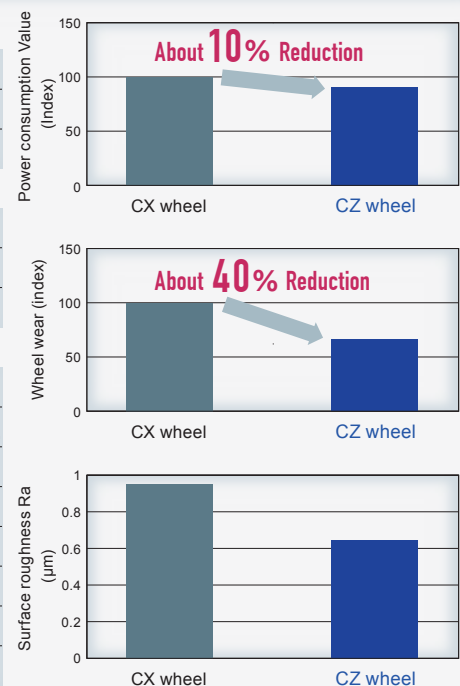
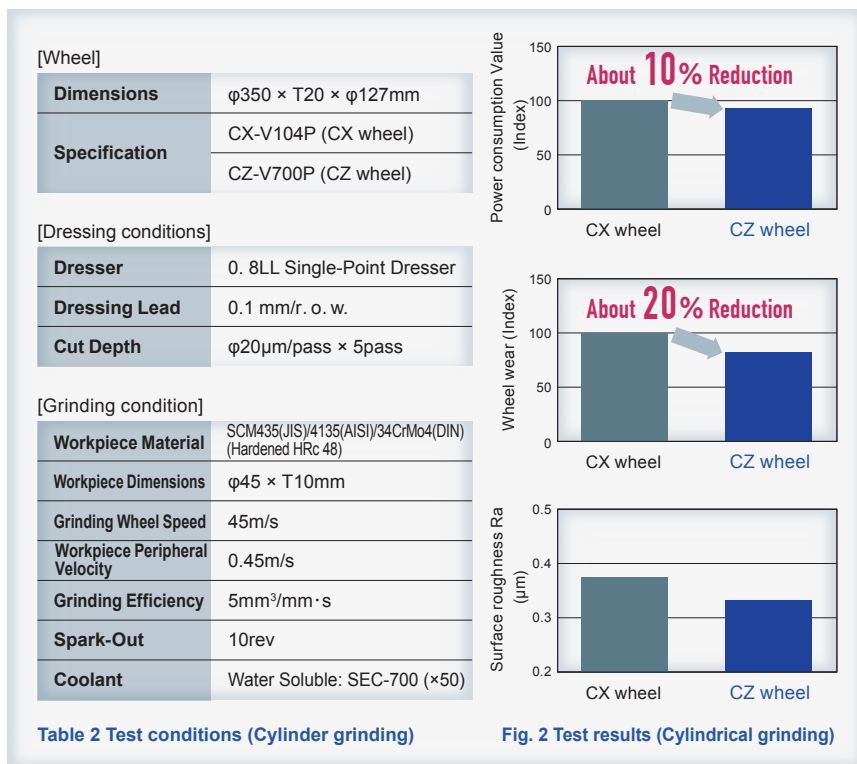


Fig. 1 Test results (Surface grinding)



in power consumption value, and 20% lower in wheel wear. Just as in surface grinding, this shows that improved cutting ability and extended wheel life can be expected. In surface roughness, the CZ wheel was finer than the CX wheel, and the work surface quality was improved.

In both surface grinding and cylindrical grinding, the CZ wheel shows reduced process load and improved surface roughness compared to the CX wheel. As a result, CZ wheels can be applied to high efficiency grinding for a variety of applications and can be expected to improve operating efficiency.

The CZ Wheel's Core Technologies for High Efficiency Grinding

As noted above, CZ wheels offer superior performance in high efficiency grinding. In order to work effectively in high efficiency grinding, CZ wheels incorporate two proprietary Noritake technologies.

1 Excellent cutting ability demonstrated by proprietary ceramic grain mixture CZ grain

Ceramic wheels self-sharpen and maintain cutting ability by crushing the grain that touches the workpiece as it removes work material. This is ideally how the grinding action should work, but depending on grinding conditions the grains may not be crushed and instead become dull, causing reduced cutting ability.

To combat this, Noritake created the CZ grain with its own ceramic grain mixture and succeeded in reducing the grain's dull surface area.

