Soft Media Blasting: An Introduction

This month's installment of the Applicator Training Bulletin was written by Lloyd Smith, Ph.D., of Corrosion Control Consultants and Labs, Inc., Glen Burnie, Maryland, USA.

While most industrial blasters are familiar with hard abrasives such as mineral sands, slags, and steels, there are many situations when softer blasting media are needed. The phrase "soft media" refers to abrasives that will not damage the substrate. Soft media, or soft abrasives, are widely used for cleaning, especially in manufacturing processes such as cleaning electronic components. This Applicator Training Bulletin will be limited to cleaning normally performed by an industrial painting contractor.

Abrasive Performance

The four parameters that determine an abrasive's performance are its hardness (hard vs. soft), shape (angular vs. round), density (mass/unit volume), and size. The purpose of abrasive blasting before painting substrates such as steel or concrete is to remove surface contaminants and impart an anchor profile (roughness) to the surface. Therefore, a dense, hard abrasive of proper shape for the contaminant to be removed and proper size to impart the specified anchor profile is used. But what if all that is needed is to remove the paint, or even remove a surface deposit from the paint? Or what if the substrate is a thin piece of metal that could be damaged or warped by a hard abrasive? These are situations where soft blasting media are used.

The Moh Scale

In 1822, Friedrich Moh devised a crude but practical method for comparing hardness of minerals, now known as the Moh scale. This scale measures the relative scratch resistance of materials (detailed in the box on p. 28). The Moh hardness and bulk density of some common abrasive materials are presented in Table 1. Moh hardness has been used by the abrasive blasting industry as a general guide to the possible cleaning rate or relative depth of anchor profile when comparing abrasives. The density of an abrasive particle is important information because a heavier abrasive particle will develop a higher impact velocity than a lighter one under the same blasting pressure, thus having more energy to do more work. The information available from suppliers is on bulk density, i.e., weight per unit volume of the bulk blasting media (which includes the air spaces between particles) and not on particle density.

Table 1:
Moh Hardness of Common Abrasive Materials

Abrasive	Moh Hardness	Bulk Density Kg/m^3 (lb/ft^3)
Sponge	–	160 (10)
Dry ice	–	800 (50)
Sodium bicarbonate	2.5–3	960 (60)
Corn cobs	2–4.5	560–720 (35–45)
Walnut shells	3–3.5	675–755 (42–47)
Plastic media	3–5	720–960 (45–60)
Silica sand	5–6	1,600 (100)
Glass media	5.5–7	1,600 (100)
Steel media	6–9	3,685–4,485 (230–280)
Slags	7–8	1,280–1,440 (80–90)
Garnet	7–8	2,085–2,325 (130–145)
Aluminium oxide	8–9	1,920–2,005 (120–125)

The term "soft media" is a relative term. Softness of the abrasive is related to the softness of the substrate. A soft abrasive that will not scratch the substrate is an abrasive that has a lower Moh scale rating than the substrate. Bulk density is an indicator of the ability of the abrasive to dent the substrate. This is also dependent on the thickness of the substrate and on blasting pressure.

For the purposes of this ATB, soft abrasives will be considered those with a Moh hardness less than silica sand. These abrasives include sponge media, dry ice, sodium bicarbonate, vegetable abrasives (ground corn cobs, shells, and pits), and plastic abrasives.

Blasting with Soft Media

Blasting with soft media usually requires extra care in setting up and operating the blasting equipment. As a general rule, the highest blast pressure possible is used when blasting with hard media to optimise production. With soft media, the intent of the blasting must be known because other factors, such as desired surface finish, are just as important as productivity. Therefore, determining the optimum blast pressure that maximises productivity while achieving the desired end result is more critical with soft media. This may not be the highest blast pressure.

Surface finish is one important reason for selecting a soft abrasive. Restoring wood, for example, may require that the original grain of the wood not be destroyed. Wood is a relatively soft material, and even different types of wood have different hardnesses. An abrasive, combined with the proper blast pressure, must be selected so as not to raise

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the grain (cause damage to the soft growth layers). Blasting concrete, masonry, or stone can be performed with a number of abrasives. A hard abrasive would be used if the intent were to remove contaminants and roughen the surface for painting. But a softer abrasive would be needed for a restoration project, i.e., when only surface cleaning is required.

