Carbide Processors, Inc.

Northwest Research Institute, Inc.
Newsletter February, 2003
3847 S. Union Ave. Tacoma, WA. 98409 (800) 346-8274
tomwalz@email.msn.com www.carbideprocessors.com

Our work

Not Our Work

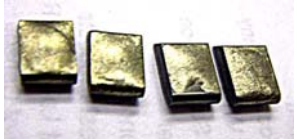
Pretinned Carbide

Why You Should Specify US Wherever You Buy Carbide

The tips are shiny, the silver solder is smooth, the flow is to the edges but not over the edges. These tips will braze and bond well. Plus they will be harder to break.

The carbide on the left is carbide we pretinned. The carbide on the right came from another source. The darker carbide is not as clean which will interfere with the bonding to the steel.

This was a mistake. We were supposed to get this pretinning work but it went somewhere else by accident. The customer asked us to look at it, give our opinion and fix everything we could.



What we found P. 2

Time Minutes	Flank Wear (mm) Carbide	Cermet
5	0.23	0.20
10	0.50	0.40
15	0.65	0.45
20	0.80	0.50
25	0.84	0.55
30	0.88	0.58

Cermet tips feed faster and stay sharper, longer

These are a couple cermet saw tips. They are lighter than carbide and feel smoother. They are pretinned and ready to braze. If you want to try them we will be happy to supply you.

Ceramic Tipped Saws

(TiCN Titanium carbonitride cermet) It has been six years of progress and success. Cermet tipped blades are considerably different than they were a couple years ago. They are much better made, with better materials and we know more about how to use them. If you want to try a cermet tipped saw we can supply a blade from one of our many customers who make saw blades.

Grinding With Oil is Hard on Grinders

The big chunks are broken diamond and the little bright spots are tungsten carbide. Diamond and tungste carbide are very hard and both have a lot of sharp fracture edges.

Why You Should Buy Our Filter Systems

Filtering is more important with oil than with water based coolants. Both oil and water hold carbide and broken diamond in suspension. This means a coarse abrasive sand is being pumped into the grind area between the wheel and the carbide. Oil is thicker than water so the particles are much bigger in oil and there are more of them.

CP 2002 $2038

CP 2002 Wall Mount $519

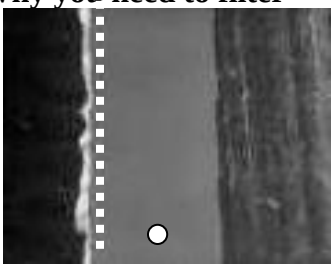
New Filter Systems for Top End Grinders Work with Oil or Water

We now have filters for our CP units that filter oil. In addition we have a small, wall mount unit that is less expensive than a full CP 2002. The wall unit is just the essential filters and housings. See P. 2

Analysis of Oil- Based Coolant Filtering

Vollmer Grinder in a Weyerhaeuser operation

Why you need to filter



This picture is magnified 100 times. It is supposed to be ground to tolerances of 0.001". If you measure straight down the white line then it looks good. The white circle shows what 0.001" looks like here.

The hard chunks in the coolant mean that you will have an edge that looks good but it will be full of chips and cracks if you look closely enough.

You should filter your coolant to a level where you remove all particles down to 10% of your tightest dimension. If you are grinding to 0.001" then you need to filter to 3 microns.

The filter systems that come with even the most expensive grinders typically are very expensive and don't filter well enough. If you are going to get the benefits of clean coolant you need a big pump and a filter that traps small particles. We were asked to modify our CP 2002 so that it fit in the grinder's coolant system. This gives you an excellent filter system for much less money. In addition the parts are readily replaceable at reasonable prices.

CP 2002 and Cl
(They remove 9 nant
particles in wate
contaminant par
The CP 2002 is
With the wall mount unit you use the pump on your grinder. In most cases you will have to replace the pump on your grinder with something stronger. To get coolant really clean you need a lot of pressure on a fine filter.



New coolant, dirty coolant and sump

We did this for Byron Richards at Milport, AL. He sent us a bottle of unused coolant, a bottle from the spout and a bottle from the sump.
We could remove just slightly better than 99% of all particles from the oil.

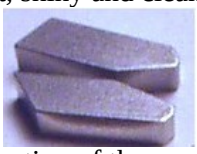

A big surprise was how much waste there was in the sump. We filtered the one bottle and got the round cake in the left hand photo. The right hand photo shows the same material in a bag with a magnet holding it up. The magnet indicates that there is probably enough cobalt to sell as scrap.

