

Diamond Recovery

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Recycling of raw materials is a "must" in today's world. Worldwide, countries and states are passing "Green" laws (photo 2) to ensure that goods are made from materials that can be re-cycled.

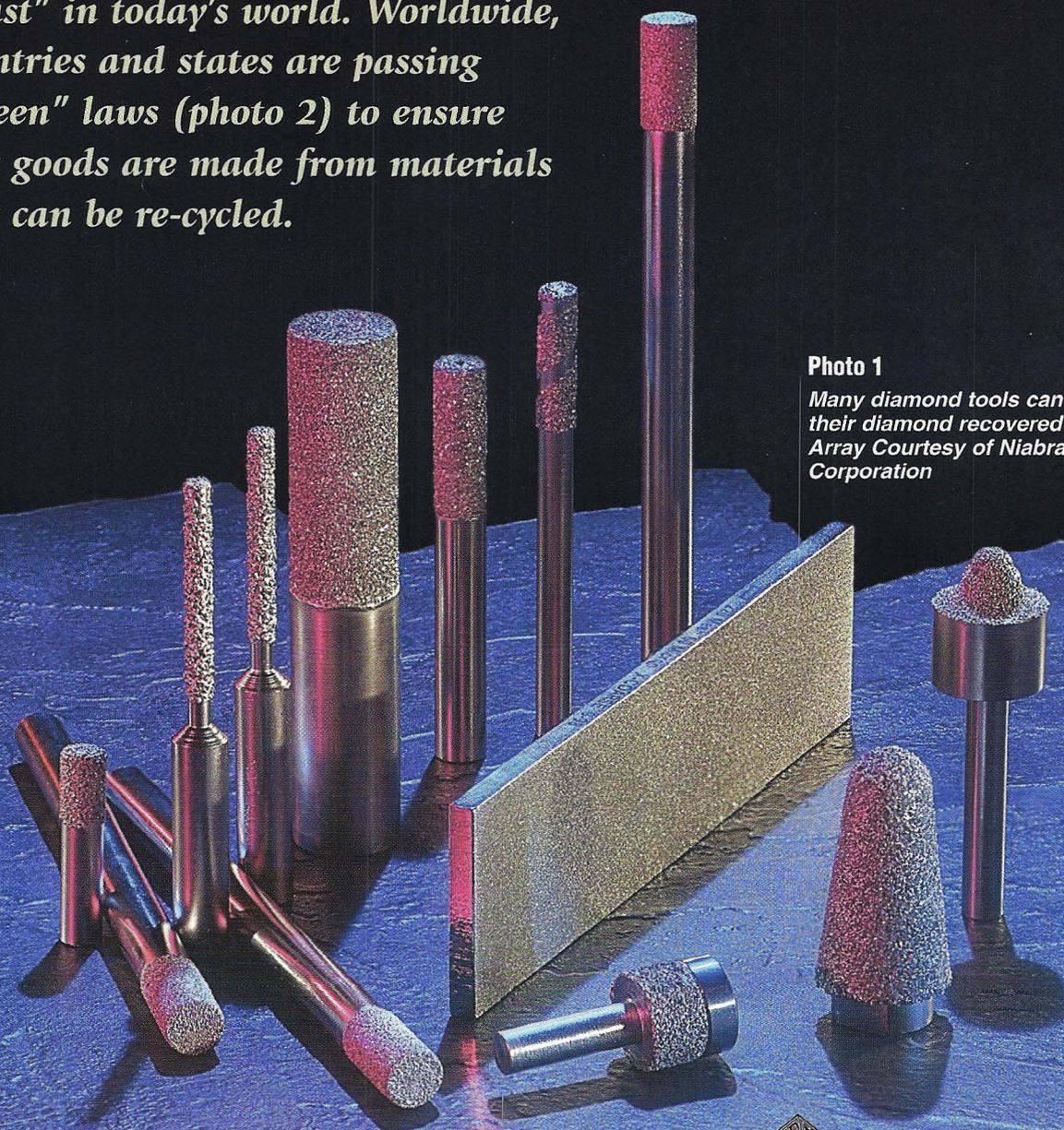


Photo 1

Many diamond tools can have their diamond recovered – Tool Array Courtesy of Niabraz Corporation

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Photo 2 – China is one of many countries invoking green laws due to high pollution

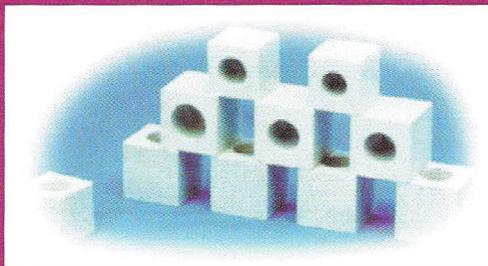


Photo 3 – Pyrophyllite blocks used as pressure transmission medium for diamond synthesis



