

13.2.6 Abrasive Blasting

13.2.6.1 General¹⁻²

Abrasive blasting is the use of abrasive material to clean or texturize a material such as metal or masonry. Sand is the most widely used blasting abrasive. Other abrasive materials include coal slag, smelter slags, mineral abrasives, metallic abrasives, and synthetic abrasives. Industries that use abrasive blasting include the shipbuilding industry, automotive industry, and other industries that involve surface preparation and painting. The majority of shipyards no longer use sand for abrasive blasting because of concerns about silicosis, a condition caused by respiratory exposure to crystalline silica. In 1991, about 4.5 million tons of abrasives, including 2.5 million tons of sand, 1 million tons of coal slag, 500 thousand tons of smelter slag, and 500 thousand tons of other abrasives were used for domestic abrasive blasting operations.

13.2.6.2 Process Description¹⁻⁹

Abrasive blasting systems typically include three essential components: an abrasive container (i. e., blasting pot); a propelling device; and a blasting nozzle or nozzles. The exact equipment used depends to a large extent on the specific application and type(s) of abrasive.

Three basic methods can be used to project the abrasive towards the surface being cleaned: air pressure; centrifugal wheels; or water pressure. Air blast (or dry) systems use compressed air to propel the abrasive using either a suction-type or pressure-type process. Centrifugal wheel systems use a rotating impeller to mechanically propel the abrasive by a combination of centrifugal and inertial forces. Finally, the water (or wet) blast method uses either air pressure or water pressure to propel an abrasive slurry towards the cleaned surface.

Abrasive materials used in blasting can generally be classified as sand, slag, metallic shot or grit, synthetic, or other. The cost and properties associated with the abrasive material dictate its application. The following discusses the general classes of commonly used abrasives.

Silica sand is commonly used for abrasive blasting where reclaiming is not feasible, such as in unconfined abrasive blasting operations. Sand has a rather high breakdown rate, which can result in substantial dust generation. Worker exposure to free crystalline silica is of concern when silica sand is used for abrasive blasting.

Coal and smelter slags are commonly used for abrasive blasting at shipyards. Black BeautyTM, which consists of crushed slag from coal-fired utility boilers, is a commonly used slag. Slags have the advantage of low silica content, but have been documented to release other contaminants, including hazardous air pollutants (HAP), into the air.

Metallic abrasives include cast iron shot, cast iron grit, and steel shot. Cast iron shot is hard and brittle and is produced by spraying molten cast iron into a water bath. Cast iron grit is produced by crushing oversized and irregular particles formed during the manufacture of cast iron shot. Steel shot is produced by blowing molten steel. Steel shot is not as hard as cast iron shot, but is much more durable. These materials typically are reclaimed and reused.

Synthetic abrasives, such as silicon carbide and aluminum oxide, are becoming popular substitutes for sand. These abrasives are more durable and create less dust than sand. These materials typically are reclaimed and reused.

Other abrasives include mineral abrasives (such as garnet, olivine, and staurolite), cut plastic, glass beads, crushed glass, and nutshells. As with metallic and synthetic abrasives, these other abrasives are generally used in operations where the material is reclaimed. Mineral abrasives are reported to create significantly less dust than sand and slag abrasives.

The type of abrasive used in a particular application is usually specific to the blasting method. Dry blasting is usually done with sand, metallic grit or shot, aluminum oxide (alumina), or silicon carbide. Wet blasters are operated with either sand, glass beads, or other materials that remain suspended in water.

13.2.6.3 Emissions And Controls^{1,3,5-11}

Emissions —

Particulate matter (PM) and particulate HAP are the major concerns relative to abrasive blasting. Table 13.2.6-1 presents total PM emission factors for abrasive blasting as a function of wind speed. Higher wind speeds increase emissions by enhanced ventilation of the process and by retardation of coarse particle deposition.

Table 13.2.6-1 also presents fine particulate emission factors for abrasive blasting. Emission factors are presented for PM-10 and PM-2.5, which denote particles equal to or smaller than 10 and 2.5 microns in aerodynamic diameter, respectively. Emissions of PM of these size fractions are not significantly wind-speed dependent. Table 13.2.6-1 also presents an emission factor for controlled emissions from an enclosed abrasive blasting operation controlled by a fabric filter; the blasting media was 30/40 mesh garnet.

