A wide range of applications exists for abrasive blasting. Although the most familiar are blasting steel bridges and concrete buildings, there are many other common blasting processes that improve the appearance of parts, remove unwanted flashing and burrs, or add strength to high-stress materials. Three of the more prevalent applications are described below.

SURFACE PREPARATION

This application category encompasses the process of preparing surfaces for coating materials. Widely known is blast cleaning of steel to remove old paint, rust, and other contaminants, or, if it is new steel, removing mill scale that has formed on the surface during the manufacturing process. The second major function when blasting steel is producing a surface profile. Profile, which is also called “etch” or “roughness,” is the texture resulting from impact of abrasive particles on the surface. Coating manufacturers generally specify the type of profile required to ensure that their coating material will perform as designed.

Surface preparation applications are not restricted to steel and masonry. Fiberglass materials are blasted to remove the top layer of glaze (gelcoat) and expose air bubbles. Aluminum, titanium, magnesium, and other sophisticated metals require elimination of corrosive matter and, if they are to be coated, a surface profile. Highly advanced materials, such as composites used in aircraft and aerospace industries, are blasted with the newer, less aggressive, abrasive media. Airplanes, helicopters, car bodies, trucks, and boats are stripped of their deteriorating paint by blasting with plastic, wheat starch and agricultural media at low air pressures.
Dear Mr. Champaigne:

Could you please furnish contact with reliable manufacturers of Black Beauty Abrasives.

We are the West Indian Distributors for Clemco Industries Corporation and Graco Industries and are looking for a supplier of the above material.

Thanks, keep up the good work.

Respectfully yours,

Neville Hobson-Garcia
Managing Director, Paints & Equipment Limited
Telephone: (809) 628-7501 Fax: (809) 628-2114

Editor's Note: Letters can now be sent to me by e-mail or an easy-to-use form called LETTERS ON-LINE. Both are accessible at our web site at www.shotpeener.com.

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The list of blast cleaning possibilities is endless. With the vast available range of abrasives and media, and various types of process equipment, there is the potential that the surface preparation on most materials can be accomplished by abrasive blasting.

**SURFACE FINISHING**

Surface finishing differs from surface preparation in that the desired result of abrasive blasting is to improve the appearance and utilization of a product, rather than condition it for coating. Typical surface finishing processes are deflashing and deburring of mold-formed parts, removal of production contaminants, and enhancement of visual features.

Primary users of abrasive blasting are metal foundries where parts are produced by sand casting, permanent mold casting, and die casting. Cast parts almost always have small burrs, which must be removed for functional and aesthetic purposes. An added benefit of blasting cast parts is the ability to remove minute cracks and defects that are not readily visible. This advantage is especially important to aircraft repair facilities that recondition airplane wheels.

Softer molded materials, such as rubber and plastics, usually emerge from molds with flashings caused by tooling separation. In many cases, flashings can be quickly trimmed off by abrasive blasting, leaving a smooth, uniform finish.

There is an enormous market for abrasive blasting in industries that use heat treating as a hardening process. Heat treating requires tremendous high temperatures, which normally create discoloration of parts. Blast cleaning these parts with various types of blast media easily removes discoloration and any heat-treat scale, which also may have formed.

Another common purpose of abrasive blasting is to improve the appearance of a product. Several types of abrasive and media are used to remove stains, manufacturing compound residue, corrosion, and tool marks. Some media can blend visual surface variations into an overall uniform appearance. This is especially true on parts with scratches and cuts caused by tooling fixtures.

High operating temperatures and hot lubricants cause buildup of carbon and burnt oil on many automotive parts. Electric motors become clogged with overheated insulation and melted motor stator lamination. In most cases, retaining original dimensions of a part is critical. Use of abrasive and media that do not affect tolerances, such as plastic media, glass beads, and agricultural abrasive, allows the integrity of the part to be maintained while removing unwanted contaminants and providing an acceptable cosmetic effect.

**SURFACE COMPRESSION**

Compressing a surface by abrasive blasting is a specialized field that has become essential to the life of high-stress components. The compressing technique by abrasive blasting is called "shot peening". Increased fatigue strength of metal surfaces is achieved by bombarding the surface with a high-velocity stream of preselected round balls. Steel shot, ceramic shot, and glass beads are prominent media used in the shot peening process. Peening gives the effect of stretching and compressing the surface, thereby reducing operational stress. As a result, a shot-peened part is more durable than its original form.

