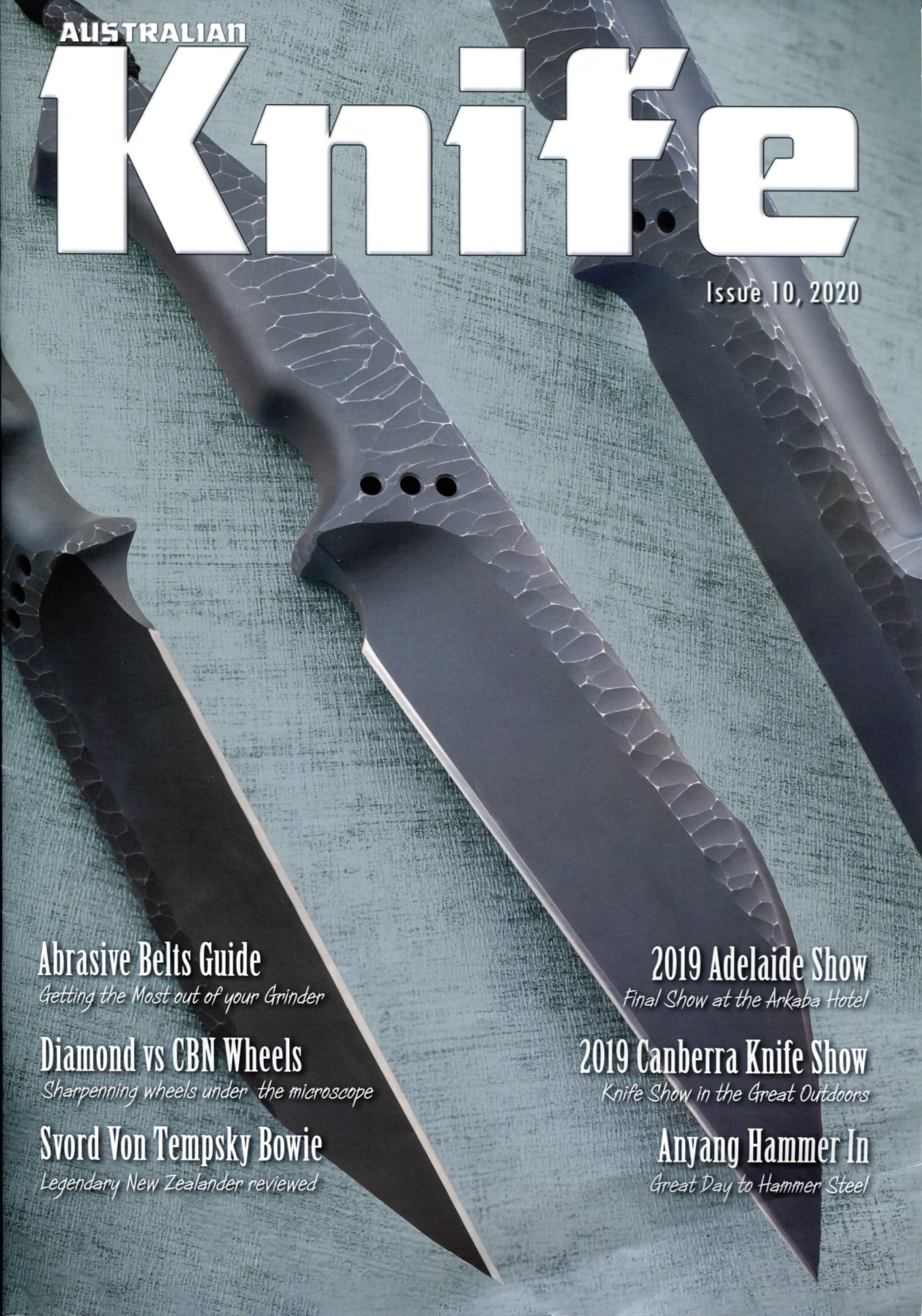
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SHARPER THAN SHARP

