

## **Chapter 12. Abrasive Blasting**

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## 12.1 Emission Estimation Methodology

This section was adapted from Section 13.2.6 of EPA's Compilation of Air Pollutant Emission Factors (AP-42). Section 13.2.6 was last updated in September 1997.

Abrasive blasting is the use of abrasive material to clean and prepare metal or masonry surfaces prior to painting. Sand is the most widely used blasting abrasive.<sup>1</sup> Other abrasive materials include coal slag, smelter slag, cast iron grit, cast iron shot, steel shot, garnet, walnut shells, carbon dioxide pellets, as well as synthetic abrasives such as silicon carbide, aluminum oxide, and glass or plastic beads. The PM<sub>10</sub> and PM<sub>2.5</sub> emission factors listed in AP-42 for sand blasting of mild steel are 13 lb/1,000 lb abrasive and 1.3 lb/1,000 lb abrasive, respectively, giving a PM<sub>2.5</sub>/PM<sub>10</sub> ratio of 0.1. Using grit or shot instead of sand as the abrasive media reduces total PM emissions by 76% and 90%, respectively.

## 12.2 Demonstrated Control Techniques

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 typically used to control emissions from enclosed abrasive blasting operations with reported control efficiencies in excess of 95%.<sup>1</sup>

Muleski and Downing recently tested the use of a polyurethane sponge material impregnated with different abrasive materials and compared the particulate emissions from this new sponge media with that from traditional abrasive materials.<sup>2</sup> The pliable nature of the sponge material allows it to surround the point of abrasive impact, thus capturing airborne dust emissions. The most commonly sold sponge media is a product containing 30 grit aluminum oxide known as "Silver 30". Using recycled sponge media mixed with fresh abrasive material per the manufacturer's recommendations reduced TSP emissions by 94% and PM<sub>10</sub> emissions by 96% compared to traditionally used abrasives such as coal slag and silica sand. In other words, when used as recommended (i.e., recycled sponge media with fresh abrasive material added), the foam-based blasting media achieved a control level essentially identical to that of fabric filtration.

## 12.3 Regulatory Formats

Fugitive dust control options have been embedded in many regulations for state and local agencies in the WRAP region. As an example, Maricopa County's Rule 312 states that all abrasive blasting operations shall be performed in a confined enclosure, unless one of the following conditions are met, in which case unconfined blasting may be performed: (a) the item

to be blasted exceeds 8 ft. in any one dimension, or (b) the surface being blasted is fixed in a permanent location, cannot easily be moved into a confined enclosure, and the surface is not normally dismantled or moved prior to abrasive blasting.<sup>3</sup> Dry abrasive blasting in a confined enclosure with a forced air exhaust requires the use of either a certified abrasive (i.e., an abrasive certified by the California Air Resources Board), or venting to an emission control system (ECS) for which the operator must maintain an operation and maintenance plan. A list of abrasives currently certified by CARB as permissible for dry outdoor blasting can be obtained from Maricopa County's website ([maricopa.gov/aq/divisions/planning.aspx#rules](http://maricopa.gov/aq/divisions/planning.aspx#rules)). For unconfined blasting, at least one of the following control measures shall be used: wet abrasive blasting, vacuum blasting, or dry abrasive blasting, provided that all of the following conditions are met: performed only on a metal substrate, use of certified abrasive for dry unconfined blasting, blasting paint that has a lead content of less than 0.1 percent, abrasive blasting operation directed away from unpaved surfaces, and the certified abrasive may only be used once unless contaminants are separated from the abrasive after each use. No dry unconfined abrasive blasting operation shall be conducted when the 1-hour average wind speed is greater than 25 miles per hour.

Maricopa County Rule 312 states no owner or operator shall discharge into the atmosphere from any abrasive blasting operation any air contaminant for an observation period or periods aggregating more than three minutes in any sixty minute period an opacity conducted in accordance with EPA Reference Method 9 ("Visual Determination of the Opacity of Emissions from Stationary Sources," 40 CFR 60, Appendix A) equal to or greater than 20 percent. At the end of the work shift the owner or operator shall clean up spillage, carryout, and/or track out of any spent abrasive material with a potential to be transported during periods where the wind exceeds 25 mph.