Continued on next page
Shot peening is a rather precise science, as underpeening and overpeening may cause early failure of a given part. Exacting specifications are written and must be followed in most applications. Two major users of shot peening are the automotive and aircraft industries. Gear manufacturers use peening to eliminate burrs and sharp edges, as well as to add strength to gear teeth. Spring manufacturers use shot peening extensively to combat stress tension throughout their products.

Another popular use of shot peening is on metal castings and forgings. In these cases, there are multiple benefits of the peening process. Shot peening provides part cleaning, elimination of porosity, exposure of defects, and improvement in appearance. Many threaded parts incorporate the peening process to remove sharp edges while increasing thread holding power.

STEEL SURFACE PREPARATION SPECIFICATIONS

There are two highly important requirements in preparing steel surfaces for painting; one is surface profile and the other is degrees of cleanliness. Both are critical to the performance of any coating systems, especially with the advanced, long-life formulations used in coatings today.

Coating manufacturers have long recognized the necessity of proper surface preparation if their coatings are to succeed as they have claimed. Improperly cleaned steel surfaces will cause costly premature failure of the coating; consequently, coating manufacturers specify how the surface is to be cleaned and textured prior to applying their products. Failure to follow specifications results in denial of coating performance guarantee.

SURFACE PROFILE

Considerable research has been conducted by coating manufacturers and professional organizations on surface profiles required for various paint systems under a wide range of environmental conditions. Studies have found that certain types of coatings require specific profiles to ensure adhesion and complete protection of the substrate. Profiles provide a mechanical method of positive, uniform bonding of the coating, allowing the coating to last as long as stated by the manufacturers.

Profile, which is sometimes called "etch" or "roughness," is produced by abrasive particles propelled by compressed air at high velocity from an abrasive blast nozzle against a surface. Abrasive particles cut into the steel to form countless peaks and valleys. The resultant contour provides a surface on which the applied coating can obtain a tight grip. Sophisticated coatings simply will not adhere to flat, smooth surfaces because there is nothing for the coating to grip.

Depth of profile is controlled by the size, type, and hardness of abrasive, and by the pressure, surface distance, and impact angle of the blast nozzle. Different abrasives create different profiles; therefore, selection of the abrasive is extremely important in complying with specifications.

Profiles are measured in mils or microns. A mil is 1/1,000 of an inch. A micron is 1/25 of a mil (i.e., 25 microns equal 1 mil). The most common term used in the United States is mil, which is used to measure paint thickness, as well as surface etch. Typically, specifications state a mil profile height average due to the wide range of abrasive particle sizes within a given abrasive supply. For example, an average profile of 2 mil (50 microns) may actually show a mixture of profiles as small as 1 mil (25 microns) and as large as 3 mils (75 microns). Precise profiles are simply not possible because there is no practical method of producing exact abrasive particle sizes.

Once the abrasive has been selected, it is important to establish strict blasting techniques. Any deviation in nozzle air pressure, nozzle distance from the surface, or angle of abrasive impact will affect profile results. Reduction of air pressure or increased nozzle distance may cause smaller profiles. Severe nozzle angles may produce a skimmed blast pattern, rather than definite peak and valley projections of a profile. For best results, nozzles should be positioned to blast at 80-90° to the surface and at a distance where abrasive speed reaches its optimum acceleration.

There are various types of instruments for measuring profiles. It is essential to utilize a measuring device to check and document profile conformance. Careful monitoring of the profiles will prevent expensive rework (see fig. 1).

DEGREES OF CLEANLINESS

Proper blast cleaning of steel surfaces is an absolute necessity prior to applying coatings. It is no mystery that paint will not last long on a dirty, rusted, or contaminated steel surface. New steel must also be blast cleaned to remove mill scale, as mill scale will loosen in time and cause premature paint failure.

Depending on the coating and type of service to which the steel product is subjected, four grades of cleanliness have been established by professional industrial organizations. The four grades are classified as degrees of cleanliness, which range from 100% removal of all contaminants to a quick blast to remove only loose materials. The four degrees are white metal blast, near white metal blast, commercial blast, and brush-off blast. Several pages of the Steel Structures Painting Council’s (SSPC) Systems and Specifications Manual are devoted to describing each degree of cleanliness, but a brief definition follows.

