

DETERMINATION OF AIRBORNE CRYSTALLINE SILICA (QUARTZ) EXPOSURE
at
Oceano Dunes State Vehicular Recreation Area
San Luis Obispo County, California

Date: December 14, 2017

Report to: **Mat Fuzie, Deputy Director**
Off Highway Motor Vehicle Recreation Division
California Department of Parks and Recreation
1725 23rd Street, Suite 200
Sacramento, CA 95816

Prepared by: **John W. Kelse, Industrial Hygienist**
152 Pulaski Highway
Ansonia, CT 06401

Overview: On November 15, 2017, personal air samplers were deployed within the off-highway vehicle (OHV) riding area of Oceano Dunes State Vehicular Recreation Area (SVRA). Oceano Dunes SVRA is a state park located in south San Luis Obispo County, California and managed by the Off Highway Motor Vehicle Recreation Division (OHMVR Division) of the California Department of Parks and Recreation (DPR).

The air samplers were affixed in the breathing zones of a maintenance worker deployed to the OHV riding area of the SVRA for approximately six hours to construct and repair fences, and to a person simulating an OHV recreationist who traversed the dunes for approximately seven hours in an open-air recreational off-highway vehicle (ROV). Additionally, a respirable dust air sampler and a total dust air sampler were affixed to the S1 meteorological tower (located in the west-central portion of the OHV riding area) at approximate adult-breathing-zone height for approximately seven hours to represent ambient conditions concurrent with the other air sampling.

The air samplers were deployed by Will Harris, a geologist with the California Geological Survey. Mr. Harris has witnessed the proper deployment of air samplers on previous investigations by this author, and in this investigation, he worked as competent surrogate in the placement and operation of the provided air samplers.

Sampling was undertaken to determine total (all size) dust, respirable particulate (particulate 10 microns or smaller in size), and respirable crystalline silica or quartz – the most common form of crystalline silica. Sampling occurred on a dry day with generally light wind conditions (see appended sampling recording sheet). The sampling undertaken in this study was limited and considered exploratory in nature.

Results: Analytical results (attached) indicate none of the samples obtained by this investigation exceeded the current occupational health standard for total dust, respirable dust or quartz. Crystalline silica (quartz) results were below the detection limit for the analytical technique applied and volume of air filtered for each sample (see appended data sheet).

Discussion: Given the respiratory risks associated with crystalline silica exposure, the amount of respirable crystalline silica that may be within dust generated in a beach and dune environment is of understandable interest. A significant portion of beach and dune sands typically includes grains of or grains containing crystalline silica (quartz). Respirable crystalline silica particulate, however, is typically 100 times or more finer than crystalline and amorphous silica particulate found in ordinary beach sand and therefore not generally viewed as a concern. Expanded discussion on the general risk of respirable crystalline silica, particle size and occupational versus general environmental exposures can be found in numerous references (<https://www.osha.gov/dsg/topics/silicacrystalline/>; <https://www.cancer.gov/about-cancer/causes-prevention/risk/substances/crystalline-silica>; <https://www.federalregister.gov/documents/2016/03/25/2016-04800/occupational-exposure-to-respirable-crystalline-silica>, etc.).

One minor anomaly was noted in the reviewed results. The total dust level (in weight) was slightly greater than the total respirable particle fraction in weight for the fixed sample. This would not be expected since respirable dust is a portion of the total dust and quartz, in turn, is a portion of this respirable fraction. However, this disparity is slight given the low dust levels collected and is sometimes seen due to the positioning of total dust cassette filter (inlet facing down or up too much, etc.). Importantly, the crystalline silica (quartz) content in the ambient respirable sample (Number 51894, collected on a different filter cassette at a different orientation) was below detection limit for the analysis despite the higher respirable level. That result is consistent with the personal crystalline silica (quartz) results and is another indicator of the importance of particle size with respect to crystalline silica in beach sand.

The United States Occupation Safety and Health Administration (OSHA) standard, known as the permissible exposure limit (PEL), for respirable crystalline silica dust in an industrial setting is a concentration of 50 micrograms per cubic meter of air averaged over an 8-hour work day. The PEL for respirable crystalline silica focuses on exposures that involve the mechanical breakdown of the crystalline particulate to respirable size (10 microns or smaller). Such exposures are typically found in workplace settings involving grinding, abrasive blasting, sanding, drilling concrete, etc. Similar crystalline silica particle breakdown to respirable size in the natural environment rarely, if ever, occurs. For this reason sampling during higher wind days is unlikely to show a significant increase in respirable crystalline silica levels even though overall airborne dust levels would be higher.