Photo 4 – Reclaimed diamond is graded and sized



Photo 5 – Used core bits prior to diamond recovery

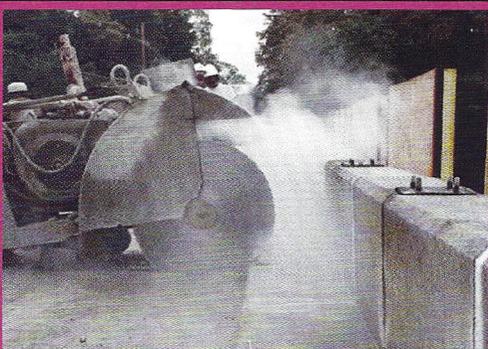


Photo 6 – Sawing concrete bridge deck

DEFINING THE RECOVERY PROCESS OF DIAMOND WHEN MANUFACTURED

Synthetic Diamond when produced comes out of the press as a slug of capsule and metal that consists of Capsule Material (Pyrophyllite - *photo 3*), Catalyst metal, unconverted graphite and diamond. The diamond has to be recovered by three separate processes.

1. Dissolving the capsule material (Pyrophyllite Hydrous Aluminum Silicate)
2. Dissolving the metal catalyst
3. Dissolving the unconverted graphite.

The recovered diamond is then lightly milled to separate any conglomerates, sized and graded (*photo 4*). Then classified diamond is subjected to a variety of Quality control tests.

DIAMOND RECOVERY FROM USED TOOLS

The recovery process of diamond from wheels, saws, drill bits and tools (*photo 5*) is subjected to an almost identical process. The diamond is liberated from the matrix, sized and graded and subjected to the same type of quality control tests. The recovered material has now been restored to QC Values identical to "Virgin" diamond. Diamond tool bonds contain materials that are considered toxic. If you do your own recovery or sub-contract recovery to an outside vendor, be sure your facility or your subcontractor's facility is in compliance with current EPA Laws. If not, you may be liable to prosecution under EPA regulations.

The Industrial Diamond Industry has always re-cycled diamond. Diamond dressers and cutting tools were always re-set as were surface set drill bits and rotary dressers. Today one of the largest consumers of diamond grit is the sawing of stone and concrete (*photo 6*). We constantly hear the comment: - "New diamond costs us less than \$0.60 per carat and to recover the diamond costs \$0.35 per carat. It is not worth recovering so we will just throw the reject segments in the dumpster". This is a very shortsighted view.

1. It is in violation of EPA regulations and
2. It is throwing away money.

EPA REGULATIONS FOR HAZARDOUS MATERIALS

Most diamond tools, wheels and saws are made with materials that are considered hazardous materials, Cobalt, Nickel, Zinc, Tungsten and Phenolic resins. For the sake of simplicity let's focus only on diamond saw segments. Diamond segments contain Cobalt, Nickel, Tungsten and Tungsten Carbide, each one considered a toxic material. If diamond segments are found in a landfill or dump site you can be sure that EPA Investigators will eventually trace the source and the manufacturer, along with the trash hauler who will be prosecuted. This can be extremely costly and can run into several million dollars for site clean up. We strongly recommend that you review the EPA regulations, which vary from state to state and consult with an Environmental Consulting Company or Environmental Lawyer familiar with the laws of your State to ensure that you are in compliance.

In summary, the EPA regulations state that materials can be stored to two ways; Containers marked "Hazardous waste" or in Containers marked "Recyclable Materials" (*photo 7*)

1. Hazardous waste - If stored as hazardous waste these containers may only be stored in a plant for 90 days and then a licensed hazardous waste hauler must dispose them of. This can be extremely expensive.
2. Recyclable Materials- EPA regulations state that these materials must be recycled within a reasonable period of time. By sending these segments to a company capable of recovering the diamond and reusing the diamond is the most cost effusive and safest way to dispose of reject or used diamond segments.

Caution! Make sure that the Company doing the recovery is properly licensed and meets state and Federal EPA standards. Sending material to an unlicensed recovery company can result in large fines and costs of dumpsite cleanup being levied against you.

