Injection Molding and Micro-Abrasive Blasting
Application Overview

I. Injection Molding Overview

Injection molding is a process of inserting melted polymer material under pressure into a cavity. Because it requires minimal finishing, injection molding has become one of the most common operations for mass production of complex parts. Use of the process is widespread and can be found in almost every industry.

II. What is Micro-Abrasive Blasting?

Micro-abrasive blasting (or "MicroBlasting") involves mixing a fine abrasive media with compressed air and propelling it through a miniature nozzle. The nozzle increases the velocity of the air and abrasive mixture as it exits the nozzle opening and provides the operator with the ability to precisely direct the abrasive stream.

Additional control of the abrasive action is achieved by varying the type and size of abrasive, the size of the nozzle opening, and the air pressure. This allows micro-abrasive blasting to be used for focused cutting, surface preparation, precision deburring, selective cleaning, and material removal on a wide variety of surfaces.

III. Micro-Abrasive Blasting Applications for Injection Molding

EDM Graphite Removal

A common method for manufacturing mold cavities is a "sinker" type EDM process. A conductive graphite tool, modeled to the desired configuration of the mold cavity, is used to electrically machine the tool steel cavity of the mold.

Often residue from the graphite master remains in the mold cavity (or cavities) after EDM processing. This build-up of residue can create an undesired finish on, or become imbedded in, the molded product. In extreme cases, the volume of graphite may be large enough to fill the cavity features, causing a change in the shape of the part. As injection molding becomes more widely used to manufacture miniature parts, the adverse effects of residual graphite are magnified.

Micro-abrasive blasting eliminates the graphite compounds from the mold cavities. The process successfully removes the unwanted material without causing dimensional changes. Because the abrasive particles are micron sized, the blasting process is effective on micro-mold tooling as well as more conventionally sized injection molds.

Both of the mold cavities shown above were completely filled with graphite as a result of EDM machining. The cavity on the right was processed with micro-abrasive blasting to remove the graphite compounds.

Laser Machining

As molds have become more complex, new tools are being used to create tight tolerance cavities. One method for achieving the precision required is to cut the mold cavity with a laser.

While the laser is capable of precision etching into tool steel, the process does leave a remelt (also known as "laser slag" or "pulse marks") on the mold. These small changes in the part dimensions can be critical, particularly in micro-molding applications.

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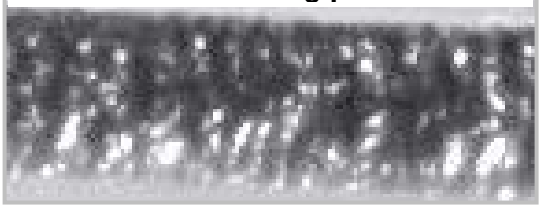
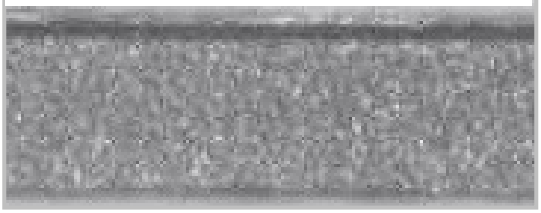
MicroBlasting effectively removes the remelt while preserving the intricate geometries of the cavity. Also during the laser machining process, a thin oxide layer can form on the surface. If left in the mold, these deposits may break off and contaminate parts during the mold process. Micro-abrasive blasting provides an excellent method of removing the oxide layers.

Pulse marks created during laser machining process



Pulse marks smoothed with micro-abrasive blasting

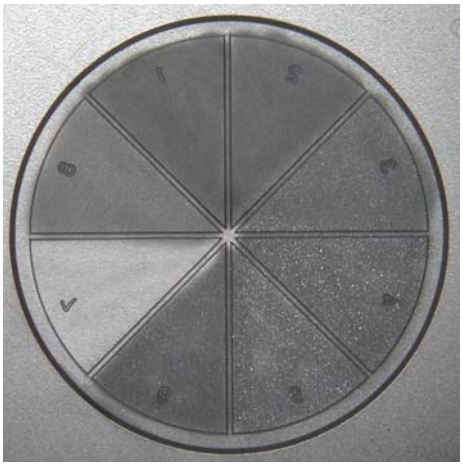


Direct machining of the mold cavities by laser does not create the same surface finish as the EDM process. With micro-abrasive blasting, molds made through laser machining can be abraded to achieve a textured finish. The abraded area can be confined with a high level of precision, limiting the texturing to only those sections where it is required.

