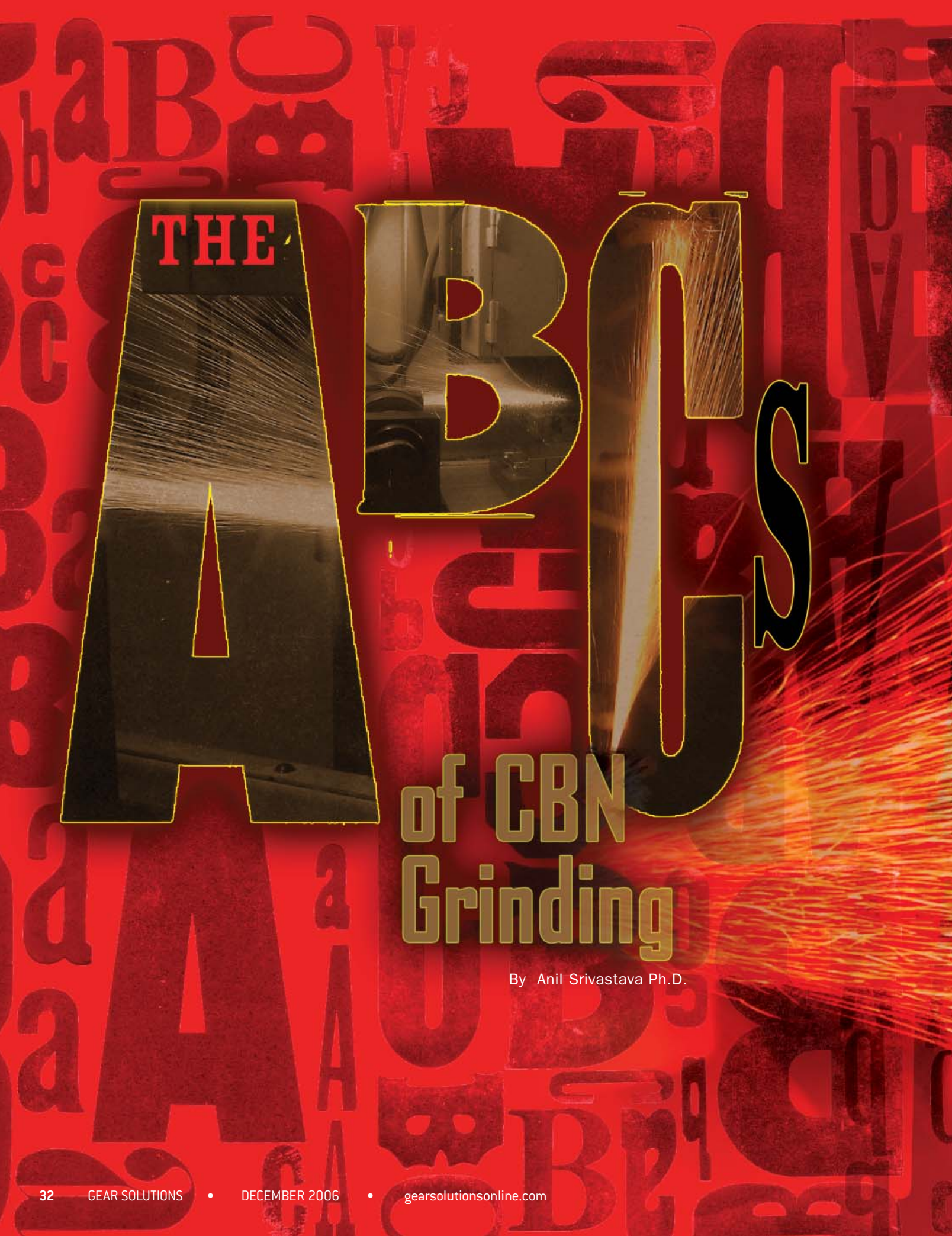


THE ABCs of CBN Grinding

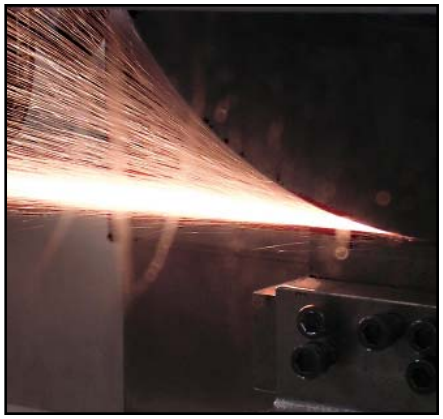
By Anil Srivastava Ph.D.

An understanding of factors such as bond type, grit size, and concentration will help you choose the proper CBN wheel for grinding sharper edges on your cutting tools.

As with all work, there's a right tool for every job. In manufacturing, successful machining depends on sharp, well-maintained cutting tools that not only ensure precision, but also speed. Successful sharpening of cutting tools depends upon the use of the correct grinding wheel, tool set-up, and method of grinding for each type of tool. This article provides some basic but valuable information about the cutting tool sharpening; designed to keep manufacturing flow as efficient a process as possible, ensuring better competitiveness nationally and even globally.

