A Closer Look At Microabrasive Blasting

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WHAT IS MICROABRASIVE BLASTING?

Although microabrasive blasting is often compared to "miniature sandblasting," there is considerably more to the process than immediately meets the eye. With a closer look it is quickly apparent that this is a highly effective process for focused cutting, selective cleaning, precision deburring, surface preparation, and material removal that has broad applications across a variety of industries--especially metal finishing.

Microabrasive blasting involves uniformly mixing a finely graded abrasive with a compressed stream of air and then propelling it out of a small nozzle tip. Sometimes it is referred to as "pencil blasting" because the system handpiece is held like an ordinary pencil and the nozzle tips are approximately the size of pencil lead (ranging in size from 0.018-0.060 in.). As a production tool, microabrasive blasting provides versatility without complexity. Operators can comfortably perform hand-held blasting operations without extensive training or experience; and yet the process is also adaptable to sophisticated automatic production.

Although frequently confused with "bead" or "grit" Masters, or the smaller venturi-type systems, microabrasive blasting fills a distinct niche and relies on three important factors: (1) steady metering of abrasive into the air stream; (2) achieving high velocities at the nozzle tip; and (3) maintaining consistency of the abrasive flow.

WHERE IS MICROABRASIVE BLASTING TECHNOLOGY USED?

Microabrasive blasting's flexibility makes it suitable for an array of applications including aggressive cutting of burrs from precision-machined parts (see Fig. 1), deburring slots in aircraft fuel spines, satin finishing of automotive injector parts, and removing discoloration in tool resharpening. Typically, microabrasive blasting is used to perform operations on delicate parts that are dependent on the precision of a tightly focused abrasive stream or a small area of a larger part. (See Fig. 2)

Microabrasive blasting has proven highly successful in applications as varied as cleaning fossilized trilobites and the restoration of the world-famous dinosaur, "Sue," at the Field Museum in Chicago; the preparation of dental ceramics; drilling slots in delicate silicon wafers; stripping insulation from fine wire; removing conformal

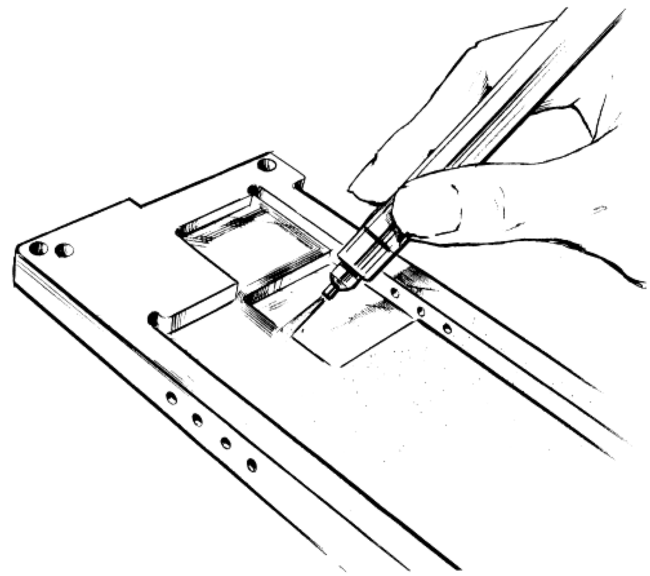

Figure 1. Deburring of a waveguide body.

coating on circuit boards; engraving production codes on optical lenses; removal of EDM recast in the manufacture of molds; and texturing of sensitive parts on advanced "invisible bomber" aircraft; as well as in prototype testing for the Mars Rover project.

HOW DOES MICROABRASIVE BLASTING WORK?

The foundation of microabrasive blasting is precision. A sensitive metering device precisely injects small amounts of abrasive media into a very dry air stream. The amount of the abrasive used will depend upon the operation (typically 0.52.0 lb of abrasive per hour). Under pressures between 20 and 200 psi the air/abrasive mixture is then forced through the nozzle, which accelerates and focuses the abrasive stream.

WHAT COMPONENTS MAKE UP A MICROABRASIVE SYSTEM?

