

QUARRY OPERATIONS

Date Initiated:

May 10, 1994

Dates Modified / Updated:

September 1, 1998

December 2023

PROCESS DESCRIPTION:

Active quarry operations use a variety of equipment and techniques to dislodge, secure, and transport large quantities of rock and soil. Quarry locations vary from soft, wet, river bed, sand deposits to hard rock, drill and shoot, granite cliff faces. Quarry operations in San Diego County typically involve heavy duty earth moving equipment consisting of front end loaders, bulldozers, scrapers, and transport vehicles. Many sites blast the rock deposits regularly and include large open material storage areas for processed material. Quarries may or may not be located next to rock and sand processing plants. Substantial haul road distances and traffic is not uncommon.

Particulate matter released from these quarry activities is most accurately quantified using generic District developed emission factors for the mineral products industry. The EPA AP-42 document does not specifically evaluate rock and sand quarry operations at this time. The District quarry emission factors include dust generated from excavation, quarry vehicles, bulldozing, and loading of transport trucks. The District factors do not include drilling, blasting, haul road traffic, open storage areas, or material processing (i.e.: transfer points, screens, crushers, etc.). Default concentrations for trace metals in the quarry dust are typical of the values observed in test results obtained from mineral product facilities throughout San Diego County. The following methods are used by the District to estimate emissions from quarry operations.

$$Ea = Ua \times EF \times Ci$$

$$Eh = Ud \times EF \times Ci / H$$

Where:

Ea = Annual emissions of each contaminant, (lbs/year)

Eh = Maximum hourly emissions of each contaminant, (lbs/hour)

Ua = Annual amount of material quarried, (tons/year)

Ud = Maximum daily amount of material quarried, (tons/day)

H = Hours of operation, (hours/day)

EF = Particulate emission factor for quarry operations, (lbs/ton)

= 0.05 lbs TSP/ton

= 0.021 lbs PM10/ton

Ci = Concentration of each listed toxic substance in process dust, (lbs/lb)

The following default values are used to speciate quarry dust emissions in San Diego County where site specific information is not available.

DEFAULT VALUES - TRACE METAL CONCENTRATIONS

Trace Metals	Range Detected in SD County (ppmw)	Default Values
Arsenic	1 to 50	20
Beryllium	0.5 to 2	1
Cadmium	1 to 1.5	1
Chromium (total)	5 to 60	50
Chromium (hexavalent)	0.01 to 0.5	0.5
Copper	20 to 650	100
Lead	5 to 120	50
Manganese	200 to 1200	500
Mercury	0 to 10	5
Nickel	3 to 25	20
Selenium	3 to 5	5
Silica (crystalline)	10% to 75%	10%
Zinc	30 to 300	200
Asbestos	Not Detected	0

EMISSIONS INFORMATION:

The general overall quarry emission factors (0.05 lbs TSP / ton quarried and 0.021 lbs PM10 / ton quarried) were developed by District Mechanical Engineering staff (Andy

Segal) and have been used for local permit evaluations and emission inventories for 10+ years. These values include emission reductions associated with the natural moisture in the quarried material. Alternative AP-42 procedures involve the calculation of each of the following quarry processes and are highly dependent upon individual site information as well as activity levels;

Potential Quarry Processes	Typical Emission Factor (PM10)
Quarry haul road traffic - AP-42, (13.2.2, 1/95)	1.5 lbs / vehicle mile traveled
General land clearing - AP-42, (Table 11.9-2, 1/95)	0.004 lbs / yd ³
Topsoil removal by scrapper - AP-42, (Table 11.9-4, 1/95)	0.035 lbs/ton
Bulldozing - AP-42, (Table 11.9-2, 1/95)	5.837 lbs/ton
Truck loading by batch drop - AP-42, (Table 11.9-4, 1/95)	0.022 lbs/ton
Storage pile aggregate delivery - AP-42, (13.2.4, 1/95)	0.001 lbs/ton
Wind Erosion - AP-42, (13.2.5, 1/95)	Depends on site specific conditions
Grading - AP-42, (Tables 11.9-1 & 11.9-2, 1/95)	0.8 lbs / vehicle mile traveled

In some cases, site specific conditions may warrant the application of additional emission control efficiencies. A consensus between the District and the local Mineral Products Industry regarding the proper application of the alternative AP-42 procedures to San Diego County facilities has not yet been achieved. The general factor should be used until more detailed procedures are developed.

The Office of Environmental Health Hazard Assessment (OEHHA) has adopted a chronic reference exposure level (REL) for respirable crystalline silica, cristobalite (CAS 14464-46-1) and quartz (CAS 14808-60-7). The REL is based on the PM₄ fraction of crystalline silica which is expected to have associated health risks. The District has chosen to implement a health protective value of 7.95% default PM₄ to PM₁₀ ratio from published data¹ in order to more accurately estimate the health risks associated with respirable crystalline silica. If available, the District recommends using District approved site-specific data to refine the PM₄ to PM₁₀ ratio.

The District's current default crystalline silica emission factor is based on local test results, which is 10% of the PM₁₀ default emission factor. The PM₄ to PM₁₀ ratio can be accurately applied to the crystalline silica default emission factor since the test results were sized to $10\ \mu\text{m}$ which was used to represent the average composition of PM₁₀. Both crystalline silica as PM₁₀ and respirable crystalline silica as PM₄ should be estimated.

2

¹ Richards, J. R., Brozell, T., Rea, C. E., Boraston, G., & Hayden, J. (2009). PM₄ Crystalline Silica Emission Factors and Ambient Concentrations at Aggregate-Producing Sources in California. *Journal of the Air & Waste Management Association*, 59(11), 1287–1295. <https://doi.org/10.3155/1047-3289.59.11.128>

ASSUMPTIONS / LIMITATIONS:

- Site specific test trace metal concentrations may be used instead of default values as appropriate.
- Particulate emission factors for wet quarry operations (river beds) are usually assumed to be negligible unless haul road and stock pile activities indicate otherwise.
- Drilling, blasting, and open storage pile emissions are currently estimated separately from quarry emissions.
- The general District quarry factors are intended to include emissions from all land clearing, quarry vehicle traffic (except pit trucks), material excavation, material drops, quarry stock pile activity, wind erosion, bulldozing, and grading. These factors are also intended to include emission reductions associated with the natural moisture content of typical quarried material.
- Quarry sizes, haul road lengths, and equipment should be verified for each inventory year since operations can substantially change over the active lifetime of a given mineral deposit / site.