ABRASIVE BLASTING – M12

Eco-efficiency opportunities for Queensland manufacturers

Blast costs away

Abrasive blasting is a method to clean or prepare surfaces prior to use. Mechanical force is used to propel blast media such as sand, sponge or glass beads at the surface to be cleaned to remove contaminants such as paint. This method is commonly used in industries such as the marine, metal finishing, foundry and surface coating.

Abrasive blasting can have a major impact on the environment, costs and health and safety of staff including:

- **Air pollution** from the blasting media rebounding off the surface and from the contaminants being released from the surface. This can be a problem especially if blasting is conducted in the open as the pollutants can be blown into neighbouring properties or around unprotected staff. This can also cause environmental damage if the contaminated dust enters waterways or hazardous materials end up in the soil.
- **Waste disposal** of both the contaminants and the blasting media. There are different impacts of waste disposal depending if a wet or dry method is used and this is explained further below. Some blast media can be recycled.
- **Hazardous waste** for example if the contaminated material on the surface contains lead paint. If the waste is classed as hazardous, disposal costs can be higher.
- **Noise** – from the machines used to blast the objects. This can be a safety issue for workers but can also cause nuisance to neighbours.

There are also other impacts on health and safety from inhalation of solvents used to prepare the surface, contaminated material or blast media.

Methods to reduce the impact on both staff health and safety and the environment include:

- choice of appropriate blast media
- containment of blasting operation
- correct waste disposal.

Blast media

There are many different types of blast media. Each type provides a slightly different function and impact on the environment. When choosing the blast media consider the following:

- is the media appropriate for the intended application – for example is it the correct shape and size?
- can it be collected, recycled and reused easily?
- does it have a low environmental impact during storage, use and disposal?

The following table compares some of the more popular blast media.

Table 1 - Blast media characteristics, recyclability and hazards[1]

Blast media	Mohs		Dust	Hazards	Comments
Natural minerals					
Silica Sand	Whilst silica sand has traditionally be a media for abrasive blasting, recent studies have indicated high levels of crystalline silica as a possible carcinogen. It is prohibited for use as an abrasive blasting medium in Australia				
Garnet • Almandite • Andradite	 7.5 6.5	 yes no	 low high		Commonly used. Hard, durable and fast cutting
Staurolite	7.5	no	mod		Not for removal of lead-based paint.
Olivine	6.5	no	mod	Possible asbestos impurities.	Used for steel where slags cause rust spotting.
Spec. Hematite	6.0	yes	mod		
Mineral slags					
Copper slag	6.0	no	mod	Possible heavy metals contamination	
Nickel, iron and coal boiler slag	6.0	no	high	Possible heavy metals contamination	
Manufactured media					
Steel grit/shot	6.0	yes	low		Metallic abrasive. Must not become wet.
Baking soda	2.0 - 3.0	no	high-dry low-wet		For sensitive parts cleaning. Requires subsequent washing of the blast object.[2]
Crushed glass e.g. beads and grit	6.0	yes	high		Iron free so can be used on all types of metals.
Dry ice		no	no waste	CO_2 is an asphyxiant - use ventilation	Can be used on hot surfaces.
Sponge blasting	Softer than minerals	Yes between 10-15 times			Media safe and transportable. Capital and media costs high.[3]
Plastic beads	Softer than minerals	Yes between 10-12 times			Capital costs for equipment are high. Spent media must be disposed of as a hazardous waste. The quality of the blasting depends on the skill level of the operator.[4]
Organic media					
Corn cobs, nut shells, starch and similar.	low			Potential for dust explosion	To remove dirt and grease (i.e. does not damage undercoating). Initial capital costs high and system moisture sensitive.[5]
Water jet blasting					
High pressure water jet blasting		Yes	No	Potential for water contamination runoff if not correctly contained.	No abrasive material required – reduced waste disposal. No masking of equipment required. Can be used on sensitive objects. Filter can be used to remove contaminants and recycle water. No dust risk to staff. No pre-cleaning solvents required.

1 Gould, J.R. and Wilson, B., 2003, Literature Review: Abrasive Blast Media, The Waste and Resources Action Programme, UK.
2 Pacific Northwest Pollution Prevention Resource Centre (PPRC), 27/05/2008 Ship Building and Repair, Material and Process Alternatives, **www.pprc.org/hubs/printfriendly.cfm?hub=32&subsec=4&nav=1**
3 Pacific Northwest PPRC, 2008, Ship Building and Repair (as per 2).
4 Pacific Northwest PPRC, 2008, Ship Building and Repair (as per 2).
5 Pacific Northwest PPRC, 2008, Ship Building and Repair (as per 2).