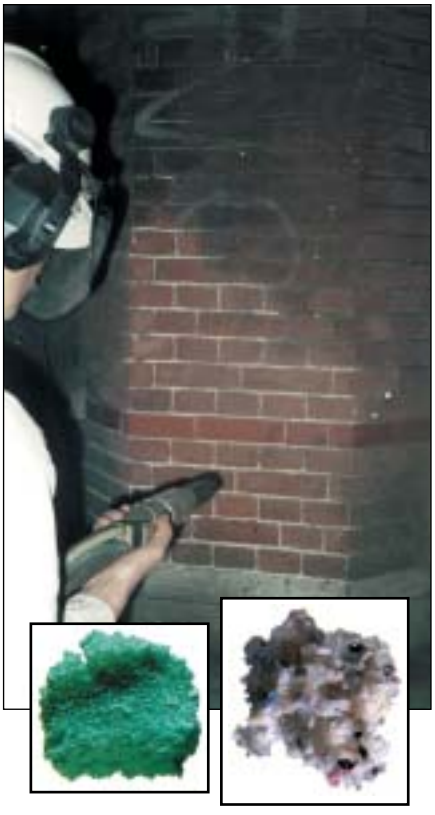
With thin metals, such as the aluminium skin of an aircraft, the abrasive must be hard enough to remove the coating but not so hard and dense that it dents or warps the metal itself. Again, the choice of abrasive and proper blast pressures to achieve this goal are important.

Soft Media

The various soft media will now be discussed in general terms, especially in terms of areas where the material can be used. There are other uses for each abrasive than the ones that will be described. Soft media are tools that are selected to meet a specific goal. The ability to remove the specific contaminant(s) present on the surface may require testing. It is always recommended to run a test on the actual surface to be cleaned to determine if the abrasive and method meet the intent of the project.

Sponge

Sponge media consist of polyurethane foam that is chopped into abrasive-size particles, usually in the range of 3.2 to 6.5 mm (⅛ to ¼ in.). Straight sponge is a soft abrasive. The sponge can be formed around other abrasive particles, including most of the abrasives listed in Table 1.



One use for sponge blasting is removing soot from brick and other substances. Courtesy of Sponge-Jet, Inc.

If the abrasive particle is considered soft, then the sponge-impregnated abrasive will also be considered a soft media.

The sponge media is actually a foam. Foams can be open cell or closed cell. The sponge media is open-cell. What this means is that the air spaces in the foam are connected. Open-cell foams have a greater ability to absorb materials, including oil, grease, and fine dust particles. The sponge particle will be flattened when it hits the surface. This takes some of the energy away from the particle, reducing its rebound and allowing it more time to absorb contaminants.

Blasting with sponges requires specialised equipment because the abrasive does not flow well in conventional blast pots. The feed units for sponge have an actuator inside the blast pot that stirs the sponge to keep it flowing. An auger at the base of the unit controls the amount of media fed into the air stream.

Straight sponge abrasive is mainly used for cleaning work such as removing oil and grease from equipment and surfaces without damaging the paint. It has been used to remove smoke and soot from brick, concrete, and other hard surfaces. It would be an appropriate selection for cleaning wood substrates. The sponge is a bit more aggressive when it is formed around plastic chips. Without marring the substrate surface, this material has been used for graffiti removal, historic building restoration, and coating removal from substrates such as tile and fibreglass.

Sponge media can be recycled between 5 and 10 times. Recycling is performed with a classifier, which consists of a series of screens. Large particles are retained on the largest screen while fine particles fall through all the screens. The middle screen collects the reusable media.

Dry Ice

Dry ice is the solid form of carbon dioxide. The blasting media consist of particles. They can vary from the size of rice grains to about 3 mm (⅛ in.). The media is very cold because carbon dioxide freezes at -78.5 C (-109 F). Particles at this temperature will damage the skin. Do not handle the abrasive without the proper gloves and other appropriate skin protection.