The South Coast AQMD's Rule 1140 states that before blasting all abrasives used for dry unconfined blasting shall contain no more than 1% by weight material passing a No. 70 U.S. Standard sieve, and after blasting the abrasive shall not contain more than 1.8% by weight material five microns or smaller.<sup>4</sup> Rule 1140 states that visible emission evaluation of abrasive blasting operations shall be conducted in accordance with the following provisions:

1. Emissions shall be read in opacities and recorded in percentages.
2. The light source should be behind the observer during daylight hours.
3. The light source should be behind the emission during hours of darkness.
4. The observer position should be at approximately right angles to wind direction and at a distance no less than twice the height of the source but not more than a quarter mile from the base of the source.
5. Emissions from unconfined abrasive blasting shall be read at the densest point in the plume, which point shall be at least 25 feet from the source.
6. Where the presence of uncombined water is the only reason for failure to comply with opacity limits, the opacity limits shall not apply. The burden of proof in establishing that opacity limits shall not apply shall be upon the operator.
7. Emissions from unconfined abrasive blasting employing multiple nozzles shall be evaluated as a single source unless it can be demonstrated by the operator that each nozzle, evaluated separately, meets the requirements of this rule.

8. Emissions from confined abrasive blasting shall be read at the densest point after the air contaminant leaves the enclosure.

The website addresses for obtaining information on fugitive dust regulations for local air quality districts within California, for Clark County, NV, and for Maricopa County, AZ, are as follows:

- Districts within California: [www.arb.ca.gov/drdb/drdb.htm](http://www.arb.ca.gov/drdb/drdb.htm)
- San Joaquin Valley APCD, CA: [valleyair.org/SJV\\_main.asp](http://valleyair.org/SJV_main.asp)
- South Coast AQMD, CA: [aqmd.gov/rules](http://aqmd.gov/rules)
- Clark County, NV: [www.co.clark.nv.us/air\\_quality/regs.htm](http://www.co.clark.nv.us/air_quality/regs.htm)
- Maricopa County, AZ: [www.maricopa.gov/aq](http://www.maricopa.gov/aq)

## 12.4 Compliance Tools

Compliance tools assure that the regulatory requirements, including application of dust controls, are being followed. Three major categories of compliance tools are discussed below.

Record keeping: A compliance plan is typically specified in local air quality rules and mandates record keeping of source operation and compliance activities by the source owner/operator. The plan includes a description of how a source proposes to comply with all applicable requirements, log sheets for daily dust control, and schedules for compliance activities and submittal of progress reports to the air quality agency. The purpose of a compliance plan is to provide a consistent reasonable process for documenting air quality violations, notifying alleged violators, and initiating enforcement action to ensure that violations are addressed in a timely and appropriate manner.

Site inspection: This activity includes (1) review of compliance records, (2) proximate inspections (sampling and analysis of source material), and (3) general observations. An inspector can use photography to document compliance with an air quality regulation.

On-site monitoring: EPA has stated that “An enforceable regulation must also contain test procedures in order to determine whether sources are in compliance.” Monitoring can include observation of visible plume opacity, surface testing for crust strength and moisture content, and other means for assuring that specified controls are in place.

Maricopa County Rule 312 states that as a minimum each owner or operator subject to this rule shall keep the following records onsite for at least 5 years at permitted Title V sources and for at least 2 years at Non-Title V sources: (a) the type and amount of solid abrasive material consumed on a monthly basis, including the name of the certified abrasive used, as applicable; and (b) Material Safety Data Sheets (MSDS) or results of any lead testing that was performed on paint that is to be removed via unconfined blasting, as applicable. In addition if blasting operations occur daily or are a part of a facility’s primary work activity, then records shall be kept of the blasting equipment including a description of the type of blasting (e.g., confined, unconfined, sand, wet, etc.), the location of the blasting equipment or specify if the equipment is portable, a description of the emission control system (ECS) associated with the blasting operations, the days of the week blasting occurs, and the normal hours of operation. If blasting

operations occur periodically, then records shall be kept of the dates the blasting occurs, the blasting equipment that is operating including a description of the type of blasting, and a description of the ECS associated with the blasting operations.

## 12.5 Sample Cost-Effectiveness Calculation

This section is intended to demonstrate how to select a cost-effective control measure for abrasive blasting operations. A sample cost-effectiveness calculation is presented below for a specific control measure (fabric filtration used to capture particulates from sand blasting of mild steel) to illustrate the procedure. The sample calculation includes the entire series of steps for estimating uncontrolled emissions (with correction parameters and source extent), controlled emissions, emission reductions, control costs, and control cost-effectiveness values for PM10 and PM2.5. In selecting the most advantageous control measure for abrasive blasting, the same procedure is used to evaluate each candidate control measure (utilizing the control measure specific control efficiency and cost data), and the control measure with the most favorable cost-effectiveness and feasibility characteristics is identified.

### Sample Calculation for Sand Blasting of Mild Steel

Step 1. Determine source activity and control application parameters.