HIGH PRESSURE WATER JET[6]

Ford Motor Company of Australia Ltd saved $300,000 annually by replacing a hot caustic paint stripper process with a high pressure water jet system to strip paint off hinged cross members called skids. Ford uses 1700 skids to transport cars around the factory. The skids were also found to cause contamination to the car body during the painting process.

The hot caustic baths consumed large amounts of energy to maintain a high temperature and was hazardous to the staff. The caustic bath system cost approximately $186 per skid to clean. Only 6 skids could be cleaned every day and so were only cleaned every 18 months.

The water jet system uses no chemicals and has a significant reduction in energy use. The system cost approximately $27 to clean a skid and could clean 20 skids per day. This allowed Ford to increase the frequency of cleaning from 18 months to every 3 months reducing the contamination onto the car bodies and increased the number of "first time right" cars by 5%.

At a cost of $120,000 to install, and with annual savings of $300,000, the initiative paid for itself in 4 months.

Some less well-known methods of abrasive blasting

Dry ice blasting

Dry ice (carbon dioxide at a low temperature) at high velocity can be used to remove impurities from surfaces. This method can be used to replace traditional blasting methods as it produces only carbon dioxide which becomes a gas when released. As a result, this method does not produce residual waste such as spent sand which then has to be disposed of. However, energy is required to capture, chill, compress, store and blast the carbon dioxide which produces greenhouse gases. Preference should be given to companies who source carbon dioxide from the byproducts of other processes to reduce the contribution to greenhouse gases.

Some advantages of using dry ice blasting over conventional blasting methods are provided below.[7]

- As the dry ice evaporated into the air once released, there is no additional waste produce formed, reducing disposal costs.
- There is no scrubbing with abrasive pads or brushes reducing labour time and costs. The dry ice stream can also be used in areas which are inaccessible by hand, improving the cleaning results.
- Once released, the dry ice evaporates into the air so there is no residual media left behind compared with blast media such as sand blasting reducing disposal costs. In addition, dry ice blasting can be used in places where sand may accumulate or be difficult to remove.
- Damage to equipment is reduced compared with abrasive method such as sand blasting as the dry ice sublimates when it hits the surface.
- As no water or chemicals are used, it is safer to use around electrical components and other sensitive equipment compared with conventional methods.
- The supercool temperature of -79 °C of the dry ice stream also kills bacteria, mould and fungus on contact reducing the need to use chemicals to sanitise.
- The systems are portable allowing flexibility to clean equipment in place and clean in difference locations.
- Health and safety of staff improves as there is less exposure to chemicals such as solvents.
- Blasting in enclosed locations is possible with appropriate ventilation.[8]

Care must be taken to ensure good ventilation during the use of dry ice blasting as oxygen levels can be depleted, the system can generate noise and particles can be distributed.

Dry ice blasting can also be used for cleaning (refer to Cleaning methods and practices (M9) fact sheet in this series for more information).

6 Australian Department of the Environment and Heritage, 2001, Cleaner Production – High Pressure Water Jet System – Ford.
7 Wickens Dry Ice Blasting, 10 benefits of dry ice blasting, **www.wickensdryiceblasting.com/wickens_benefits.htm**
8 ColdJet Australia, Dry Ice FAQ, **www.coldjet.com.au/dry_ice_faqs.html**

Sponge blasting

Sponge blasting is another alternative method to sand blasting. Small pieces of sponge containing abrasive materials, are blasted at the surface to be cleaned. The sponge flattens against the surface exposing the abrasives and then capturing the contaminants within the sponge. The sponge is then regenerated to be used again.

The benefits of this system compared with sand blasting include:[9]

- approximately 90% reduction in rebound of materials and dust improving worker health and safety, and community relations
- Reduction in pollution and waste generation
- increase in first pass visibility tests, reducing defects and rework.

However, whilst the blast media can be recycled the initial costs to purchase the material can be quite high.

Baking soda cleaning

Baking soda or sodium bicarbonate is a soft media that can be used to blast sensitive objects as it does not damage the product. This allows objects to be cleaned without masking sensitive areas reducing overall cleaning time. It can be a wet or dry process, but if operated as a wet system it can suppress dust and improve removal of greases and oils.[10]

The media cannot be recycled as it splits apart on contact with the object. The effect of this option depends on using appropriate nozzle pressure, standoff distance, angle of impact, flowrate, water pressure and speed of projection.[11]

A baking soda–aluminium oxide media blend can be used if rust needs to be removed and a like-new finish is required.[12]

Containment of blasting operation

The Brisbane City Council Pollution Solutions Abrasive Blasting Operator's Environmental Guide has been widely adopted throughout Queensland Municipal Councils as the standard for abrasive blasting. This document can be found at **www.gladstonerc.qld.gov.au/finance5Licensing/licensing/docs/ERAs/PollutionSolution/AbrasiveBlasters.pdf**

Due to the amount of dust generated from both the abrasive media and the contaminant removed from the object, abrasive blasting should occur within bunded, enclosed areas with an impervious surface. Large or immovable objects should be fully enclosed or screened and textile or plastic structures constructed around the object to contain the dust. For the Brisbane City Council region, for example, unenclosed screening structures must be at least 2 meters above the blasting operation area.[13]

Smaller objects can be blasted in totally sealed enclosures vented via a dust collector.