Critical point: Clean oil is in very, very small drops. As the oil gets dirtier the drops get bigger because they contain pieces of carbide, wheel, etc.

1. Oil based coolants need stirring more than other coolants. In this test we found a definite layer of clean coolant mixed with the sludge on the bottom. This means that the coolant was being changed more often than it had to be and that the coolant was getting warmer than it should have been.
2. As coolant gets used the dirty oil forms bigger and bigger globules around particles of dirt.
3. Oil based coolants have a strong tendency to suspend particles and then leave them on critical surfaces.
4. Oil based coolant has a stronger tendency to grow bacteria.
6. The proper size filter of the right material removes the old coolant while leaving the good coolant untouched.

Good Pretinning

The tips are bright, shiny and clean.

You can see the reflection of the camera strap in the left tip. The right tips show that the sides are clean and that the alloy ends at the edges of the top.

Bad Pretinning


These tips have been very badly burnt. The braze alloy has flowed across the top and down the side. The braze alloy is very rough.
They should not be used.

Here are more bad tips. The middle tip was pretinned upside down.

These tips don't look as bad as the others but they might be worse. The rough areas indicate that something is wrong with the underlying carbide surface. Because they don't look too bad they are likely to be used. They will probably stay on well enough during brazing and maybe through testing but they will not have full bond strength and may fail in cutting.

Buys scrap carbide
Renee Barnes PM Recovery, Inc.
renee@pmrecovery.com
503 620 1005 Harrison, NY

Quit Using Poor Quality Carbide
Some of you are using carbide that has already been rejected by someone else.

If you test the same grade of carbide from two different suppliers you can find that one will break with fifty pounds of force but you have to use two hundred pounds of force to break the other one. (See our 'vice test' online)

There are some really easy, simple ways to test carbide. We have them on our web site or we will send them to you if you call. If nothing else get samples from two or more suppliers, put them on a concrete floor or a steel surface and hit them with a steel hammer.

Special Grades of Carbide and Other Materials

We have some carbide inventory here for Peerless and IKS. If you need carbide in a hurry we would be happy to help. Just call them or us.

We also sell some carbide and other materials directly from us. The material we sell is special grades for unusual, high – performance applications. If you

Sorry - Customer reclassified this top secret

This is an easy example. It gets harder when you compare saving one cent a saw tip versus an unscheduled saw change. If you are interested in high performance material we would be happy to help you.

Carmen Morgan
Johann Holm of Cerametal called to say that Carmen Morgan had not retired.
Al Bouchard has a system for sharpening saws that uses 22 passes of the grinder. This sounds extreme until you realize it is Al doing it. Al is famous for the painstaking care and exacting procedures he uses. As one guy said, even people who are fussy themselves think Al is really fussy. I told Al that and he thought it was funny.

Michael Mellner
Georgia Pacific Coos Bay Oregon
Uses metric – Because the metric system has smaller increments you just naturally get better tolerances.

Finding NiCut and Tantung
Tantung is a product of Fansteel VR Wesson. We have been asked several times if we know another source. Eagle International Carbide (800 633 – 8068) sells Jonally which they say is equal to Tantung but gives superior performance because it is void free.

Nicut was a product of Sintex. After Dr. Rudy passed away the Nicut inventory was sold to Firth Sterling. Tom Quale, who ran the plant at Sintex, and Janijo Weidner, who ran everything else, are having the carbide made overseas. As of January 28 they had the first parts in and inspected. Tom says the quality is excellent. They hope to be shipping parts soon.
T & J Carbide, LLC (503)647-0014
djweidner@aol.com

Dr. Rudy – Memorial Symposium
There is a memorial symposium for Dr. Rudy of Sintex at the October 2003 convention of the American Society for Materials (Pittsburgh Pennsylvania, USA) "Cemented Carbides and Related Hard Materials-Past, Present and Future" Contact Margaret Ziomek-Moroz, Albany Research Center
Ph 541-967-5892

Our Web Page Is Averaging 3822 Hits per Day
If you would like to link with us and get a mention on our web page please let us know. This is free if we do business with you. We also sell banners on some of the pages. One client who bought a banner has had 570 hits the first month

Grinding Information
The following people asked to be mentioned here. Because I know them and their work I can recommend them along with others.