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Diamonds vs CBN Wheels

Best applications explained

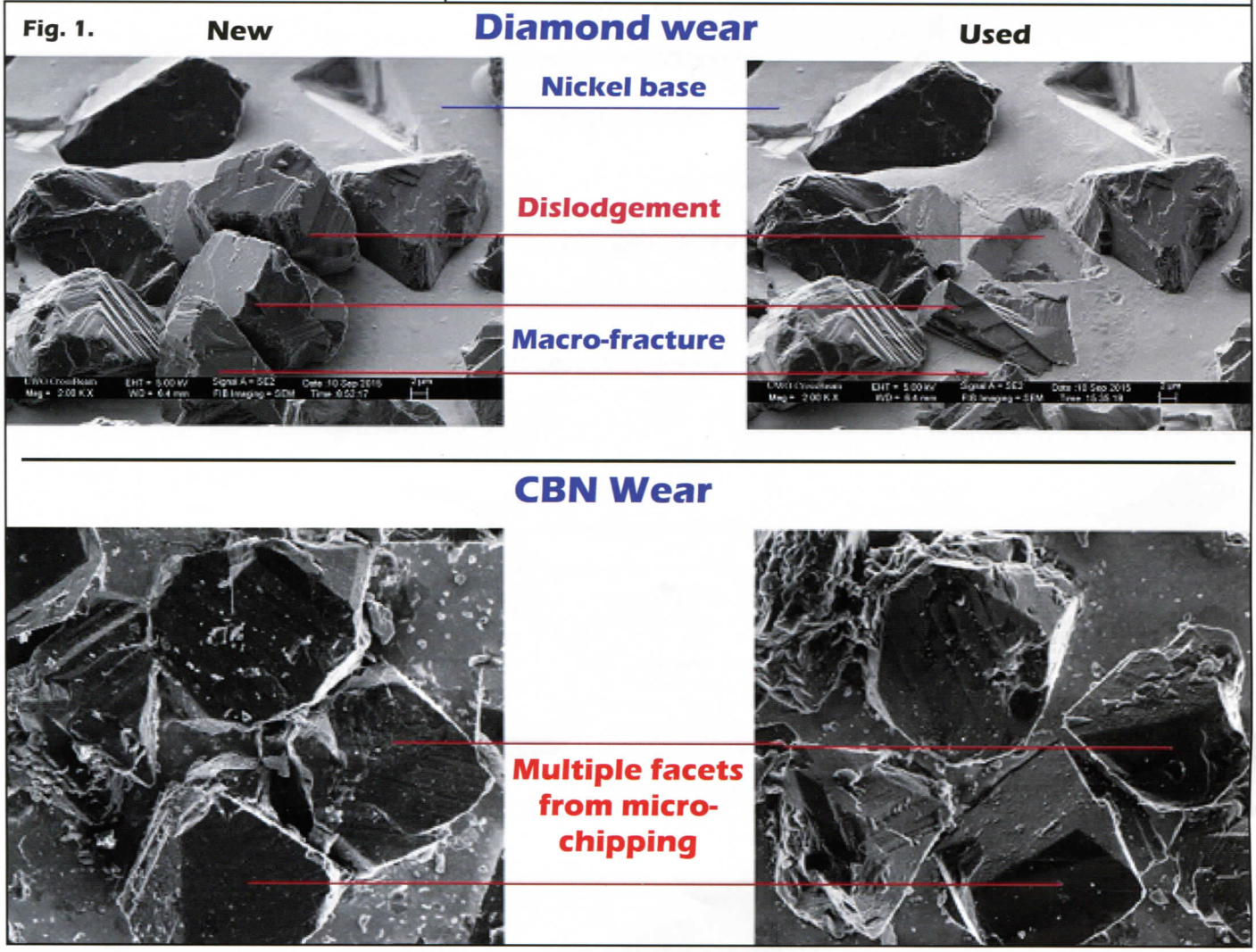
In our sharpening workshop we are into our 4th year of using diamonds and CBN. I often hear people thinking they are similar by function, and thought it might be interesting for our readers to know the difference.