Limited data from Reference 3 give a comparison of total PM emissions from abrasive blasting using various media. The study indicates that, on the basis of tons of abrasive used, total PM emissions from abrasive blasting using grit are about 24 percent of total PM emissions from abrasive blasting with sand. The study also indicates that total PM emissions from abrasive blasting using shot are about 10 percent of total PM emissions from abrasive blasting with sand.

Hazardous air pollutants, typically particulate metals, are emitted from some abrasive blasting operations. These emissions are dependent on both the abrasive material and the targeted surface.

Controls —

A number of different methods have been used to control the emissions from abrasive blasting. These methods include: blast enclosures; vacuum blasters; drapes; water curtains; wet blasting; and reclaim systems. Wet blasting controls include not only traditional wet blasting processes but also high pressure water blasting, high pressure water and abrasive blasting, and air and water abrasive blasting. For wet blasting, control efficiencies between 50 and 93 percent have been reported. Fabric filters are used to control emissions from enclosed abrasive blasting operations.

Table 13.2.6-1. PARTICULATE EMISSION FACTORS FOR ABRASIVE BLASTING^a

EMISSION FACTOR RATING: E

Source	Particle size	Emission factor, lb/1,000 lb abrasive
Sand blasting of mild steel panels ^b (SCC 3-09-002-02)	Total PM	
	5 mph wind speed	27
	10 mph wind speed	55
	15 mph wind speed	91
	PM-10 ^c	13
	PM-2.5 ^c	1.3
Abrasive blasting of unspecified metal parts, controlled with a fabric filter ^d (SCC 3-09-002-04)	Total PM	0.69

a One lb/1,000 lb is equal to 1 kg/Mg. Factors represent uncontrolled emissions, unless noted.
SCC = Source Classification Code.

b Reference 10.

c Emissions of PM-10 and PM-2.5 are not significantly wind-speed dependent.

d Reference 11. Abrasive blasting with garnet blast media.

References For Section 13.2.6

1. C. Cowherd and J. Kinsey, *Development Of Particulate And Hazardous Emission Factors For Outdoor Abrasive Blasting*, EPA Contract No. 68-D2-0159, Midwest Research Institute, Kansas City, MO, June 1995.
2. Written communication from J. D. Hansink, Barton Mines Corporation, Golden, CO, to Attendees of the American Waterways Shipyard Conference, Pedido Beach, AL, October 28, 1991.
3. South Coast Air Quality Management District, *Section 2: Unconfined Abrasive Blasting*, Draft Document, El Monte, CA, September 8, 1988.
4. A. W. Mallory, "Guidelines For Centrifugal Blast Cleaning", *J. Protective Coatings And Linings*, 1(1), June 1984.
5. B. Baldwin, "Methods Of Dust-Free Abrasive Blast Clearing", *Plant Engineering*, 32(4), February 16, 1978.
6. B. R. Appleman and J. A. Bruno, Jr., "Evaluation Of Wet Blast Cleaning Units", *J. Protective Coatings And Linings*, 2(8), August 1985.

7. M. K. Snyder and D. Bendersky, *Removal Of Lead-Based Bridge Paints*, NCHRP Report 265, Transportation Research Board, Washington, DC, December 1983.
8. J. A. Bruno, "Evaluation Of Wet Abrasive Blasting Equipment", *Proceedings Of The 2nd Annual International Bridge Conference*, Pittsburgh, PA, June 17-19, 1985.
9. J. S. Kinsey, *Assessment Of Outdoor Abrasive Blasting*, Interim Report, EPA Contract No. 68-02 4395, Work Assignment No. 29, U. S. Environmental Protection Agency, Research Triangle Park, NC, September 11, 1989.
10. J. S. Kinsey, S. Schliesser, P. Murowchick, and C. Cowherd, *Development Of Particulate Emission Factors For Uncontrolled Abrasive Blasting Operations*, EPA Contract No. 68-D2-0159, Midwest Research Institute, Kansas City, MO, February 1995.
11. *Summary Of Source Test Results, Poly Engineering, Richmond, CA*, Bay Area Air Quality Management District, San Francisco, CA, November 19, 1990.
12. *Emission Factor Documentation For AP-42 Section 13.2.6, Abrasive Blasting, Final Report*, Midwest Research Institute, Cary, NC, September 1997.