1. Ben Broussard 800 323-0727
U.S. Diamond Wheel

2. Gary Miller
Pengar 909 883-1440

3. Lou Sgro
A. Landau 215 675 2700

4. Greg Byrnes
O'Byrne, Inc. 541 343-9218

I read an excellent article written by Dr. Kris Kumar, GE Superabrasives Contact GE Superabrasives (614) 438-2000 Carmen.Kassing@gep.ge.com http://www.AbrasivesNet.com.

A Good Little Inspection Scope
Radio shack


This is new, $10 and much better than the old ones they sold. It is light, pocket size and variable power from 60 x to 100 x. It is a cheap, easy, handy way to examine carbide and tools. If you are not doing this you will be surprised by what you can see.

Charles Lee - Cascade Wood Products
Charles Lee sent a saw to me and asked me to analyze it. Charles is a nice guy and good customer. Plus he makes a good saw. Anyway I looked at it and did some tests and measurements. I came up with some ideas but basically just confirmed that he makes really good saws. I didn't know it but he also asked Brian Wallinger of West Coast Saws and Paul Duclos of Peerless Saw Co. to look at the same saw. We all saw about the same things.

A good supplier should be able and willing to help you solve a problem. It helps if you are a nice person and a good customer. Different opinions do not necessarily make anybody wrong.

Why Carbide Breaks

Sometimes breakage is caused entirely by the condition of the carbide and sometimes the carbide is used improperly. Most of the time carbide breakage is a combination of the two.

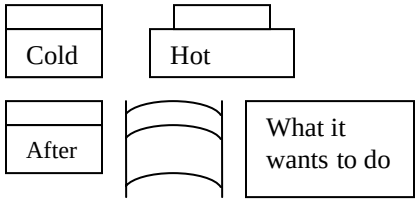
Bad Carbide?
The term 'eta phase' is often used. Eta phase occurs when too much carbon is removed during sintering. This creates a brittle condition that leads to chipping

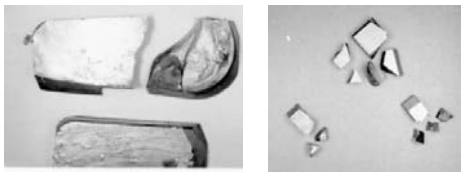
and cracking. Eta phase is not good or bad by itself. It is just a way to describe the condition of the material. For example United States Patent Application # 20020051886 specifies an eta phase condition as desirable.

The following page has carbide information supplied by Valenite Die and Wear Walmet. © 1999-2002 and used with permission. This material and great deal more is available on their web page at http://www.vdww.com

Using Carbide Improperly
Bad carbide does exist but a great part of the problems with carbide breakage come from improper use.

Heat Stress
Carbide grows when you heat it. Steel grows about three times as much. When you pull the heat away the braze alloy sets and locks the carbide and steel tighter. As it cools the steel pulls on the carbide like drawing a bow.



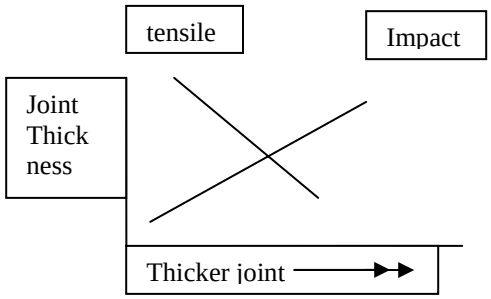


Heat stress breakage can show up as smooth curves, (left) while impact breakage is more likely to be jagged chunks (right).
(To calculate thermal expansion http://hyperphysics.phy-astr.gsu.edu/hbase/thermo/thexp.html)

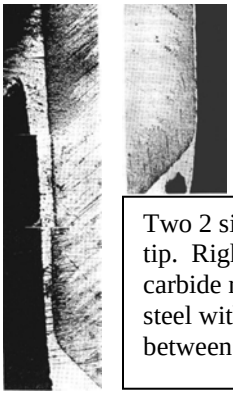
Wrong Braze Alloy
Braze alloy (silver solder) holds the tip on but it should also cushion the tip and relieve stress. Below are tests of 4 common alloys. The Cadmium alloy used to be the standard but is now rarely used for health reason. The Manganese alloy works as well or better.