The most common method to sharpen a worn out tool is grinding. Both conventional (aluminum oxide and silicon carbide) and super abrasive (cubic boron nitride, or CBN) wheels are used for this purpose. However, conventional wheels dull faster and become glazed and burnished, thus reducing grinding productivity and causing thermal/metallurgical damage to the tool being ground. When choosing a grinding wheel, and looking at costs of improvement versus the effect to the bottom line, here are some major factors which make CBN wheels a better choice than conventional wheels for sharpening cutting tools.

CBN grains have 55 times higher thermal conductivity, four times higher the abrasive resistance and twice the hardness of the aluminum oxide abrasives. This combination makes CBN wheels especially well suited for the grinding of high-speed and super-alloy steel tools, providing: long wheel life at high material removal rates; little or no thermal damage to the cutting edge because of the cool cutting



consistent sharp, burr-free cutting edges with no loss of hardness; easy and more effective control over tool sizes, shapes, and finishes and, finally; increased tool grinding productivity because of less down-time due to wheel breakdown and conditioning, and less time required for gauging, spark-out, and wheel changes.

CBN grains do not chemically react with steels and retain their strength above 10000C.Grinding with CBN wheels also improves the fatigue strength and extends the useful life of the cutting tool. However, before replacing an aluminum oxide wheel with a CBN grinding wheel it is important to make sure that the grinding system can take advantage of the productivity potential that a CBN wheel offers. The major factors to be considered are: the grinding machine (which must have tight spindle bearings and close fitting slides to eliminate vibration and chatter, constant spindle speed to boost efficiency and reliable feed-rates to preserve wheel life); horsepower requirements (material ground with CBN wheels are usually hard and require more horsepower to remove a given amount of material from the workpiece), and; the proper use of coolant.

Wheel Selection

When selecting a CBN wheel for tool and cutter grinding operations, the following points must be considered:

- **Bond Type:** The bond is a primary consideration in selecting the proper CBN grinding wheel. Resin-bond wheels are used for most tool and cutter grinder operations. Electroplated wheels are used when form grinding.

- **Grit Size:** When replacing an aluminum oxide wheel with a CBN wheel, it is wise to follow the recommendations listed in the following table regarding grit sizes.

COMPARATIVE GRIT SIZES

Aluminum Oxide wheels	CBN Wheels
46-60	80-140
80-120	170-325
150-220	325-400

- **Concentration:** Wheels with 75 to 100 concentration are recommended because they provide good material-removal rates and long wheel life and are usually the most cost-effective.

Factors such as the grinding method, grinding mode, and the speed and feed rates used also affect the efficiency of a tool and cutter grinding operation. For example, the grinding method can be either wet or dry, and both can be used with success. Dry grinding with the resin-bond CBN wheel has proved to be effective. Low feed rates are recommended to prevent workpiece burning during dry grinding. Wet grinding with either straight oil or a heavy duty water-soluble oil is very effective. It is important that the cutting fluid be applied directly to the work-wheel interface for the maximum cooling and lubrication.

As far as grinding mode is concerned, if the grinder has sufficient power and rigidity, creep-feed single pass grinding is recommended. Generally this mode of grinding produces the highest productivity, longest wheel life, and best workpiece finish. Conventional multi-pass grinding is also very effective for most tool and cutter grinding operations. The recommended wheel speeds during dry grinding is in the range of 3000 to 4500 SFPM (15 to 23 m/s). The higher wheel speeds may cause burning of the tool edges. In wet grinding, wheel speeds in the range of 5000 to 6500 SFPM (25 to 33 m/s) provide excellent results. In general, the higher speeds improve both wheel life and metal-removal rates. The traverse feed rate should be kept constant because of the cool, free-cutting characteristics of CBN grinding wheels. Whenever possible use the creep-feed, single-pass grinding mode. Use lower feed rates when grinding dry. Roughing cuts should be about 0.002 in. (0.05 mm) deep, while finish cuts are usually 0.005 to 0.001 in. (0.01 to 0.02 mm) deep. Spark-out passes are not necessary when using CBN wheels because, if the grinder is in good condition, whatever is set for the depth of cut is what is removed from the tool being ground.

To make the grinding operation successful, CBN wheels should be mounted on a high-quality adapter and should be kept together as a unit for the life of the wheel. A dial indicator should be used to true the wheel to within 0.001 in. (0.02 mm) or less run-out on the wheel face. Also, an appropriate truing device should be used for a given type of CBN wheel, and the wheel should be trued and properly dressed on the machine on which it will be used.

In recent years, new developments have been made in tool grinding machines that combine automation with flexibility, and promise increased precision and productivity. The use of CBN grinding wheels for the grinding of end mills, milling cutters, hobs, and a variety of hardened cutting tools can reduce the cost of grinding, while at the same time producing better-quality cutting edges. Since CBN wheels last much longer than do conventional grinding wheels and require little or no conditioning, there is less downtime for wheel maintenance. The savings in grinding costs with CBN wheels may range from 20-50 percent, or even higher, depending on applications.

ABOUT THE AUTHOR:

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