



abrasives are peripheral grinding of some tungsten carbide tool inserts and fluting of carbide end mills.

Initially, the main use of CBN was in tooling and cutting of high-speed steels. While still an important application area, CBN has gained acceptance in the automotive and aerospace industries.

### Coated Abrasive Selection

As noted earlier, selecting abrasive grains can be a task. In the furniture and woodworking industry, fused aluminum oxide has been proved effective over many years. This abrasive is considered by many as a workhorse and is still relatively inexpensive.

But there are newer alternatives available that may improve productivity. Blending zirconia into the melt during manufacture of fused aluminum oxide produces zirconia alumina, providing additional toughness for longer cutting action. Also available are seeded-gel ceramic abrasives, which are produced using a patented process that results in a tightly controlled microstructure. Each seeded-gel grain contains millions of micron-sized crystallites, allowing them to stay sharp longer during sanding operations and have a controlled breakdown during use that constantly exposes new cutting points.

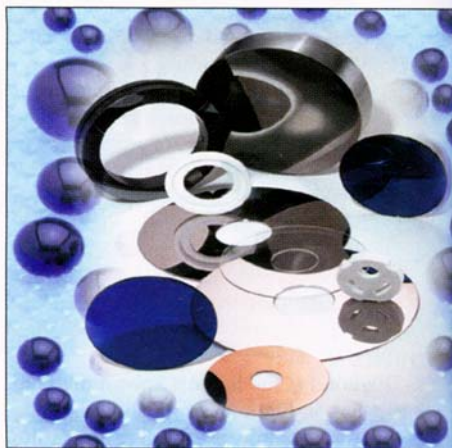
In furniture finishing applications, the seeded-gel abrasive can provide two to six times the life and a more consistent finish than standard aluminum oxide. One wood furniture manufacturer, for example, reported that the seeded-gel belts ran for six full days as opposed to three days using standard aluminum oxide grain on wide belt sanding machines. In another case, running on a variety of wood types, a manufacturer reported running an average of four days using seeded-gel abrasive compared to less than one day using standard aluminum oxide.

Backing selection is important in belt sanding applications. On sanding machines, cloth-backed coated abrasives are a better

choice than paper for several reasons. Cloth backing will stretch, especially on primary contact rolls where wood parts have a tendency to be thick and uneven. Paper backing is a more economical selection when used in platen type sanding equipment where it can produce a high quality finish. In some cases a paper belt with a seeded-gel grain can equal or outperform a traditional aluminum oxide cloth belt.

### CBN Selection

Automotive and aerospace applications using CBN abrasives use four main bond



*An array of products finished using superabrasives, including polished hard data storage disks, magnetic heads and ceramic balls.*

systems—resin, vitrified, electroplated and sintered metal. Matching the abrasive material and bonding system to the application is critical to productivity and wheel life.

In one automotive application, a systems approach was implemented to account for all machine and tool factors in grinding of 1050 steel camshafts. The study looked at mechanical, thermal, chemical and microstructure properties of the abrasive material, workpiece geometry, wheel shape, edge profiles and part conformity all were considered.

Researchers evaluated the grinding wheel on the basis of bond type, porosity, core material and design. Finally, they accounted for such operational factors as fixtures, wheel balance, dressing, truing, feed rate, wheel speed, grinding cycle and coolant.

In abrasive selection for high-precision applications, engineers must consider more than average particle strength. Crystal morphologies and surface conditions can also impact performance. The application described above required a CBN abrasive with measurable controlled reduction in strength when exposed to elevated temperatures. The fracture mechanism also needed to be considered, because controlled breakdown was required under high workpiece loading. In addition, surface chemistry of the crystal needed to withstand the bond curing temperature.

The abrasive was matched with a new high temperature glass bond to enable the user to increase wheel life from a baseline of 25,000 parts/wheel to 90,000 parts/wheel.

In this case, a systems approach to abrasive development yielded a significant increase in productivity. Matching an engineered abrasive to an engineered bond can also produce grinding wheels to reduce or replace hard turning and peel grinding operations. These new CBN vitrified wheels can be designed to maximize strength, stiffness and wear resistance, thereby increasing wheel life by 50–200% compared to standard bond systems.

### Diamond Selection

Like CBN, selection of a diamond species is only part of the overall picture when specifying a diamond abrasive. The unique combination of application specifics—machines, coolant, workpiece and wheel geometry—affect productivity, as do wheel specifications, shape and bonds.

A couple of tool grinding applications illustrate the effect of diamond wheel selection on productivity. In such applications,

consistent diamond content is required; our company recommends that 4.4 carats/cc be used as a standard concentration for consistent performance in most superabrasive applications.

In one case, the user was fluting a 30° helix on a one-inch diameter end mill using a 35-hp Walter grinding machine at wheel speed of 3,600 rpm. Selecting the proper diamond wheel (in this case, Warren's Univel DC) resulted in a 40% reduction in cycle time over a stock competitive wheel. In another case involving periphery grinding of tungsten carbide inserts, switching to a Univel DC 280 wheel resulted in a 20-fold increase in productivity over a standard super abrasive grinding wheel.

It should be noted that differences in machines, coolant, workpiece material and wheel geometry affect productivity. High material removal rates can boost grinding productivity, but these gains are sometimes reduced by increased wheel costs.

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#### ■ Cost Cutting Measures for Abrasive Finishing

Valley Chrome Plating (Clovis, CA) had been employing six polishing machines to finish chrome bumpers until engineers switched to a new type of coated abrasive that could be used with the company's semi-automatic polishing machine.

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