Further, the frequency and duration of exposure to crystalline silica (quartz) **must** always be considered when assessing risk potential. As mentioned, the OSHA PEL for respirable crystalline silica is based on exposure for an 8-hour workday, performed five days per week for 40 years. This standard is believed to be adequately protective for pneumoconiosis (silicosis in this instance) and cancer of the lung in an industrial workplace setting. It is an extremely conservative number (overly protective) if it is used for evaluation purposes to assess associated risk in a natural environment setting such as a beach and associated sand dunes.

Conclusion: The crystalline silica (quartz) analytical results for the air filter samples collected in the OHV riding area of Oceano Dunes SVRA on November 15, 2017 were below the detection limit for the analytical technique applied and volume of air filtered, and as such provided no evidence of a realistic pulmonary (inhalation) risk with respect to respirable crystalline silica. The desirability of

additional, more expansive air sampling should include consideration of the above discussion regarding crystalline silica particle sizes differences in industrial versus natural environments.

A request was made by DPR to review and comment upon prior respirable crystalline silica analysis for air filter samples collected by others at the CDF site, an air quality monitoring station managed by the San Luis Obispo County Air Pollution Control District that is inland from the Oceano Dunes SVRA. That review document is appended to this report.

Attachments: Results Report to John Kelse from the Hartford Risk Engineering Laboratory, December 8, 2017, Sampling Data Recording Sheet, November 15, 2017, Dust Sampling Data Sheet and Calibration of Pumps Record.

Comments Concerning Crystalline Silica Monitoring Analytical Results Obtained from Air Sampling at the CDF Station, 2391 Willow Road, Arroyo Grande, California, in April/May/June of 2017, John Kelse, December 14, 2017.

DUST SAMPLING DATA SHEET:

Sampling Date: November 15, 2017
 Sample Location: Oceano Dunes SVRA, San Luis Obispo County, California
 LAB REF# 33097: The Hartford – Risk Engineering Laboratory
 AIHA-LAP, LLC Accredited Laboratory #100124

Analysis: Total dust by gravimetric (NIOSH Method 0600M)
 Quartz (free silica) by XRD (NIOSH Method 7500)

OSHA Workplace Regulatory Standards Applied:

Total Dust (includes inhalable): 10 milligram/meter³ 8 hr. Time-Weighted Average (TWA)
 Respirable Dust: 3 milligram/meter³ 8 hr. TWA
 Quartz (free silica): 0.05 milligram/meter³ 8 hr. TWA (Respirable fraction).

Sample #	Sample Time	Liter Vol.	Location	Contaminant	mg/m ³ Found 8 Hr equiv.
51621	6 hr 12 min.	635	Per. Marko Morales, Maint. of fences and dunes	Respirable Dust Quartz	<0.039 <0.016
51864	7 hr 1 min.	703	Per. Will Harris, General area, dunes/rec. area	Respirable Dust Quartz	<0.036 <0.015
51899	7 hr 2 min.	846	Fixed Sampling at S1 Tower	Total Dust	0.14
51894	7 hr 2 min.	713	Fixed Sampling at S1 Tower	Respirable Dust Quartz	1.1 <0.015

THE HARTFORD - RISK ENGINEERING LABORATORY
ONE HARTFORD PLAZA
HARTFORD, CT 06155
TOLL FREE 1-800-986-3509



AIHA-LAP, LLC ACCREDITED LABORATORY #100124

DATE COLLECTED :
 DATE RECEIVED : 12/01/2017
 REPORT DATE : 12/8/17

RESULTS REPORT :
 JOHN KELSE
 RT VANDERBILT COMPANY
 30 WINFIELD STREET
 NORWALK, CT 06855

LABORATORY NUMBER: 33097
 ACCOUNT: RT VANDERBILT CO.
 ACCOUNT ADDRESS: NORWALK, CT

LABORATORY NUMBER: 33097

FIELD ID	VOL (LITERS)	TIME (MINS)	ANALYTE	MG	MG/M3	PPM	MRL (MG)	REFERENCED METHOD:	ANALYSIS DATE
AA71781 51621	635		RESPIRABLE DUST QUARTZ	< 0.025 < 0.010	< 0.039 < 0.016		0.025 0.010	GRAV/NIOSH 0600M XRD/NIOSH 7500 M	12/4/17 12/8/17
AA71782 51864	703		RESPIRABLE DUST QUARTZ	< 0.025 < 0.010	< 0.036 < 0.015		0.025 0.010	GRAV/NIOSH 0600M XRD/NIOSH 7500 M	12/4/17 12/8/17
AA71783 51899	846		TOTAL DUST	0.12	0.14		0.025	GRAV/NIOSH 0500M	12/4/17
AA71784 51894	713		RESPIRABLE DUST QUARTZ	0.80 < 0.010	1.1 < 0.015		0.025 0.010	GRAV/NIOSH 0600M XRD/NIOSH 7500 M	12/4/17 12/8/17
AA71785 CONTROL 52402	0		RESPIRABLE DUST QUARTZ	< 0.025 < 0.010	--- ---		0.025 0.010	GRAV/NIOSH 0600M XRD/NIOSH 7500 M	12/4/17 12/8/17

