

Diamond recovery - what's it worth?

In Europe and North America, more stringent environmental legislation is one reason why companies need to look carefully at their waste management and deal with waste in a responsible way. Penalties for failing to deal with waste can be punitive but apart from the potential fines there are other significant losses such as a loss of reputation and tarnishing of brand image to be considered. Corporate Social Responsibility is a philosophy now firmly embedded in corporate culture and programmes such as waste minimisation, recycling and recovery demonstrates to the world at large what a company's attitude is towards its workers, customers and society at large. This can have an impact on brand images which reflects on customer perceptions and buying patterns.

The lack of landfill sites for waste disposal and the increasing cost to companies to use this diminishing resource also supports the economics of recycling to minimise disposal costs. Plus, there is the potential residual material value in the used tooling to be considered as part of the recycling mix.

With the constant downward pressures on the cost of synthetic diamond, the question of whether or not recovery of diamond in tools is really worth the effort is probably one that has crossed the mind of many in the diamond tooling industry. Anecdotal evidence suggests that recycling of diamond in the global industry is now small; with only between 8-10% of new material bought is reclaimed. Report by E. McClarence.

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Legislative trends

In general, environmental legislation is moving towards managing products 'from cradle to grave' i.e. from raw materials, production, use and disposal, manufacturers have to consider the environmental impact of its products and processes.

Products suitable for diamond recovery

- ◆ Dressers
- ◆ Turning tools
- ◆ Mining bits
- ◆ Oil well bits
- ◆ Rotary dressers
- ◆ Metal bond wheels
- ◆ Saw segments
- ◆ Bit segments
- ◆ Vitrified wheels
- ◆ Plating tanks
- ◆ Saw blades



Europe and North America have strong legislation in place backed by environmental authorities with the powers to punish offenders. China, India and other emerging economies have less developed waste management legislation and systems in place which has had a detrimental effect on their environment.

Legal frameworks

In Europe, for example there are a number of directives that provide framework legislation for all EU member countries. The Directive on Hazardous Waste complements the Waste Framework Directive by providing a framework for the control of hazardous waste. It lists a number of properties of waste, which render it hazardous (such as explosive, flammable, carcinogenic, or corrosive). Although the Directive does not substantially augment the requirements of the waste framework directive as regards permitting and registration of waste management facilities, it contains additional requirements concerning the mixing of hazardous waste, record keeping and international shipments of waste.

The Directive requires that:

- ◆ a record of every site where tipping of hazardous waste takes place
- ◆ the prevention of the mixing of non-hazardous and hazardous waste
- ◆ the separation of hazardous waste from other waste where technically and economically feasible
- ◆ hazardous waste to be transported packaged and labelled in accordance with international and European Union standards waste to be transferred with an identification form
- ◆ producers and disposal sites to be inspected
- ◆ permitted sites to keep records for three years

The Regulations set out procedures to be followed when disposing of, carrying and receiving hazardous waste. They require that waste movements are tracked using "consignment notes" and specify which materials are to be considered hazardous. In the UK for example, the regulations also require for any producer of hazardous waste (with some exceptions) to register their premises with the Environment Agency.

Similarly, In the US, the Environmental Protection Agency has outline regulations, which vary from state to state. As diamond recycling expert, Keith Reckling from National Research, the leading company in North America that recovers and recycles superabrasives, says, "For diamond tools most metal bond tools are considered hazardous waste. The law basically says that scrap/reject tools can be stored in two ways – in a container marked hazardous waste or in a container marked material for recycling. If stored as hazardous waste they have 90 days to have it removed from plant and must use a hazardous waste hauler which is expensive. If stored as material for recycling it must be processed in a reasonable amount of time, generally one a year is considered the outer limit. Recovering and recycling the diamond is far cheaper and safer but we still have tool makers who ignore the law and sell the scrap tools off as scrap metal because it is high in cobalt or tungsten."

Recovery processes

Modern diamond reclamation processes have become more efficient but consist essentially of the same processes that are used in high pressure, high temperature diamond synthesis. Essentially the diamond is recovered by dissolving metals and other materials to leave the diamond. The recovery and grading removes all the particles that may be of marginal quality. In the USA Norton offers a programme for customers to dispose of used conventional grinding wheels and are one of a few manufacturing companies that offer this service in USA. Keith Reckling explains that recovered material, properly processed and graded, can be used in new tools and deliver high performance. Both diamond and cubic boron nitride can be recycled in this way.

Cost of recovery

The cost in 2010 to recover diamond from metal bond tools is roughly 25 to 40 cents per carat depending on what has to be done to the grit. However, that direct cost has to be offset against the cost of disposal of waste material, the potential fines for failure to deal with waste material properly, and indirect costs of failing to live up to CSR. As Keith Reckling points out the diamond in used tools no longer has any intrinsic value but recognises that the economics of diamond recycling is more complicated today compared to a few years ago. A dramatic fall in the cost of diamond thanks to the mass production brought about by volume synthesis coupled with the increased performance of tools has been one factor.

As Keith Reckling explains, "Exploration drilling bits in the 1960s, for example, used natural diamond that cost from \$5.00 per carat to \$35.00 per carat. Diamond was also tax exempt. Therefore when bits were sold they were priced in two parts, diamond and setting. The diamond belonged to the customer and they would send bits back for diamond recovery and resetting. Bits were reset and some new diamond added to replace unusable stones. It was a costly process of keeping records on every bit, Bit life at that time was on average about 60 feet of drilling and penetration rates were slow. Today with more powerful drill rigs and impregnated bits containing synthetic diamond at about \$0.60 per carat bits typically drill over 2000 feet and have high rates of penetration."

That said, Keith Reckling advises that the safest way to dispose of them is to recover the diamond and recycle. And money can still be made on the deal and giving new life to used diamond and other materials in the tool. Companies like National Research in the US offer services that grade, size and test the material and bring it very close to the original quality specification. "While the diamond in the segment that does the cutting is weakened slightly during segment manufacture in a new blade, if the diamond is recovered properly and regraded it often works as well or better than the new material and seems in most cases not to weaken further from sintering," explains Keith Reckling. He points out that people are starting to recognise that, despite the low cost of diamond, they have a lot of money sitting in drums full of scrap segments or reject metal matrix mixes. ◆

◆ Acknowledgment

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