Dry ice blasting requires equipment that is specific to the abrasive. It may be necessary to make the abrasive on-site. This is done either by shaving chips off a block of dry ice or forming the pellets from liquid carbon dioxide, depending on the manufacturer of the equipment. Preformed abrasives can also be supplied. The project must be reasonably close to a source of dry ice/liquid carbon dioxide. Specialised blasting tools are also needed.

Dry ice blasting may require large vol-

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Dry ice sublimes during blasting, going from a solid directly to a gas.

Dry ice particles vary to about ⅛ in. (3 mm)
Photos above courtesy of Cold Jet, Inc.

umes of air to clean effectively. A compressor that can deliver 117 l/sec (250 cfm) may be required. The blasting can be very noisy, and proper hearing protection is required.

Dry ice has the unusual property that it sublimes at room temperature. This means that it goes from a solid to a gas without ever becoming a liquid. So when the abrasive particles pulverise upon hitting the surface, the abrasive disappears. Any small particles that land on the ground will quickly disappear by sublimation. This means that the amount of waste is minimised since no abrasive is in it.

Uses of blasting with carbon dioxide include oil, grease, and soot removal, and restoration of concrete, brick, and masonry. Dry ice blasting finds use in factory settings for general cleaning and maintenance. The fact that the abrasive sublimes and leaves no residue cuts down on-site preparation and clean-up time. It will not affect motors, bearings, or electrical equipment so a lot of masking or removal of equipment is not necessary. It has also been used for cleaning production equipment.

Sodium Bicarbonate

Sodium bicarbonate abrasive, also known as baking soda, is the same material used in powder form for baking, in toothpastes, and in a number of other consumer products. The abrasive particles pulverise completely on impact to a fine dust that will make it impossible to see in contained areas and will collect on nearby surfaces. Therefore, sodium bicarbonate blasting is most commonly done in the wet mode, i.e., wet abrasive blasting. Specialised equipment is needed to feed the sodium bicarbonate into the water stream, or water into the sodium bicarbonate stream.

Specialised equipment is needed for sodium bicarbonate blasting.

Sodium bicarbonate, also known as baking soda, is a water-soluble abrasive. Photos above courtesy of Armex®

Sodium bicarbonate is soluble in water. Therefore, the abrasive will be dissolved or can be washed off after the blasting is completed. This reduces the amount of abrasive debris compared to the amount of material removed from the surface. If the cleaned surface is going to be painted, the sodium bicarbonate must be washed off. Hot water is most effective at dissolving sodium bicarbonate. A final rinse may also be required.

Sodium bicarbonate has been found to be effective in removing oils and greases. An additional advantage is that pumps, motors, and bearings do not have to be covered because the sodium bicarbonate solution will not harm or affect them. Sodium bicarbonate has been used around or on a variety of machinery because there are no hard dust particles to affect operating parts.

Sodium bicarbonate has been used in architectural operations such as smoke, soot, and graffiti removal, and his-

toric restorations. It finds uses in general plant maintenance, especially in the food industries. Sodium bicarbonate is non-sparking, so it is useful in natural gas and petroleum refining plants.

Sodium bicarbonate can be harmful to shrubbery. Any shrubs or plants in the immediate work area should be covered when blasting.

Because of its alkaline nature, sodium bicarbonate solutions can be helpful or harmful materials. Any water treatment plant that handles acidic wastes uses materials such as sodium bicarbonate to neutralise the wastewater. Therefore, in a plant environment, it would be an advantage to let the water run down the plant sewers because it actually saves the industrial waste water treatment plant (IWTP) some money. The limitation is that the IWTP must be able to handle the other constituents from the cleaning operation that would be in the water. Check with the IWTP to see if the water is acceptable or if the plant drains will have to be protected.