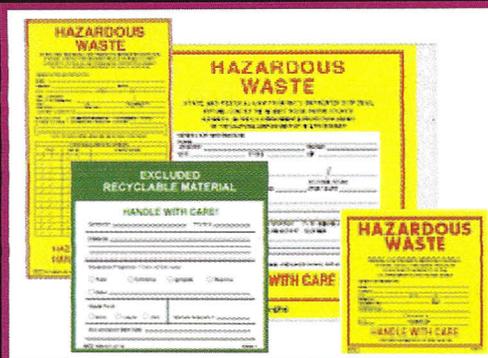


Photo 7 – Reclaimed or used tools containing hazardous or recycled materials must be properly labeled

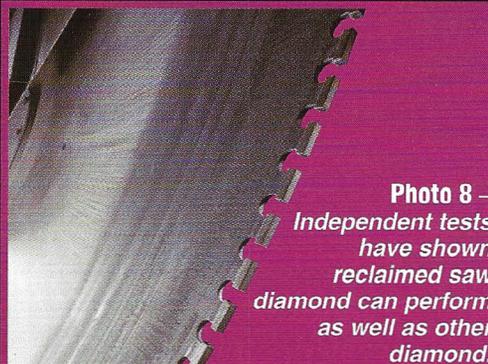


Photo 8 – Independent tests have shown reclaimed saw diamond can perform as well as other diamond.

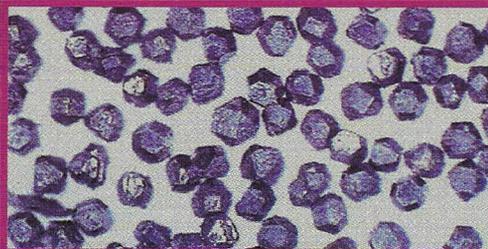


Photo 9 – Recovered Moly coated synthetic diamond



Photo 10 – Natural Diamond Recovered from Rotary Dressers (Reconditioned and Polished)

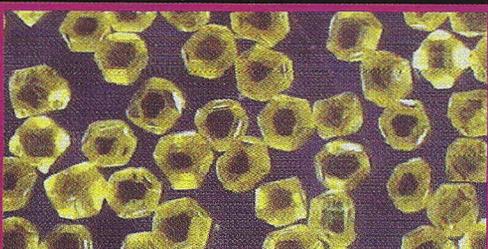


Photo 11 – Reclaimed saw diamond

ARE YOU THROWING AWAY MONEY?

Assume the diamond cost in a new segment is \$0.60 per carat and the Recovery, Grading and Sizing cost is \$0.35 per carat. A typical segment is 2" x 3/16" x 1/4" and has a volume of 0.094 cubic inches. At 25 concentration or 18 carats per cubic inch at \$0.60 per carats, the segment contains 1.69 carats or a diamond value of \$1.01. From a production batch some segments are rejected. This is the point at which it appears some saw segment manufacturers view costs incorrectly. We are constantly receiving the comment: "If we have to pay \$0.35 to recover the grit, our diamond now costs \$0.95 per carat. This is incorrect if one follows standard cost accounting practices. Reject segments should be valued at zero and the real manufacturing cost of the approved segments should include the cost of the reject segments. In effect, by recovering the diamond at a cost of \$0.35 per carat, material is now suitable for recycling with a saving of \$0.25 per when compared to new diamond. Let's say a company produces 10,000 segments per month and has a reject rate of 2% or 200 segments. With a diamond content of 1.06 carats per segment and an 80% recovery then there is a recovery of .84 carats + Scrap or 168 carats at \$0.25 = a recovery savings of \$42.00 per 200 segments.

RECOVERED DIAMOND PERFORMANCE

The question that most saw segment manufacturers have is, can they reuse recovered diamond safely without jeopardizing the performance of their saw blades (photo 8)? The answer is yes, provided the recovered diamond is properly sized and graded as part of the recovery process. The chemical recovery process has no effect on the diamond. There is a perception that the sintering process weakens synthetic diamond and recovered diamond is therefore scrap and should not be reused as new diamond... This is a misconception. All synthetic diamond contains a small amount of catalyst metal inclusions in the form of tiny metal platelets trapped in the diamond during the conversion from graphite to diamond. On heating, these platelets expand causing a reduction of impact strength by 6-12% (A metal coating process on new diamond grit reduces impact strength by ±5%). Assume a good quality diamond prior to sintering has a strength index of 90% and is weakened 8% by sintering to 82%. A new segment, which that has passed all QC standards, is presenting diamond to the work piece that has a strength of 82% not 90% (natural crushed diamond has a value of ± 45%). When the diamond is recovered and properly graded the top quality recovered material will have strength of 82%. Sawing tests using 100% recovered and properly graded diamond have shown no drop in performance, since the diamond does not appear to weaken further with a second or third recycle. In several instances tests with recovered material have shown increased performance most likely due to the diamond crystals now being more uniform because marginal crystals have been removed in the recovery and grading process.