A basic microabrasive blasting system consists of six components: the blaster, nozzles, media, air dryer,

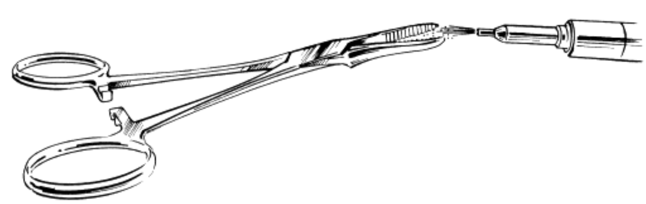

Figure 2. Texturing of surgical instrument.

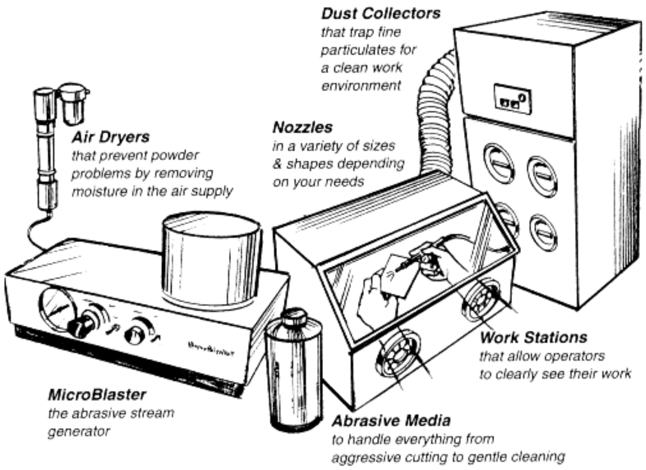

Figure 3. Six major components of a microabrasive blasting system.

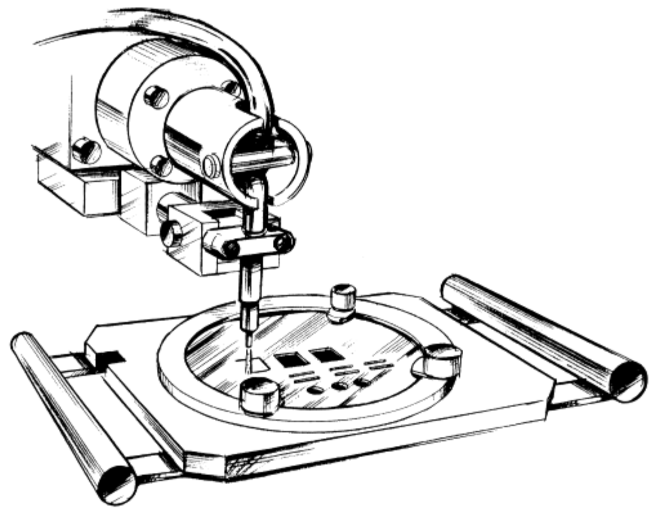

Figure 4. Fixture for drilling inkjet cartridge heads.

workstation, and a dust collector. (See Fig. 3) There are two common groupings of blasters--smaller units designed for manual or intermittent use, and larger, more robust units for heavy production use.

TWO CHOICES IN BLASTING UNITS

The smaller units are designed to cover the widest range of operations and are commonly used when an operator needs a high degree of control over the abrasive stream. They are the logical choices when a small nozzle is needed (typically 0.0180-0.060 in.).

Larger machines have additional enhancements for superior performance in high-production environments. Designed to run under heavy-production requirements with a minimum of maintenance, the larger units' design factors in wear points, which have been hardened to resist the damaging effects of the abrasive itself. Greater-capacity tanks and a larger-diameter-abrasive hose allow these units to run both larger nozzles and multiple nozzle arrays.

The microabrasive process and the pencil handpiece are highly conducive to fixturing and automation in precision machining industries. (See Fig. 4.) The use of computer programming, rotating spindles, multiple-axis positioning, slide or shuttle mechanisms, and conveyor transports can be adapted for specific automatic or semiautomatic microabrasive blasting applications.

MICROABRASIVE NOZZLES

In the microabrasive process, the nozzle gives focus and velocity to the air stream. When the air and abrasive pass through the nozzle, they pick up speed or energy. This kinetic energy is then released when the particles strike the work surface.