Vegetable Abrasives

Vegetable abrasives are those that come from plant life. The most commonly used vegetable abrasives are derived from corn cobs, walnut shells, fruit pits, and rice hulls. Vegetable abrasives have low hardness and low bulk density. They will not etch most industrial substrates or even wood. Vegetable abrasives are mainly used for cleaning valves or turbine rotor blades, for removing grease from motors, and for removing dirt or other deposits on paint films. They are also used for removing old, flaking paint prior to recoating, especially from wood, fibreglass, and aluminium. Vegetable abra-

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Table 2:
Plastic Media per MIL-P-85891

Designation	Plastic Material	Moh Hardness
Type I	Polyester	3.0
Type II	Urea formaldehyde	3.5
Type III	Melamine formaldehyde	4.0
Type IV	Phenol formaldehyde	3.5
Type V	Acrylic	3.5
Type VI	Poly (allyl diglycol carbonate)	3.0
Type VII	Starch-g-acrylic	2.0

Moh's Scale of Relative Hardness

The Moh's scale is a rating system for hardness that ranges from 1 to 10 with 1 being the softest and 10 being the hardest. Moh took ten well-known and easily available minerals and arranged them in order of their "scratch hardness." If a specimen to be tested can be scratched by a known mineral from this list, the scratched specimen is softer than that mineral. Likewise, if the test specimen can scratch a mineral on the list, then it is harder than that mineral. The ten minerals are as follows.

1. Talc
2. Gypsum
3. Calcite
4. Fluorite
5. Apatite
6. Feldspar
7. Quartz
8. Topaz
9. Corundum
10. Diamond

This scale should be more accurately called a "table" because it is not to scale. For example, the difference in hardness between talc and gypsum is not the same as the difference in hardness between gypsum and calcite. Therefore, it is just an ordered list. Moh hardnesses of some common materials are as follows.

Fingernail: 2.5

U.S. copper penny: 3

Steel knife blade or window glass: 5.5–6

Hardened steel file: 7

Emery cloth: 8–9

There are many different aspects of a material that can be considered as a measure of hardness such as resistance to scratching, indentation, bending, abrasion, or fracture. It is very easy to confuse durability or toughness with hardness. A simple example is the difference between a glass ball and a rubber ball. Glass is harder than rubber, but rubber is more durable. Try bouncing both of them on a hard floor. The glass ball will shatter while the rubber ball will bounce. The Moh's scale is just a measure of scratch resistance.

sives are non-sparking, so they find use in hazardous areas where all parts to be cleaned are adequately grounded and there is adequate ventilation.

Vegetable abrasives are used with normal abrasive blasting equipment. The abrasive must be dry to flow effectively.

Some shells, such as pecan shells, contain oil or stain that may not be suitable for some surfaces, especially when repainting. They are a one-time use abrasive.

Plastic Media

Plastics as abrasives were originally developed in the 1980s to replace chemical stripping of paints from aircraft. Blasting with plastic media is normally performed with high air volume but low blast pressure, e.g., 69 kPa–345 kPa (10–50 psi). The low pressures eliminate warpage of the substrate. Plastic media can be recycled about 5 to 20 times. The main uses of plastic media are in the aerospace industry and in automotive restoration.

U.S. Military Specification MIL-P-85891, Plastic Media for Removal of Organic Coatings, classifies the media into seven types, as presented in Table 2.

Media with a Moh hardness of 2.0 (Type VII) are used on surfaces such as fibreglass and soft metals. Media with a Moh hardness of 3.0 (Types I, VI) are generally used for removing paints from soft aluminium or copper. Media with a Moh hardness of 3.5 (Types IV, V) remove coatings from hard aluminium and steel. Type III abrasives (Moh hardness of 4.0) are used for removing harder coatings such as powder coatings from steel.

Conclusion

Soft blast media are abrasives that are softer than the substrate being cleaned. They are used to clean the surface without damaging the substrate. Some of the soft blast media require specialised equipment. Other soft media use traditional blasting equipment. Controlling blast pressure to achieve the desired end result at the maximum production rate is one factor that separates soft blast media from hard blast media.

Editor's Note: The SSPC/NACE Joint Task Group is preparing a technology update on alternate blast media. Contact SSPC at www.sspc.org for additional information.

Coming Next Month:
Measuring Moisture in Concrete