OTHER PRODUCTS THAT CONTAIN DIAMOND SUITABLE FOR RECYCLING

In addition to the aforementioned saw diamond here is a sample list of tools that are sources of material for re-cycling (photos 9-13):

- | | |
|-------------------|------------------|
| Dressers | Saw Segments |
| Turning Tools | Bit Segments |
| Mining Bits | Vitrified Wheels |
| Oil Well Bits | Plated Wheels |
| Rotary Dressers | Plating Tanks |
| Metal Bond Wheels | |



Photo 12 – Reclaimed cbn



Photo 13 – Natural diamond from Plating Baths

Also, Cubic Boron Nitride grit can be recovered from Vitrified, Plated and Metal Bond wheels.

St. Gobain/Norton Abrasives has a program called "Full Circle Abrasives Recycling" and can be found on their website search at www.ind.nortonabrasives.com To quote the St. Gobain program:

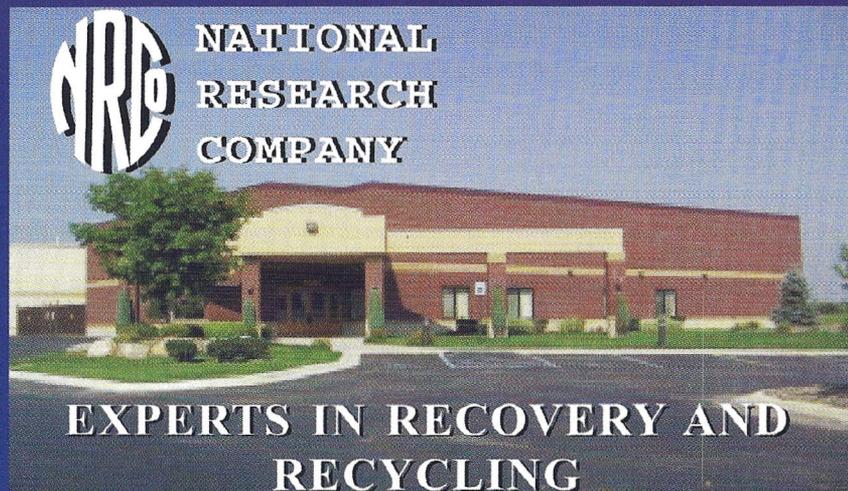
THE LESS LANDFILL THE BETTER

From an ecological point of view, protecting our environment is a sound policy. Most corporations are realizing it makes for sound economic policy as well. The national plan for cleaning up hazardous waste sites - Superfund - has already cost corporations and the Environmental Protection Agency (EPA) \$9 billion. The EPA estimates the total tab to clean up 1,222 sites on its National Priority List will reach \$40 billion. Many of these sites were contaminated before the dangers of pollution were fully understood and before it was declared improper to dump certain materials. This no longer serves as an excuse. Today, federal laws maintain that a company may be held responsible for cleaning up a hazardous waste site if it owns or manages the property, or is responsible for the generation, transport or storage of such material, currently or in times past.

YOU COULD END UP PAYING FOR ANOTHER COMPANY'S POLLUTION

Under the Superfund law, liability is "joint and several". So if one party is unable to pay its share of clean-up costs, the EPA can recover the remaining funds from those capable of paying... even though they may have contributed very little to the problem. The "deep pockets" syndrome can be painful, with clean-up costs for a typical hazardous waste site averaging \$30 million. And that doesn't even take into account the impact of negative publicity on stock prices, brand names, employee morale, and community standing. These are compelling reasons to be careful of how you dispose of materials - even those considered harmless now. In the future, they may be reclassified and deemed hazardous. As for landfills, they're being phased out of the picture as an alternative. According to the EPA, 80 percent of the landfills in the U.S.A. will close in the next 18 years. Meanwhile, disposal costs will continue to escalate at available sites. How can a concerned company dispose of materials left over from the manufacturing process in a responsible manner?" **Be Smart. It takes years of hard work to build a successful company. Don't put all your hard work at risk by ignoring EPA regulations. Recycling is safe, economical and just makes sense.** ♦

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EXPERTS IN RECOVERY AND RECYCLING

Diamond & CBN from used tools

Why recycle and recover used crystals?

- ◆ **Recycling is safe and economical**
- ◆ **Used tools have valuable crystal content**
- ◆ **Global "Green" laws demand recycling**
- ◆ **Tests prove recovered diamond and cbn have high performance**
- ◆ **Discarding used tools is EPA violation**

***Don't Throw Away Money ...
Recycle and make a profit!***

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