If it is not possible to fully enclose the blasting operation, then blast in a downward manner to reduce the amount of dust pollution and avoid blasting on windy days.

A suitable buffer distance between the blasting operation and adjoining land use is required. For the Brisbane City Council region the minimum buffer distance is 50 meters from wet blasting and 200 meters from dry blasting. However refer to your local authority for local regulatory requirements.[14]

9 Sponge-Jet, 2009, Features and benefits, **www.spongejet.com/features.php**
10 National Center for Remanufacturing & Resource Recovery (NC3R), August 2000, Surface Cleaning – Cleaning Automotive Parts with Baking Soda. **www.cims.rit.edu/ne/pubs/NC3R_1bakingsoda_web.pdf**
11 NC3R, August 2000, Surface Cleaning (as per 10).
12 NC3R, August 2000, Surface Cleaning (as per 10).
13 Brisbane City Council (BCC), 2000, Pollution Solutions - Abrasive Blasters **www.gladstonerc.qld.gov.au/finance5Licensing/licensing/docs/ERAs/PollutionSolution/AbrasiveBlasters.pdf**
14 BCC, 2000, Pollution Solutions - Abrasive Blasters (as per 13).

PEEL AWAY —AN ABRASIVE BLASTING ALTERNATIVE[15]

Haymes Paint produce a Peel Away paint removal series. This thick paste is applied to the surface and sealed with a laminated cover sheet and allowed to emulsify up to 30 layers of paint. The paint is peeled away from the surface within the sheet sealing up the fumes and dust.

This series of paints are suitable for surfaces such as wood, aluminium, fibreglass, bricks, concrete, laminated and compressed boards. The types of contaminants removed include oily/lead alkyl based paints, antifouling coating, varnishes and water-based paints.

Waste is contained within the laminated cover sheet which is a dust free method of removing paints especially those with hazardous components such as lead.

Waste disposal

Disposal of the waste blast media and the removed contaminant is an essential consideration in the choice of blast media. Operating in bunded areas will assist in the collection of spent blast media. Permanent blast chambers for operators who work on smaller items can also improve recovery of spent abrasives. Often these abrasives can be regenerated and reused. Table 1 above outlines which media can be recycled.

In many jurisdictions, abrasive blasting is not permitted if there is lead present. Paints suspected of containing lead should be tested before blasting.

Wet and water blasting generates wastewater which should be collected in a holding tank to prevent it from entering and contaminating the ground or waterways. It should also not be allowed to dry and contaminants become wind borne. The water should be treated and reused where possible. If treatment and reuse is not possible the water must be disposed to sewer under a tradewaste permit or collected by a licensed waste contractor.[16]

PLASTIC MEDIA PAINT STRIPPING REDUCES WASTE AND LABOUR COSTS[17]

Carstrip Pty Ltd tried several options to remove paint from vehicles prior to applying new surfaces but had problems with waste generation and chemical usage. They tried brushing the paintwork with paint stripping solvent, allowing it to soak in then scraping away the paint and washing with water but this generated large amounts of wet waste that had to be disposed of. Acid baths generated sludge that was difficult to get rid of. These two options also provided a less than desirable finish as the chemicals migrated onto the body of the car. Hand stripping was time consuming and sand blasting was not suitable as it would damage the metal.

Carstrip decided to trial finely ground plastic under a mild abrasive action to remove the paint. The process is undertaken within an enclosed booth allowing collection and reuse of the blast media. It was much quicker and generated much less waste. There were no harmful chemicals involved and the labour requirements were greatly reduced. At a cost of $140,000 to install, it had pay back period of between 2-3 years in reduced waste disposal and labour costs.

This series of fact sheets provides examples and suggestions to the modern manufacturer on how to achieve both economic and environmental benefits from eco-efficiency. Visit the project website **www.ecoefficiency.com.au** for more ideas and case studies.

15 **www.haymespaint.com.au/haymes/main.php?c=86**
16 BCC, 2000, Pollution Solutions - Abrasive Blasters (as per 13).
17 Australian Department of the Environment and Heritage, 2001, Cleaner Production – Plastic Media Paint Stripping – Carstrip Pty Ltd.

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