Braze alloy test	
Silver %	% Good
50 with Cadmium	100%
50 Cadmium free	25%
56 with Tin	all failed
49 with Manganese	100%

Joint Too Thin
There was not enough clearance between the steel holder and the carbide bit. A thin joint is very strong but does not provide enough stress relief.

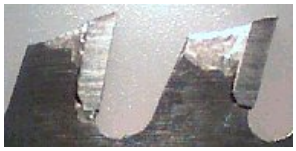


A thin joint is stronger but a thick joint prevents breaking.



Two 2 sides of the same tip. Right side has the carbide resting against the steel with no braze alloy in between

<u>Bad Cleaning and Brazing</u>



Because the plate was dirty the braze alloy didn't flow onto it. It also failed to stick between the carbide and the steel. They tried to make it work by using too much heat and that just made it worse.

Bad Grinding

The tip on the right is pretty good. The tip on the left was ground too fast with the wrong wheel. The chips and gouges serve as force concentrators during cutting and will tear the tip apart. A very light honing is often a good idea.

MAKING BAD CARBIDE WORK
This was a carbide drill bit in a tool that cost about $50,000. They typically lost a day of operation if the drill broke unexpectedly.

They started with seventy bits. All were brittle because of eta phase. They needed fifty completed tools. Twenty out of the first thirty failed so they needed one hundred percent success with the last forty.

Besides the eta phase problem they could not get the carbide to wet using standard braze alloys. They found a vacuum brazing house that got the carbide to wet but they had to go to 1800F to do it. This high temperature put a huge amount of thermal stress on the carbide.

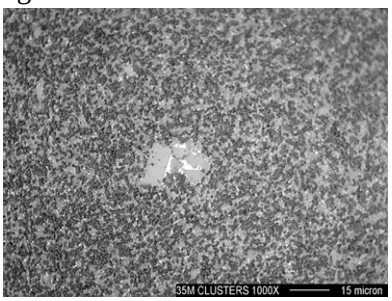
They had to go to a high temperature braze alloy because they couldn't use a braze alloy with zinc in it. If the braze alloy contained zinc then the zinc would come out during the brazing and contaminate their furnace. This high temperature braze alloy did not give the kind of cushioning and stress relief that normal braze alloys do.

Solution
We Tuffco treated the carbide so it wet well. Then they could use a lower temperature braze alloy. They opened the joint so that there was more braze alloy between the carbide and the steel for more stress relief. They still had bad carbide with eta phase material in it but they made it work.

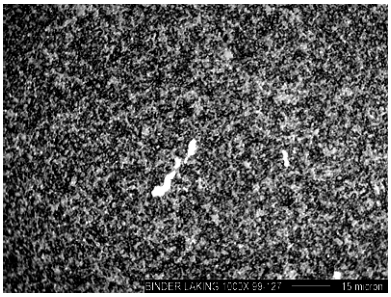
Valenite's Technical Definitions

All pictures are microphotographs, most at 1,000 x.

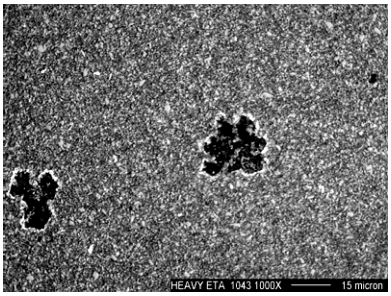
Hardness (Ra, HRa) - Measured on the Rockwell A Scale. Harder grades generally have greater wear resistance. Wear resistant grades are generally in the 92-95 HRa range. Tougher grades have hardnesses in the 88-90 HRa range.



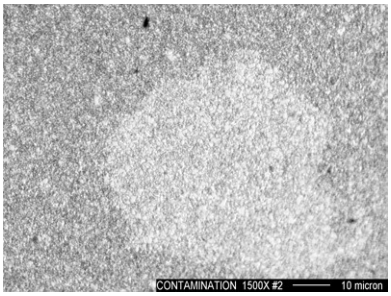
Clusters (Cls)
Clusters are defined as groups of three or more WC grains that are significantly larger than the average grain size. It is difficult, if not impossible, to avoid clusters completely. Low levels are not considered harmful to the integrity of cemented carbide parts. Large numbers of these clusters can adversely affect performance, especially where shock is involved.