A wide variety of nozzle shapes and sizes are available including right angle and extended nozzles suitable to deburr intersecting holes in precision manifolds. Typically, larger-diameter nozzles are used to provide greater material removal or surface coverage. An appropriate nozzle will have the ability to remove selected material without affecting the surrounding surface.

New high-performance nozzles have been developed to increase the speed of the abrasive particles and to keep them moving in a straighter line, decreasing overspray--making them an excellent choice for fixtured applications, as well as for cutting or deburring projects that benefit from the higher particle velocity.

MICROABRASIVE BLASTING MEDIA

The selection of a particular media is dictated by workpiece material and the desired surface effect. Abrasive media ranges from soft sodium bicarbonate to hard silicon carbide. Media used in microabrasive blasting is very different from anything used in a larger "grit" blaster. The microabrasive blasting media must be free of impurities and dry with a typical moisture content of less than 1%.

The most common media sizes used in microabrasion are between 17.5 and 50 microns. Naturally, the relatively small particle sizes make this media sensitive to moisture. Proper storage of abrasive media in a cool, dry environment will help to extend its useful life.

Abrasives can be broken down into three categories: (1) media that is aggressive against brittle materials; (2) media that is aggressive against pliable materials; and (3) peening media.

Aluminum oxide and silicon carbide are ideal examples of aggressive media for use against hard, brittle materials. Their hardness, combined with sharp edges, make them very effective at cutting through metals and ceramics. Sodium bicarbonate, with its

Figure 5. Microabrasive blasting workstation with partial views of dust collector (left) and air-dryer (upper right).

needlelike shape, is the most effective tool for cutting pliable materials including polymers where a "blocky" particle would simply bounce off. Plastic media and walnut shells have similar properties to sodium bicarbonate. Lacking sharp edges, glass bead is ideal to "peen" a surface. Glass beads are often used where the preservation of tight tolerances is critical combined with the need to relieve machined stresses, light deburring, or applying a satin-like finish. It's important to remember that the media characteristics will have the greatest impact on the blasting process.

AIR DRYERS FOR MICROABRASIVE BLASTERS

Moist air is the biggest enemy of the microabrasive process. While most grit-blasting operations are capable of using compressed air after it passes through a refrigerant dryer, this is not sufficient for microabrasive blasting. For most abrasives a dew point of -25°F is required. Sodium bicarbonate is more sensitive to moisture and a lower dew point is needed. For a single station running intermittently this can be achieved with a desiccant-type dryer. For multiple blast stations or facilities operating more than one shift per day, a membrane or continuous-duty dryer is the cost-effective and efficient choice.

MICROABRASIVE BLASTING WORKSTATIONS

Microabrasive workstations serve multiple functions. (See Fig. 5.) They are designed to contain spent media, illuminate the work area, and create a comfortable environment for the operator. An effective workstation must also be designed to provide a good airflow path over the parts, allowing the dust collector to work at peak performance. Accessories, including magnifiers and microscopes, can be attached to the workstation, as well as static dissipative devices when working with sensitive electronic components.

DUST COLLECTORS

Microabrasive blasting media can only be used for one cycle, then must be collected and removed from the work area. Industrial dust collectors are used to filter out the fine media particles and, at the same time, provide a high volume of air flow.

CUSTOM MICROABRASIVE BLASTING SYSTEMS

Custom designed units for semiautomatic production allow for high volume and precision requirements. Applications may call for a programmable X-Y table, tracing over parts, or parts to be carried on a conveyor belt under the abrasive stream to abrade the top surface of flat parts.

ARE THERE TECHNICAL LIMITATIONS WITH MICROABRASION?

While microabrasive blasting has broad applications, there are some limitations to the technology. Microabrasive blasting is not appropriate for coverage of large areas, use with extremely coarse abrasives, removal of large burrs, high-gloss polishing, or use in a clean room environment.

In summary microabrasive blasting offers an extremely versatile method of cleaning, cutting, deburring, surface preparation, and material removal with the potential for automation and fixturing, combined with the ease of operator training and resulting cost effectiveness. Microabrasive blasting is well worth a closer look.

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