Silica sand abrasive use (tons/year)	10
Control Measure	Fabric Filter
Control application/frequency	Continuous
Economic Life of Control System (yr)	10
Control Efficiency (Reference)	95% (AP-42)

The amount of abrasive material used on a yearly basis and the economic life of the control system are assumed values for illustrative purposes. A fabric filter filtration system has been chosen as the control measure for reducing fugitive dust emissions from abrasive blasting of mild steel.

Step 2. Obtain Uncontrolled PM Emission Factors. The uncontrolled PM10 and PM2.5 emission factors for sand blasting of mild steel published in AP-42 are 26 lb/ton of abrasive and 2.6 lb/ton of abrasive.

Step 3. Calculate Uncontrolled PM Emissions. The annual uncontrolled PM emissions are calculated by multiplying the PM emission factors by the amount of abrasive material used per year divided by 2,000 lb/ton to produce emission estimates in tons per year, as follows:

$$\begin{aligned} \text{Annual PM10 Emissions} &= (26 \text{ lb/ton} \times 10 \text{ tons/year}) / 2,000 \text{ lb/ton} = 0.13 \text{ tons} \\ \text{Annual PM2.5 Emissions} &= (2.6 \text{ lb/ton} \times 10 \text{ tons/year}) / 2,000 \text{ lb/ton} = 0.013 \text{ tons} \end{aligned}$$

Step 4. Calculate Controlled PM Emissions. The controlled PM emissions (i.e., the PM emissions remaining after control) are equal to the uncontrolled emissions (calculated above in Step 3) multiplied by the percentage that uncontrolled emissions are reduced, as follows:

$$\text{Controlled emissions} = \text{Uncontrolled emissions} \times (1 - \text{Control Efficiency}).$$

For this example, fabric filters with a control efficiency of 95% has been selected as the control measure. Thus, the annual controlled PM10 and PM2.5 emissions estimates are calculated to be:

Annual Controlled PM10 emissions = (0.13 tons) x (1 – 0.95) = 0.0065 tons  
 Annual Controlled PM2.5 emissions = (0.013 tons) x (1 – 0.95) = 0.00065 tons

Step 5. Determine Annual Cost to Control PM Emissions.

Capital costs (\$)	10,000
Annual operating and maintenance costs (\$)	1,000
Annual Interest Rate	3%
Capital Recovery Factor	0.12
Annualized Cost (\$/yr)	2,200

The capital costs, annual operating and maintenance costs, and annual interest rate (AIR) are assumed values for illustrative purposes. The Capital Recovery Factor (CRF) is calculated from the Annual Interest Rate (AIR) and the Economic Life of the control system, as follows:

$$CRF = AIR \times (1 + AIR)^{\text{Economic life}} / ((1 + AIR)^{\text{Economic life}} - 1)$$

$$CRF = 3\% \times (1 + 3\%)^{10} / ((1 + 3\%)^{10} - 1) = 0.1172$$

The Annualized Cost is calculated by adding the product of the Capital Recovery Factor (CRF) multiplied by the Capital costs to the sum of the operating and maintenance costs, as follows:

$$\text{Annualized Cost} = (CRF \times \text{Capital costs}) + \text{Operating and Maintenance costs}$$

$$\text{Annualized Cost} = (0.1172 \times \$10,000) + \$1,000 = \$2,172$$

Step 6. Calculate Cost-effectiveness. Cost-effectiveness is calculated by dividing the annualized cost by the emissions reduction. The emissions reduction is determined by subtracting the controlled emissions from the uncontrolled emissions:

$$\text{Cost-effectiveness} = \text{Annualized Cost} / (\text{Uncontrolled emissions} - \text{Controlled emissions})$$

$$\text{Cost-effectiveness for PM10 emissions} = \$2,172 / (0.13 - 0.0065) = \$17,590/\text{ton}$$

$$\text{Cost-effectiveness for PM2.5 emissions} = \$2,172 / (0.013 - 0.00065) = \$175,895/\text{ton}$$

## 12.6 References

1. USEPA, 1997. *Abrasives Blasting*, Section 13.2.6 of Compilation of Air Pollutant Emission Factors, September.
2. Muleski, G. E., and Downing, J., 2006. *Control of Abrasive Blasting Emissions through Improved Materials*, paper presented at the EPA 15<sup>th</sup> International Emission Inventory Conference, New Orleans, LA, May 16-18.
3. Maricopa County, 2003. *Rule 312 - Abrasive Blasting*, July 2.
4. South Coast AQMD, 1985. *Rule 1140 – Abrasive Blasting*, August 2.