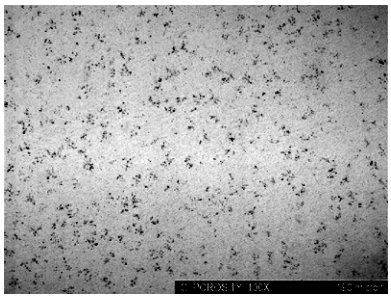
Binder Lakes (Blk)
Binder lakes are pools of cobalt binder in the microstructure. Low levels of binder lakes are not considered harmful to performance, but a large number of lakes may structurally weaken a cemented carbide part.



Eta Phase (Eta-1, Eta-2, Eta-3)
Valenite's internal rating system for eta phase. Eta phase is a carbon deficient form of tungsten carbide that results in a harder, more brittle cemented carbide part. Eta phase is generally considered to be harmful to the performance of cemented carbide parts.

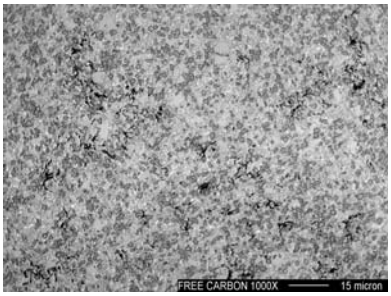


Grade Contamination
An area of a distinctly different grade in the microstructure. Cross Grade Low levels of grade contamination are not considered harmful but a large number of these areas may adversely alter the physical properties of the cemented carbide part.



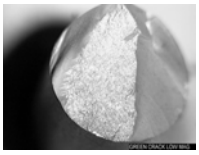
Porosity
The picture above is C porosity at 100x.

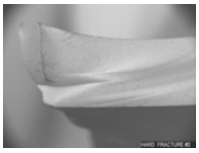
A Porosity - Pores in the microstructure less than 10 microns in diameter rated from A01 to A08
B Porosity - Pores in the microstructure 10-25 microns in diameter rated from B00 to B08.
C Porosity is not true porosity but discrete areas of graphite. Rated C00 to C08.



Free Carbon: A term used to describe C Porosity in excess of C00

Other Considerations
Pits: Any void in the microstructure whose longest axis exceeds 25 microns but is less than 100 microns.
Macrovoids: Any void in the microstructure whose longest axis exceeds 100 micron





Green Fracture Hard Fracture

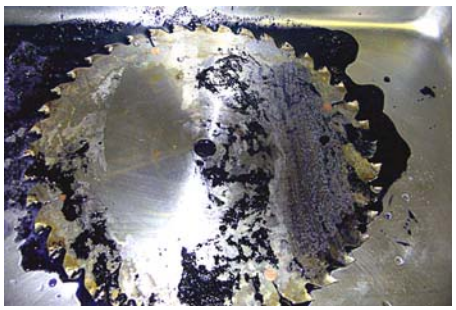
Green Fracture: A fracture that developed before the part had been fully sintered. Green fractured surfaces are coarse when compared to hard fracture surfaces.
Hard Fracture: A fracture that developed after the part had been fully sintered. Hard fractured surfaces have a smooth texture and usually contain ripples or ridges.

NOTE:
1. This is material I copied off the web page (with permission) and edited down to fit this small space. There is great deal more information on the Valenite web site. http://www.vdww.com It is well worth spending some time there.
2. This article does not mean I necessarily endorse Valenite over any other supplier. However I do like suppliers who deliver a lot of information to help make good buying decisions. I would be happy to run any information anyone else cares to supply.

Cleaning Steel for Brazing

Tools

Spray on left and wipe on right



After rinsing

This is an old saw plate sprayed with WD 40. A thick, water based ink solution was poured over it to show the underlying grease. The left side was sprayed with Easy Off oven cleaner and the right side was wiped three times using a paper towel soaked in acetone. In the middle picture you can see the oven cleaner bubbling up on the left and the streak marks on the right from the acetone wipe. Finally the plate was rinsed under running water. The oven cleaner side rinsed clean and the acetone left side has streaks.

Solvents are not cleaners. They can be used to clean but that is not their intended use.

Solvents

Solvent comes from dissolve which means to merge with a liquid. The idea is that you dilute the oil and make it easier to wipe away. However, you are only dissolving the oil so there will always be a little remaining even if it is in a much smaller concentration. Also, the oil sticks to the saw plate and a solvent dissolves from the top down so it does not get under the oil and remove it.