Fig. 3 shows the inspection results of the wheel surface inspection after the surface grinding mentioned in the previous section. The white areas in the pictures show the dull surfaces. Compared to the CX wheel, the CZ wheel shows less dull grain surface area, so it can be assumed that it maintains its cutting edge. Therefore, the CZ grain can suppress the dulling of the grain and demonstrate cutting ability even in high efficiency grinding.

2 Optimization of structure by CZ wheel-specific bond V700

The CZ grain used in CZ wheels is a proprietary ceramic grain mixture, and the CZ wheel-specific bond, V700, is designed to maximize the performance of this ceramic grain.

In addition, V700 includes another measure to maintain cutting ability. This proprietary bond system improves wheel structure.

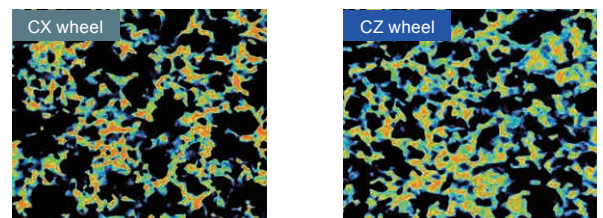
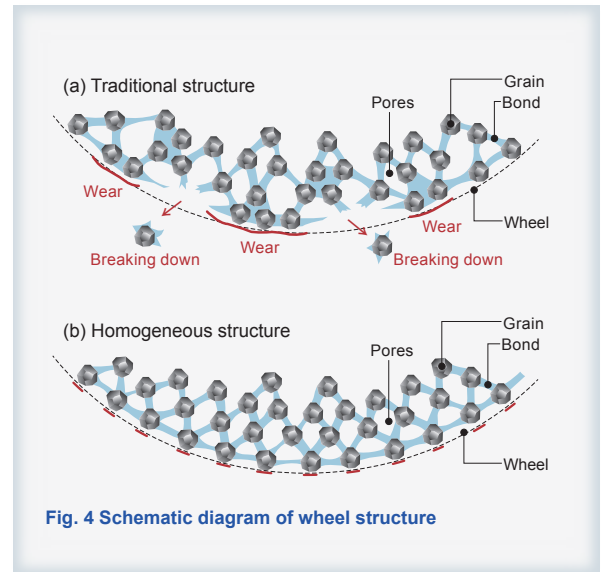
Vitrified grinding wheels are made up of many grains bonded together in the shape of a wheel, however the space between grains isn't necessarily uniform throughout the wheel, but rather varies between large and small gaps. Small grain gaps



Fig. 3 Wheel surface inspection results after surface grinding.

can lead to dull grains and loading, and areas with large grain gaps have insufficient grain holding force, making grains fall out easily. Both situations lead to a lower cutting ability (Fig. 4 (a)). Therefore, in order to prevent this decrease in cutting ability, V700 makes the grains more evenly distributed throughout the structure (Fig. 4 (b)).

To verify the difference in structure between traditional wheels and CZ wheels, we evaluated the height distributions of the wheels after the cylindrical grinding mentioned in the previous section (Fig. 5). The red areas show the highest parts of the wheel surface. Most of these red areas are the grains. Conversely, the black areas are pores. Comparing the structures of the CZ and CX wheel, the CZ wheel shows less bias toward grains or pores. In addition, the surface area covered in grains for the CZ wheel is larger, indicating less grains have fallen out, so it can be assumed that the cutting edge is better maintained. It is considered that this is a result of the V700-enabled optimized structure, which maintains the cutting edge, thereby improving cutting ability.



Examples of Adoption at Sites Requiring Improved Grinding Efficiency

CZ vitrified porous ceramic wheels for high efficiency grinding are used in a wide range of applications from basic cylindrical grinding to applications requiring high precision such as guide rail groove grinding, and are offered to customers seeking to improve the efficiency of their grinding process. We hope that CZ wheel will help customers improve their productivity.

[Literature]

[1] Hiroshi Oyama: LIFE KING, NORITAKE TECHNICAL JOURNAL 2018 (2017), 28

Q How does one choose between CX and CZ wheels?

A CZ wheels are recommended for applications requiring higher efficiency, such as when even shorter cycle times, than possible with CX wheels, are desired.

Q What applications are they suited for?

A CZ wheels are suited for high efficiency, high-load grinding, and for difficult to grind materials where loading easily occurs.

Q What is the price range of CZ wheels?

A Although prices are higher than those of CX wheels, we believe that the long wheel life will result in an overall reduced cost.

Q Can it be used for grinding unhardened steel?

A Yes it can. This product is not only effective for unhardened steel but also for high-efficiency processing of hardened steel.