Texturing Mold Cavity Surfaces

Once a mold has been designed and cut into the steel cavity by means of laser, EDM, or other method, the surface finish may require alteration. Some plastics like crystal styrene will stick to the cavity and not release easily if the surface has a frosted or satin finish. With softer materials like polypropylene, the satin finish is actually preferred.

Selecting the correct powder from the range of abrasives available enables the user to achieve the desired surface finish. To impart a satin-like finish on tool steel, glass bead or plastic media is used. These powders have a peening effect on the surface of the material. As with all applications related to injection molds, the primary benefit of micro-abrasive blasting is that throughout the process dimensional properties of the mold cavity maintain their original integrity.



Using media with different abrasive characteristics allows micro-abrasive blasting to produce a variety of surface textures on tool steel.

Mold cavities manufactured using EDM technology typically have a textured surface. Over a period of time, these cavities can acquire a smooth finish. This occurs most often when working with glass and mineral-filled molding compounds. The smooth surface causes the molded part to stick to the cavity, creating difficult part ejection as well as changing the finish of the molded part. In many cases, with selective abrading of the mold cavities, the original textured finish can be restored, providing the finish required for improved part ejection.

Cleaning Molds, Hot Runner Nozzles, and other Delicate Components

Keeping the mold cavity clean is a necessary part of routine maintenance. The finish on a molded part is often as important as its shape. Residue on the mold from previous processing can create discoloration, impart an undesired finish or pattern on the part's surface, or become imbedded in the finished part.

Traditional cleaning methods run the gamut from brass picks or wooden barbecue skewers to Dremel-like tools. Manual cleaning methods are labor intensive, and the results are highly inconsistent from operator to operator. Dremel type tools equipped with rotating brass brushes can speed up the process but can also deposit brass particles on the surface of the mold, which become difficult to remove. Some residues can be removed with solvents, but then issues of hazardous waste safety and handling procedures become a concern.

Injection Molding and Micro-Abrasive Blasting

The ability of the MicroBlaster® family of abrasive blasting equipment to effectively remove a surface material without damaging the base structure makes it an ideal tool for cleaning molds. Using the correct abrasive, micro-abrasive blasting can quickly break down the residue without cutting into the tool steel underneath. The high level of control inherent in the process reduces sensitivity to operator changes, yielding a far more consistent end product and extending the life of the mold. Micro-abrasive blasting can often clean the mold cavity while leaving the mold assembly intact.

Hot runner nozzles that deliver the plastic to the molds are subject to similar residue build-up. The nozzles can be cleaned manually, but the risk of damage is very high. An operator using micro-abrasive technology to clean the nozzles has more control over the process. The small nozzles used by the MicroBlaster® model allow the operator to direct the abrasive with pinpoint accuracy, limiting its effects to the section requiring treatment. It may take more time to clean the parts with micro-abrasive blasting, but the additional time is more than offset by the savings in replacement nozzles.

Hot runner nozzle encrusted with residue build-up

Hot runner nozzle after treating with micro-abrasive blasting

IV. Commonly Used Abrasive Media

Sodium Bicarbonate and Plastic Media

Because they are very soft abrasives, these media are commonly used to remove surface contaminants from tool steel molds. Sodium bicarbonate is the most common choice for the removal of graphite from new mold cavities. This media is “sharp” enough to quickly cut through the graphite but is not hard enough to damage the mold dimensions. Plastic media works well when a polymer layer needs to be removed from the surface of a mold. It is more aggressive than the sodium bicarbonate, allowing it to remove tenacious molding compounds.

Glass Bead and Crushed Glass

The hard, spherical shape of the glass bead media makes it very effective at applying a satin-like finish to a new mold. When a heavier texture is desired, the sharp edges of crushed glass provide an abrasive that will leave a rougher, EDM type finish on the surface. Both media offer the ability to change the surface finish of the mold cavity without physically altering its dimensions. The fine nature of the two media enables them to be precisely focused on specific areas of the mold cavity.