Easy Off makes soap

The sodium hydroxide (caustic soda) in Easy Off mixes with the oil or grease to make soap. Dishwashing detergent and laundry soap use the same process but they use milder chemicals than oven cleaner does. Another example of this process is the old-fashioned method of making lye soap. It called for mixing lard with lye and cooling the mixture to form soap.

Soaps and detergents

Molecules of detergents are long and thin, like a match. The head end dissolves in water and the tail dissolves in grease. When something greasy is washed in detergent, the grease-soluble tails plug themselves into globules of grease. They surround it and form ball-shaped micelles, which float the grease, into the water.

Ultrasonics

Ultrasonics can be extremely effective. However ultrasonics just apply energy to help the chemicals work. How you load the machine is very important because these are sound waves and can be blocked by corners and walls just as voices are. In addition the ultrasonic echoing effect in the tank can be either good or bad. Also thick grease probably attenuates the sound, causing it to deaden and decreasing its effectiveness.

Vapor degreasing

Chemicals used in vapor degreasing are most effective when they go through the evaporation and condensation cycle. When used merely as solvents they lose a great deal of their effectiveness.

This is a picture of the braze joint where carbide (top) is attached to the steel (bottom). The braze alloy balled up between the steel and the carbide. Both sides were dirty so the braze alloy did not stick well to either side. You can also have steel or carbide that is not completely clean and it won't show up on the sides. It will create pockets inside where the alloy doesn't stick and that means weak joints.

Carbide that came off showing pockets in the braze alloy.

Using Cermets to Make Brazed Tools

- We would like to see you make high performance tools using our technology.
- We will sell you parts, treat your parts or sell you a license to treat parts in your plant.
- You need to do it because the Japanese are already doing it and selling against you in the U.S.
- There is not much profit left in carbide tools. There is still good profit in cermet tipped tools.
- We make it easy to braze the parts.
- You can grind them with your current, good equipment it just takes a little longer.

Longer wear

Time	Flank Wear (mm)	
Minutes	Carbide	Cermet
5	0.23	0.20
10	0.50	0.40
15	0.65	0.45
20	0.80	0.50
25	0.84	0.55
30	0.88	0.58

The U.S. is slightly ahead of most of the world but the Japanese are way ahead of everyone else.

Globally materials used as cutting tools are 44% steel, 49% carbide and 7% Diamond, CBN & Ceramics

The U.S uses approximately 30% steel, 60% carbide with possibly 10% other materials

Japan uses 25% cermet, 50% coated carbide including TiCN coatings and 25% all other materials

The Japanese are about ten years ahead of the U.S. in this area. In Japan many million cermet tips are used each month and whole product lines have been converted to cermets.

The Japanese were forced into switching from carbide to cermets because the Chinese drastically raised the price of raw materials. This change came from the Japanese manufacturers and suppliers for materials such as carbide, cermet and ceramic. Now Japanese saws and tools are rapidly penetrating U.S. markets.

As usual, what's new in the saw and tool industry is what has been used for 10 to 20 years in metalworking where approximately 30% of cutting tip material is tungsten carbide, 60% is coated carbide and ceramics and 10% is diamond and CBN. The brazed tool industry uses about 90% tungsten carbide and maybe 10% all other.

The global cutting tool market is worth 10-12 billion U.S. $, with ceramics, cubic BN and diamond tooling perhaps 7% market share, carbide products 49% and high speed steel 44%. There is a great deal of room to introduce advanced materials in new areas.

Cermet Advantages

In wood and related products the advantage that seems most important to the customer is the ability to feed material faster and get good or better cuts. It takes a while before they notice that cermets wear longer. Cermet tipped saws are quieter, use less energy, and run cooler so there is less build up.

Overall it is the ability to take a carbide tipped blade off, put a cermet tipped blade on and then feed faster.

Drawbacks

1. Cermets are new. 2. You have to have a good operation and really good equipment to use them. Even then a good man still has to experiment to find the right wheel and how to use it. 3. Cermets pretty well have to be fed faster. Cermets are like second gear and carbide is like first gear. If you use cermets at carbide feed rates they will drag in the cut and may not last as long as carbide. Cermets are more expensive, partly because they are a lot harder to make but mostly because there is no volume yet.