While synthetic diamonds resemble natural diamonds, the Cubic Boron Nitride is purely a man-made invention and has no analogue in nature. Production of CBN is more expensive than that of synthetic diamonds.

Cubic Boron Nitride properties include extreme hardness, stability under heat, and superior chemical resistance. CBN is the second-hardest

known material on the planet (after diamonds), but has higher heat and

Fig. 1.



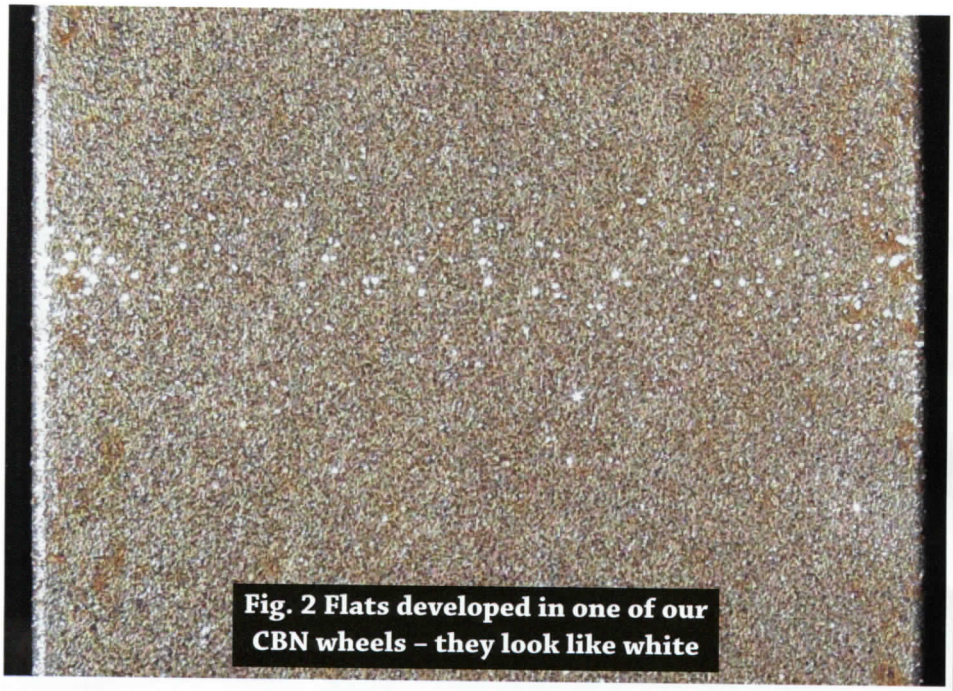


Fig. 2 Flats developed in one of our CBN wheels – they look like white

crushing resistance than diamonds, and therefore CBN is preferred over diamond in grinding.

Under workload, the CBN crystals gradually chip maintaining sharp facets, while diamond crystals macro-fracture, forming flats on the wheel.

Compare the following SEM of the electroplated diamond and CBN wear **(Fig. 1)**: So, the main difference between the diamond and CBN crystals is that when the diamond crystal fractures you lose it, but when the CBN crystal fractures it becomes sharper.

Since diamonds macro-fracture from pressure, Tormek's instructions on their diamond wheels, stress that the sharpening pressure should be "very light". CBN wheels withstand the pressure better and you can grind on them with firm pressure, but not overly hard. Under workload, the CBN crystals gradually micro-chip maintaining sharp facets. Thanks to that the CBN wheels maintain their cutting ability for a long time.

With use, both diamond and CBN grinding wheels or plates develop flat areas and you see a drop in performance. However, the flats in diamond are bald spots, while the CBN keeps grinding.

The following photo **(Fig. 2)** shows flats developed in one of our CBN wheels – they look like white spots. SEM microscopy shows that these flats have sharp facets **(Fig. 3)**.