Aluminum Oxide

The growing use of laser machining molds has created a need for a media that can quickly remove the oxide layer, recast, and laser pulse marks without significantly damaging the mold cavity. A fine, carefully sized aluminum oxide will quickly remove the unwanted material without aggressively eroding the tool steel base material. Aluminum oxide can also be used to impart an EDM type finish when desired.

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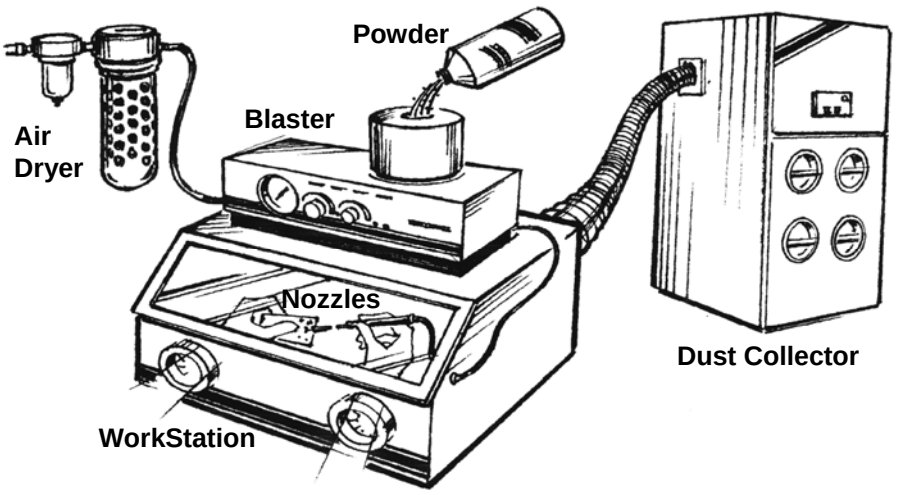
V. Equipment Requirements – What Constitutes a Complete MicroBlaster® System



Effective micro-abrasive blasting requires a system comprised of six basic components: Micro-abrasive blaster, workstation, dust collector, air dryer, nozzles, and powder. The MicroBlaster® unit combines the abrasive media with dry, compressed air to produce the abrasive stream. A workstation is used to confine the spent abrasive and provide the operator with a clean work area that allows good visibility. An industrial dust collector is necessary to evacuate the spent media from the work chamber and store it for disposal. Since the micron size particles used in the process are highly susceptible to the effects of moisture, a desiccant or membrane type air dryer is required to ensure proper abrasive media flow. Nozzles provide focus and acceleration to the abrasive stream. The abrasive powder influences the action of the process based on the size, shape, and hardness of the individual particles of each type of media.

VI. Summary

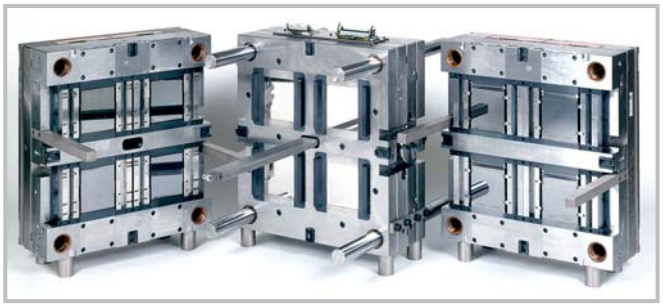
The ability to achieve and maintain tight control over the action of the abrasive stream makes micro-abrasive blasting a versatile production tool. This control allows different operators to work with the MicroBlaster® model abrasive blaster on a specific application yet maintain a high degree of precision and consistent results.

The abrasive properties unique to each type of powder and the use of nozzles with varying size and shape provide flexibility to the process. This enables micro-abrasive blasting to work effectively on a range of materials and to perform diverse tasks. It is equally efficient at removing EDM recast and laser slag from tool steel as it is cleaning intricate mold cavities without causing dimensional changes to the mold geometries.

AccuFlo AF10 on Comco's ProCenter Plus

The ProCenter Plus combines the workstation, dust collector and air dryer into a single compact unit.

Whether your need is in the mold manufacturing process or in the area of mold maintenance, you should start benefiting from the flexibility and power of a Comco MicroBlaster® abrasive blasting machine in your facility today.



Hot runner mold system

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