Abrasive-Impregnated Sponge as a Blasting Medium

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One of the main problems of using conventional blasting media is the high level of dust created. This can lead to an "unfriendly" working environment and very low visibility for the operator as well as the need for very tight control of containment to prevent dust from escaping and harming machinery and other workers.

One solution to reduce the effect of these problems is to use an abrasive encapsulated in urethane sponge granules.

This is a relatively new process, brought about by increasing demands to reduce dust levels and to increase public and worker safety. Additionally, it provides a surface preparation system that can meet the demands of paint manufacturers' profile specifications.

Available Alternatives

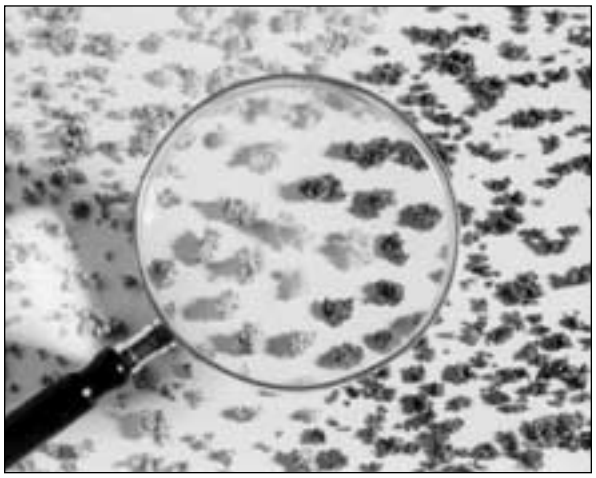
Dry blasting with conventional abrasives is very efficient, fast, and cost-effective, in most instances. As noted, it does have drawbacks, which can reduce its effectiveness or prohibit its use in certain circumstances, such as in very close proximity to machinery, the general public, or other workers.

Water blasting at high or ultra-high pressures can be a very effective way to resolve some of these problems, but it also has drawbacks. Water runoff and spray may be totally unacceptable, especially inside sensitive areas. In addition, the runoff may contain pollutants that must be collected and disposed of in accordance with hazardous waste requirements. Also, blasting with water alone will not provide a profile on steel.

Chemical cleaning can be environmentally unfriendly, slow, and, in some cases, hazardous.

Various mechanical hand and power tools have been used for many years. However, they are not as fast and efficient as blast cleaning methods nor do they provide the surface profile required by many modern coating systems.

Finally, novel or unconventional methods such as cryogenic cleaning can also present problems, such as high noise levels during operation.



Various types of abrasive-impregnated sponge media (Photo courtesy of Sponge-Jet, Inc.)

Abrasive-Impregnated Sponge

Urethane sponge granules can contain a range of different abrasive particles, such as steel grit, aluminium oxide, or plastic chips. Details of the impregnating process are proprietary, but it is clear that the sponge and abrasive are mixed together, chemically bonded to each other, and allowed to set prior to being sized into the working particles.

The sponge particles then are fed into a pressure hopper and fired at high velocity toward the surface to be cleaned—similar to conventional blast cleaning. However, sponge granules react differently than other abrasive media when they hit the target. The abrasive particle within the sponge abrades the old coating or rust from the surface, drawing the residue onto the sponge.

As a result of the very low rebound velocity of the sponge and its capacity for capturing the product being removed, dust and other particles in free suspension are dramatically reduced in the work area. This allows blasting to be done in the vicinity of other workers, sensitive machinery, etc.

Following are some advantages of this method of surface preparation.

- It offers a significant reduction in airborne particulate dust. In addition, because of low dust levels, containment requirements are reduced.

• The system operates completely dry. This can be an advantage, depending on where the work is being done, because it can be difficult sometimes to contain and dispose of contaminated water from wet blasting operations.
• Used sponge can be disposed safely and economically by incineration under controlled conditions rather than being deposited in a landfill.
• Operating pressures from 1–5.5 bar, depending on the work task, are feasible. Such low operating pressures mean low noise levels.
• The method is very controllable, allowing it to be used for selective coating removal or heavy profiling of a substrate.

In addition, based on his experience as a contractor, the author has found that sponge particles can be recycled up to 10 times, depending on the substrate being cleaned, that it can be recovered much more quickly than grit, and that it can clean up to four times faster than hand tools.

Disadvantages are that blasting with sponge can be slower—up to 30–35% slower, in the author's experience—and more expensive than blasting with conventional abrasive materials. Also, to be economical, the sponge must be recycled, which means there must always be a containment system in place for this type of operation.

Media Types

Urethane sponge can be impregnated with various types of abrasive for different applications.
• Steel grit can be used to remove elastomeric or extremely thick coating systems, mill scale, and heavy corrosion products. Cleaning rates vary from 2–6 m^2/h on flat steel plates. It is capable of producing an 85-micron profile.
• Aluminium oxide can be used to remove normal paint and corrosion. Cleaning rates also range from 2–6 m^2/h on flat steel plates. This abrasive is capable of producing a profile of 50–75 microns. In addition, sponge impregnated with a very fine grade of aluminium oxide, originally developed for use in the aerospace industry, has proven to be quite effective at removing coatings from aluminium or composite materials. It provides a very fine profile. Cleaning rates depend on its use.
• Staurolite can be used to remove selective coatings, light corrosion, graffiti, grime, and pollution products. Cleaning rates vary depending on its use.

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A 40-micron profile is achievable on flat steel plates.

• Plastic chips can be used for tasks such as removal of coatings on delicate substrates in aerospace or military equipment and in historic restoration projects. Cleaning rates depend on its use. No profile is produced.