When CBN crystals chip, the newly formed facets sustain their cutting ability even in the flat areas. Thanks to that even a worn CBN wheel remains usable, while a worn diamond wheel goes to the trash bin. Overall, CBN wheels represent the single biggest advance in sharpening in a very long time.

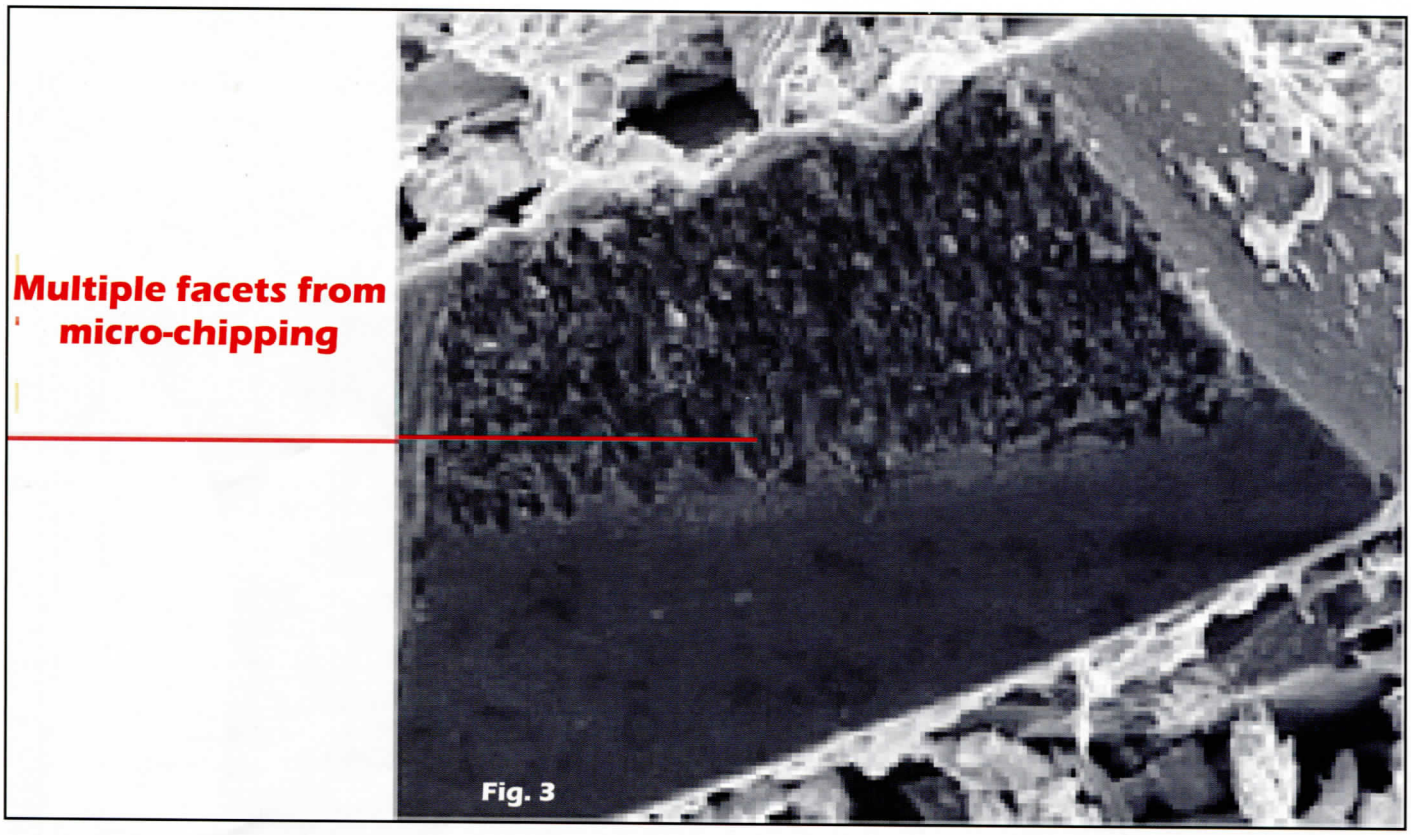
Diamonds, however, have advantage over CBN in honing.

