Technology Course

Structure of Grinding Wheel

(Structure and Concentration)

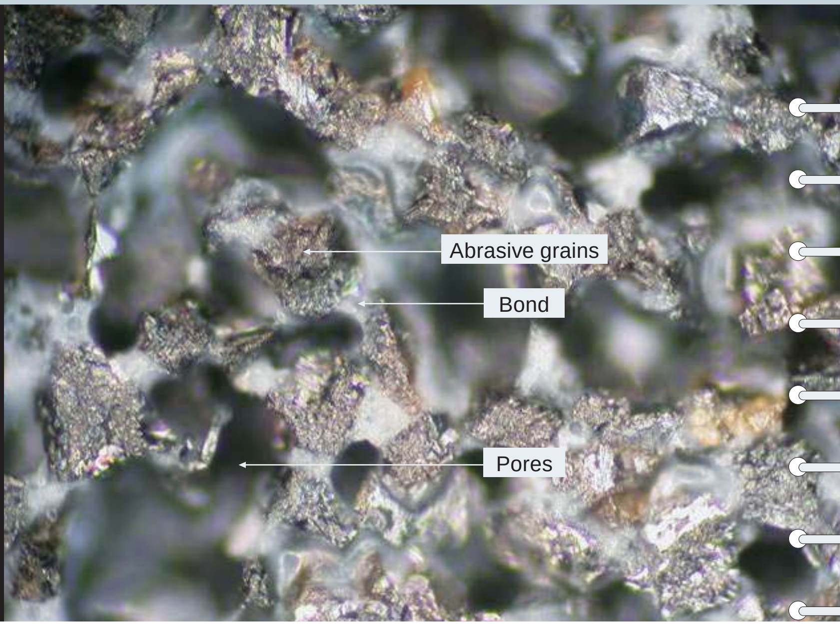

Fig. 1 Grinding wheel photo (vitrified-bond CBN wheel)

Grinding wheel and specs

A grinding wheel is one of the tools used in machining, but what exactly is a grinding wheel? Let's take a particular grinding wheel as an example, and have a closer look at the structure using a microscope. Grinding wheels are generally composed of the 3 elements "abrasive grains (grains)", "bond" and "pores" as shown in Fig. 1, and each of these plays the following roles.

1. Abrasive grains: Grain act as cutter, and mainly they remove the surface of workpieces.
2. Bond: Bond ties grains together, and holds them in position when loads are applied during grinding.
3. Pores:
   - Provide gaps necessary to remove chips produced during grinding .
   - Hold, and supply coolant to grinding points.
   - Release heat generated at grinding points into the atmosphere.

These 3 elements are closely related to the grinding wheel specs. In other words, whenever you use grinding wheel, by understanding its spec, you'll know what that grinding wheel is.

Example	*WA*	*80*	*J*	*7*	*V35*
	Grains	Size	Grade	Structure	Bond

Grinding wheel specs are indicated with 5 factors: "abrasive grains", "grit size", "grade", "structure", and "bond". These 5 factors are described briefly below.

■ 5 factors of conventional wheels

1. **"Abrasive grains"**: Type of grain used to grind objects
2. **"Grit size"** : Size of abrasive grains
3. **"Grade"** : Abrasive grain bonding strength
4. **"Structure"** : Abrasive grains content
5. **"Bond"** : Type of material used to bond abrasive grains together

Note that grinding wheels are referred to as conventional wheels* and diamond/CBN wheels* depending on the raw material used, and with diamond/CBN wheels, "structure" is expressed as "concentration". As grinding performance is greatly affected by 5 factors, it is important to understand the effect of these factors to grinding performance in order to obtain the required accuracy.

Often on the job floor, multiple issues occur and it may be difficult to solve such issues with incumbent grinding wheels. Noritake developed a new grinding wheel which may be the solution to such issues by focusing on structure homogeneity. Before discussing the influence of homogeneity on grinding performance, we will explain the factors of structure and concentration.

What are "structure" and "concentration "?

Conventional wheel "structure" and diamond/CBN wheel "concentration" express the volume percentage of grains exist in the grinding wheel or abrasive material layer, and this percentage is referred to as "grain content". The higher the grain content, the more grains exit in the grinding wheel, resulting in a "dense" structure. On the other hand, a lower grain content results in a "open or porous" structure.

Table 1 shows the relationship between conventional wheel structure and grain content, and Table 2 shows the relationship between diamond/CBN wheel concentration and grain content.

A structure value of 6 represents a grain percentage of 50%, change in 1 structure value changes 2Vol% grain content. JIS standards state a range of 0 to 25, however, a structure of 7 to 10 is commonly used for grinding. A concentration of 100 represents a grain percentage of 25%, and grain content is calculated with dividing the concentration by 4.

Table 1 Relationship between conv. wheel structure and grain content

Dense ← → Open

Structure	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Grain content (Vol%)	62	60	58	56	54	52	50	48	46	44	42	40	38	36	34

Table 2 Relationship between diamond/CBN wheel concentration and grain content

Open ← → Dense

Concentration	25	50	75	100	125	150	175	200
Grain content (Vol%)	6.25	12.50	18.75	25.00	31.25	37.50	43.75	50.00

How is grinding performance affected by changes in "Structure" and "Concentration"?

How is grinding performance affected by changes in "structure" and "concentration"? Consider a case where the strength of the bond between grains is uniform, and only the ratio of grains and pores varies.

With a dense structure, the content of grains increases, while the volume of pores decreases, the distance between grains in the grinding wheel becomes short (Right in Fig. 2). In such case, there are many points of contact between the grains and workpiece during grinding, thus smaller load is applied to each individual grain. As a result, grains are less likely to break down, and the tips of the grains tend to wear down smoothly. Cutting ability is therefore sacrificed, however, the workpiece surface roughness becomes finer.

With a open structure, on the other hand, the content of grains decreases, while the volume of pores increases, and so the distance between grains in the grinding wheel becomes wider (Left in Fig. 2). In such case, as opposite to the dense structure, there are fewer points of contact between the grains and workpiece durling grinding, and greater load is applied to each individual grain. Grains are more likely to crack, and the tips of grains form sharp cutting edges.

Cutting ability is therefore good, however, the workpiece surface roughness becomes rougher.

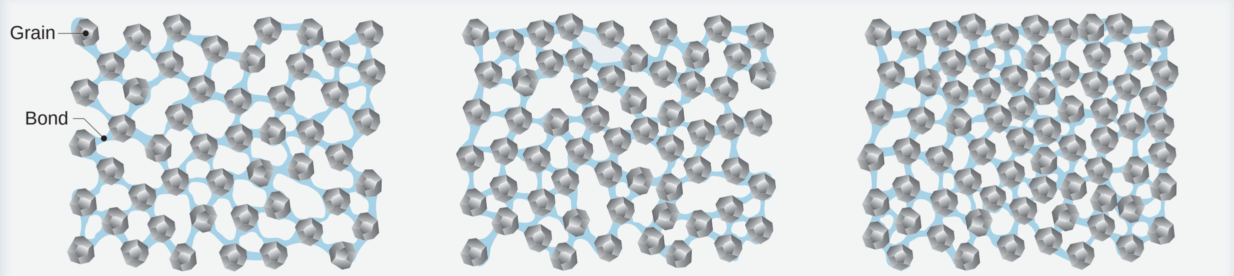

Fig. 2 Schematic diagram of various structures