Figure 1. When surface profiles exceed the maximum specifications, the peaks may protrude through the coating system, causing it to fail.
TABLE 1. STANDARDS for CLEANLINESS

<table>
<thead>
<tr>
<th>Degree of Cleanliness</th>
<th>SSPC Std.</th>
<th>NACE Std.</th>
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<tbody>
<tr>
<td>White metal blast</td>
<td>SSPC-SP 5</td>
<td>NACE No. 1</td>
</tr>
<tr>
<td>Near white metal blast</td>
<td>SSPC-SP 10</td>
<td>NACE No. 2</td>
</tr>
<tr>
<td>Commercial blast</td>
<td>SSPC-SP 6</td>
<td>NACE No. 3</td>
</tr>
<tr>
<td>Brush-off blast</td>
<td>SSPC-SP 7</td>
<td>NACE No. 4</td>
</tr>
</tbody>
</table>

White metal blast: Removal of all visible rust, mill scale, paint and foreign matter. This level of cleanliness is usually required where sophisticated paints, such as zinc-rich coatings, are applied to materials that are located in highly corrosive areas. Typical applications are salt water bridges, chemical plants, and offshore drilling rigs.

Near white metal blast: Blast cleaning until at least 95% of the surface area is free of all visible residue. Very similar to white metal, but allowing for some slight staining on the metal. This degree of cleaning is required for high-performance coatings where the steel is exposed to harsh elements and heavy usage.

Commercial blast: Blast cleaning until at least two-thirds of the surface is free of all visible residue. For most applications where standard coatings are applied, commercial blast is specified. It primarily allows tightly adhering old paint to remain on the surface because of the contention that if the old paint is still good, why remove it.

Brush-off blast: Blast cleaning of all except tightly adhering residues of mill scale, rust, and coatings, exposing numerous evenly distributed flecks of underlying metal. This cleaning method is acceptable for materials that are not subjected to severe environments or where long-term coating life is not expected.

Complementing the written definitions of degrees of cleanliness are several visual comparators produced by professional organizations. The SSPC has produced a set of photographs in a pocket booklet form that shows the cleanliness grades on four types of surface conditions. The four conditions cover steel surfaces with mill scale, mill scale and rust, total rusting, and rust with pitting. The National Association of Corrosion Engineers (NACE) developed a set of encapsulated steel coupons that simulate the four degrees of cleanliness. For reference, the four degrees of cleanliness standards are shown in Table 1.

Abrasive blasting should be attempted only by trained and experienced personnel knowledgeable in the standards of surface preparation. Advancements in the quality and longevity of paints developed by coating manufacturers dictate the need for perfection in surface preparation.

BLASTING PRINCIPLES

There are two operating principles of blasting - suction blast and pressure blast. Suction machines are usually small pieces of equipment primarily designed for light duty work or minor cleaning applications. The most common use of the suction principle is in blast cabinets where work areas are limited and blasting requirements are less aggressive. Pressure blast machines are also used with cabinets for tough cleaning jobs. Pressure blasting is utilized in blast room applications.

Suction (sometimes called “venturi”) uses a method of drawing abrasive from a nonpressurized container into a gun chamber and propelling abrasive particles out of a nozzle. Typically, a suction system consists of a blast gun, two hoses - one for air and one for abrasive - and an abrasive container. The blast gun has a nozzle, air jet, gun body, and hose connections. By mounting an air jet in line and behind a nozzle, compressed air flowing through the gun body from the air jet will develop a drawing action. This brings abrasive up through the abrasive hose into the gun body, where it is accelerated through the nozzle.

Suction blasting yields one-fourth to one-third the velocity and surface impact of pressure blasting. Consequently, suction blasting is more appropriate for light to moderate applications. More popular uses center around soft sophisticated metals where mild deburring, light shot peening and thin scale removal are required without deep penetration of the base metal. As a typical example, aluminum, titanium and magnesium automotive and aircraft parts are suction blasted.

Pressure blast systems are easily distinguishable from suction types by the use of one hose, as opposed to two hoses, to feed the nozzle. Air and abrasive travel through a single blast hose at high air pressure and rapid speed, resulting in intense surface impact.

We will start with Ventilated Enclosures in the next issue of Abrasive Blast Cleaning News.

Success

To laugh often and much; to win the respect of intelligent people and the affection of children; to earn the appreciation of honest critics and endure the betrayal of false friends; to appreciate beauty; to find the best in others; to leave the world a bit better, whether by a healthy child, a garden patch or a redeemed social condition; to know even one life has breathed easier because you have lived. This is to have succeeded.

—Ralph Waldo Emerson