In the worst case you buy a trial of forty WD 7135 cermet saw tips treated and pretinned from us at a cost of about $28 versus $ 7 for carbide. Cermet tipped saws typically sell for twice the price of carbide. If you buy 100,000 tips from directly form Kennametal Victoria (250 474-1225) and just have us treat them so you can run them through your autobrazer then your price comes down to maybe $9.50 vs. $3.60 for carbide.

Bob Budke (Systi Matic) and Lowell Freeborn (Freeborn tool) were selling carbide tipped saws to cabinet shops in the 1950's and the price then was over $200 a blade.

New Cermet Technology

Cermets now are much, much better than they were when we started this in 1996. Sumitomo, Kyocera and Kennametal all have very successful new grades of cermets.

Dr. Kris Kumar at General Electric Superabrasives has done excellent work defining grinding parameters for cermets.

We can supply cermets you can braze just like carbide using a torch, an oven or induction. They work with hand brazing and with automatic machines.

What didn't work before now works very, very well.

Sumitomo
"Cermet is being used because of the excellence in corrosion and abrasion resistance compared with carbide. Furthermore there is increased use in cemented carbide cutting tools coated with ceramics such as Ti (C, N). Cutting speeds have increased in recent years so percent in use exceeds 50% in cutting tools."

Kennametal Inc.
"Cermets are hard and chemically stable, leading to high wear resistance. Recently developed cermets combine excellent resistance to deformation and chemical wear with a degree of toughness."

Kyocera
"Cermets offer better wear resistance, longer tool life, higher cutting speeds and superior surface finishes in comparison with coated carbide alternatives. Where high cutting speed and wear resistance are the primary requirements, cermets are superior."

Made With a Cermet Blade

Acermet blade customer in Hawaii liked it so well he sent us this bank. He makes them from old post office box doors. He loves the blade and says it saves him a lot of sanding. (More P. 3)

Industry experts

Robert Caron at Valenite graciously allowed me to use his material here. I also got advice from Shawn Teague at Multi Metals, Ron Mills at China PacifiCarbide, Pete Sandell at Cerametal and Chris Comer at Eagle.

Lou and the folks at A. Landau Company have a lot of good information on their web site at http://www.alandau.com/ . See it for grinding information. I am running Lou's information here because he got it to me. Look for more information from other experts in future issues.

Patent Law

We have U.S. Patent 6,322,871 and more pending for brazed ceramic tools. Our plan is to provide this technology for wide use at very low prices.

Quit Using Poor Quality Carbide **see P. 3**

Future of the American Brazed Tool Industry

1. The Chinese are starting to dominate the inexpensive tool market. They are supplying sintered carbide and finished tools. The Chinese are willing to invest in new technology. Some U.S. firms are more successful selling new technology to China than they are selling it here.

2. The Japanese are starting to dominate the high cost / high performance end of the market. The number of U.S. tool patents owned by Japanese companies is truly frightening.

3. U.S. companies are holding on to some segments of the market. These market segments are shrinking from both ends. There is a great deal of throat cutting due to drastic price cutting. These are price cuts without increases in productivity or market share so profits are dropping drastically.

4. American companies are working to increase productivity using European, Korean and Japanese machinery.

The U.S. brazed tool industry is following the path of the U.S. television industry. Television sets used to be made in the U.S. and now Motorola just moved its last plant to Mexico.

Our solution is to take proven technology from other industries and adapt it for use in brazed tools. This provides high profit products where there is no competition. We like it, the people making tools with our products like it and the end users love it. P. 7

Possible Solution?
Try something new?

If what you are doing isn't working the way you want it to then maybe you need to try something new. If you just keep doing the same things then it is just going to get worse.

New for Tools

What is new for brazed tools is what is old in mechanically held tools. That is the way it has always been. Steel, tool steel, carbide and diamond all started in machining and then moved to saws.

New Materials for Brazed Tools

"Absolutely Wonderful"
Customer reaction to a Cermet tipped saw from General Saw – Thanks Roman

TiCN coated carbide is the most widely used material in machining. While TiCN coating is hard to use on brazed tools we have made solid TiCN tips very easy to use.

Cermets have improved greatly in the past few years. A web search will find articles by Kennametal, Seco Carboloy, Kyocera and Sumitomo. All are advertising their new grades of cermets.

Our books on Coolant Management and Carbide and Ceramic Brazing are on the web at www.carbideprocessors.com

Northwest Research Institute, Inc.
Carbide Processors Inc. Newsletter
3847 S. Union Ave.
Tacoma, WA 98409