Because of its' resistance to crushing and tendency to macro-fracture, your honing diamonds with use develop a mix of finer crystals. For example, your 5-micron diamond honing paste, with use will also have, along with the nominated 5-micron crystals, a fraction of smaller 3-micron and 1-micron diamonds from the crushed original crystals, eventually giving a better polished finish.

And this is how we use them in our workshop. We grind bevels and set edge on CBN wheels, then hone on paper/felt wheels with diamonds.

Difference between the CBN and conventional abrasives.

CBN super-abrasives remove material in a unique way; due to their super hardness the abrasion process is similar to a milling operation, while using conventional abrasives like aluminium-oxide and silicon-carbide is akin to sanding or belt grinding. The result is a CBN wheel produce sa smaller burr and a sharper edge apex as compared to aluminium oxide and



silicon carbide. Comparing the results from different abrasives reveals that conventional abrasives produce burrs which tend to be long and thin, whereas for CBN's burrs tend to be relatively small and thick.

Particulars of grinding on CBN and diamond wheels.

Our CBN wheels can be used with common tap water, metal-working fluids or even dry. Only our CBN wheels can be run with common running water from your house or workshop tap thanks to the special embedding technology. Note that if you run CBN wheels from other manufacturers with tap water, the CBN coating may detach from their wheel base.

Tormek diamond wheels must be run in their rust-inhibiting solution, an expensive consumable.

Wet grinding is limited to the speed at which cooling liquid starts steaming. Steam literally blows up the CBN crystals. It is difficult to find in literature a clear delimiter, but we observed in industrial knife sharpeners grinding on CBN wheels with metalworking fluid at 250 RPM, so up to this speed it is definitely safe. Pressure on diamonds should be light, while on CBN it can be firm, but not overly hard.

We've noticed 3 distinct phases in the life of a CBN wheel.

Phase 1: The CBN crystals settle in following the initial break-in period. The broken-in wheel cuts somewhat less aggressive than in the very beginning; by the end of grinding you can see some sediment in the trough of CBN crystals which chipped off the wheel – this is normal.

Phase 2: Under workload, the CBN crystals gradually micro-chip, maintaining sharp facets. Micro-chipping of CBN particles continues throughout the wheel's life, progressively increasing the topographical density of the active grains which sustains its grinding ability for a long time.

Phase 3: A worn CBN wheel remains usable, but as a finer grit. With use, the CBN wheel gradually takes on the characteristics of a finer grit, e.g. the #160 wheel behaves more like #200-300, the #400 wheel becomes more like #600, and the #1000 more like #1200.

Particulars of honing with diamonds.

Diamonds are formulated for honing as a paste or emulsion.

Leather can hold diamonds up to 2 micron in size. If you put larger diamonds on the leather you will simply lose them. Leather can take both the paste and emulsion.

Paper wheels can hold diamonds up to 10 micron in size. Paper wheel requires oil-based paste.

Felt wheels accept emulsion the best and hold diamonds of any size very well. When using felt as a substrate, make sure its density is at least 0.80 gram/cm^3. Such felt is commonly called "rock-hard" felt. If you use just "hard" (0.70 gm/cm^3) of "medium"felt (0.60 gm/cm^3), you'll be rounding the edge.

What you can and can't grind on CBN/Diamond wheels.

You might have come across a lot of misinformation about this. You can sharpen any knife and tool steel (carbon, stainless, hard alloys) on diamond or CBN wheels, as long as the steel has been **hardened.** Never grind unhardened steel like knife blanks etc on the CBN wheel – the ground soft metal will "gum" (glaze) your CBN or diamond. Never grind metal other than hardened knife and tool steel on the CBN wheel e.g. iron, galvanized steel, zinc-plated metals, aluminium, brass etc.