In addition, sponge particles without any added abrasive can be used for cleaning food processing and industrial machinery, for radioactive decontamination, for removal of graffiti, smoke damage, etc. Cleaning rates vary from 4–20 m^2/h. No profile is produced.

Blasting Equipment and Process

While the goal in using sponge for blast cleaning is the same as conventional media, the method of operation is slightly different.

Compared to conventional abrasive blasting, in which the minimum air pressure is usually 7 bar, pressures used with sponge blasting equipment for removal of normal coatings are not higher than 5.5 bar. Normally, even less pressure is used. For instance, pressures for the removal of graffiti are in the order of 3–4 bar. To remove coatings from aircraft, pressures as low as 1–1.5 bar are used. However, high air volume is required—normally 6 m^3/min (at 5.5 bar) of clean, dry air when using a 9 mm nozzle. A larger compressor is needed for a 12 mm nozzle and to run extra equipment such as a separation sifter for recovered media.

Blast cleaning with sponge media requires a blast pot that can control media flow and air pressure. The media must be agitated and fed into the blast hose. This is achieved by a mechanical auger drive, rotating feed unit, and an air jet stirrer. A conventional blast hose and deadman control can be used.

After each use, the media is collected by shovelling or vacuuming. Since it is lightweight and easy to handle, clean-up can be fast. Since the sponge media is dry, painters can begin work immediately. Used media is put through a mechanical sifter or sieve to separate and remove paint, rust, and other debris from the sponge granules. The sifter is air-driven from the compressor. The media is then recycled.

The particle size of sponge media is designed to be most effective after it has been recycled several

times, and most operators report that sponge performs best after two or more uses.

When the particles are reduced in size to the point that they fall out with the paint chips and rust particles in the grader, they are discarded. New sponge can be added to replace the used sponge on a continuous basis, or it can be allowed to degrade completely before replacement. The media can be safely disposed of by normal means, or it can be incinerated if required, depending on whether it is contaminated by the removed coating material. If the waste contains hazardous materials, it must be disposed in accordance with local regulations.

Although this blasting system creates very little dust from the breakdown of the sponge, adding a small amount of clean water to the media—just enough to make it slightly damp to the touch—can reduce the generation of dust even more. A slight amount of detergent also can be added to help the cleaning operation.

The cost of sponge media, depending on the grade and after recycling 10 times, is £210–250/tonne. In comparison, here are prices of selected other abrasive media, based on a survey of suppliers: slag, £80–90/tonne; sodium bicarbonate, £400–500/tonne; garnet, approximately £180/tonne. However, while media price per pound is the most obvious and common comparison, there are several other factors that must be considered when calculating the total job cost of blasting operations.

- Recyclability—Because sponge media is recyclable up to 10 times, spent media can be collected, sieved, and mixed with new media, thus extending its useful life. Recyclability and low dust characteristics are both economic benefits of sponge, since spent media does not need to be replaced as often and the need for dust handling equipment is limited.
- Freight and waste disposal—The recyclability of sponge media also keeps waste collection, transportation, and disposal costs in line. Waste reduction in lead abatement becomes even more important when you consider the high cost of hazardous waste disposal.
- Dust levels—Less airborne dust means significantly improved visibility for the operator, which means better productivity because he can see better while blasting. This means cost savings as well. In lead abatement operations, low dust also means reduced risk of lead exposure to operators and support personnel, fewer crew rotations, and significantly lower labour costs. Furthermore, less dust means requirements for

negative air pressure and dust handling can be reduced. This, in turn, has a positive effect on the cost of equipment. However, normal health and safety regulations and precautions still apply when dealing with removal and disposal of lead-based paints.

Containment

Since sponge granules are larger than conventional abrasive particles, they pose less risk of infiltration of machinery being cleaned and they are easy to contain. In addition, rebound of sponge from a surface during blasting is generally no more than 3–3.5 m. Finally, because of their size and light weight, clean-up of sponge granules is relatively easy.

Example of Sponge Cleaning

During construction of a new power station, a major problem was encountered with paint layers disbonding from the structural steelwork or from each other. Depending on the degree of disbonding, it became necessary to remove either the entire coating back to bare metal or the topcoating that was not adhering properly to the underlying layers.

Due to the time limits set by the builders and the need to perform the coating removal without affecting other construction work in the area or contaminating already installed equipment, sponge impregnated with two types of abrasive was used: aluminium oxide for total coating removal and staurolite for selective removal of peeling topcoat material.

The job required the use of four complete blasting units for part of the project and a team of 18 operators working around the clock. While most of the work was done from scaffolding, some of it was carried out from cherry pickers. This allowed for fast access to the roof area steelwork, eliminating the need for scaffolding there. The repainting crew followed, also working from cherry pickers, which enabled the project to proceed quickly.

At one point, four blast pots were in operation in one relatively small building at the same time with only simple sheeting to contain the sponge particles. However, no contamination of surrounding areas or disruption of other work occurred.

This is just one example. According to one manufacturer of sponge for blast cleaning, it also has been used on various projects to remove graffiti, smoke, and soot; oil, mill scale, rust, and other contaminants; and paint, including lead-based paint. Among the types of surfaces and environments in which sponge cleaning has been used are ship bilges, galvanised steel, aluminium tracks, concrete floors and ceilings, tank car linings, submarine hulls, paper manufacturing equipment, boiler heat exchanger tubing, and pipes and welds.

Conclusion

Blasting with impregnated sponge is not a replacement for other types of blast cleaning, chemical cleaning, or mechanical cleaning methods. Rather, it is one more option in the surface preparation arsenal. It allows for jobs to be done safely for both workers and the environment, and it provides for efficiency in cleaning with relatively low levels of dust and easy clean-up.