NOTE: The concentration values (e.g. MG/M3, PPM) were calculated at the laboratory using data and information (times and/or flow rates) supplied to the laboratory by the submittor.
 NOTE: If applicable, organic sampling tubes are analyzed separately. "<" means not measured at the method reporting limit (the amount of this material that can reliably be reported based on analytical conditions).
 NOTE: Sample results have not been corrected for the amount of contamination found on the field blank sample, unless otherwise noted.
 NOTE: Reported values have been rounded. However, calculations were performed using intermediate unrounded results.
 NOTE: The reported results relate only to the items tested. Unless otherwise noted, all samples were received at the laboratory in satisfactory condition.
 ABBREVIATIONS: MG = Milligrams MG/M3 = Milligrams per Cubic Meter of Air PPM = Parts Per Million MRL = Method Reporting Limit Referenced Method "M" = Modified

Laboratory Analysts :
 D. White
 A. Neiman
 R. Ross
 A. van der Swaagh
 R. Cona
 L. Schoepflein




 ROBERT ROSS
 LABORATORY TECHNICAL MANAGER

Nov. 15, 2017

SAMPLING DATA RECORDING SHEET:

Filter #	Pump #	TIME ON	TIME OFF	TYPE OF SAMPLE (PERSONAL OR FIXED) NAME & ACTIVITY
51621 (Respirator)	12 (cal. 1.704)	08:27	14:15	Personal: Marco Morales, Maintenance of Fences in Dunes
51894 (Respirator)	5 (cal. 1.709)	09:21	016:23	Ambient cyclone @ S1 Tower
51904 (Respirator)	10 (cal. 1.701)	09:27	16:28	Personal: Will Harris, Throughout Dunes, recreation Sim.
51999 (Total dust)	4 (cal. 2.01)	09:21	16:23	Ambient no cyclone @ S1 Tower

Control Filter # 52402

Date of Survey: Nov. 15, 2017

Available Info on conditions: (temps, wind aspects, rain, etc.)

7:30 AM Partly cloudy, light wind, 51°F

9:20 AM Partly cloudy, light west wind

10:30 Modest Breeze W. NW 68°F

4:20 PM 62°F light to modest

wind from west.

Mostly cloudy

Describe dust exposure - what the mineral composition of this exposure is likely to be - particularly for possible interferences.

Coastal Dune environment. Coastal material

CALIBRATION RECORD:

<u>Pump #</u>	<u>Filter #</u>	<u>Start L/ min.</u>	<u>End L/min.</u>	<u>L/min Difference</u>	<u>Final L/min.</u>	<u>Min. Time Sampled</u>	<u>LITER VOLUME</u>
12	51621	1.704	1.710	+ .006	1.707	372	635
10	51864	1.701	1.63	- .071	1.67	421	703
4	51899	2.01	2.00	- .01	2.005	422	846
5	51894	1.708	1.680	- .018	1.69	422	713

Comments Concerning Crystalline Silica Monitoring Analytical Results Obtained from Air Sampling at the CDF Station, 2391 Willow Road, Arroyo Grande, California, in April/May/June of 2017

BY: John W. Kelse , Industrial Hygienist

Date: December 14, 2017

At the request of the California Department of Parks and Recreation (DPR), I have reviewed airborne crystalline silica sampling results obtained from air filter samples collected at 2391 Willow Road, Arroyo Grande, California. This address is the location of an air quality monitoring station, known as the CDF Station, managed by the San Luis Obispo County Air Pollution Control District (SLOAPCD). The CDF location is approximately 2.5 miles from the ocean shoreline and about one mile from the eastern boundary of the Oceano Dunes State Vehicular Recreation Area (SVRA), a state park managed by the DPR. The reviewed analytical reports, from Forensic Analytical Laboratories of Hayward, California, are attached to this document.

It is presumed the samples were collected and analyzed as part of an environmental monitoring program undertaken by the SLOAPCD. According to data presented on the analytical reports, a total of four air filter samples were collected and analyzed. The samples were collected on April 25 and 27, 2017, May 12, 2017, and June 12, 2017. Samples were analyzed using National Institute for Occupational Safety and Health (NIOSH) Method 7603 (with infrared, or IR, analysis) and NIOSH Method 500/600 Modified. It is assumed, since the methods employed require respirable fraction analysis, that the crystalline silica (quartz) sample content represents respirable crystalline silica (particulate that is 10 microns or smaller in aerodynamic size) with collection times spanning 6 to 8 hours.

Analytical Method: With respect to the analytical method applied, it is my understanding that IR analysis is a reliable analytical methodology (originally developed for detecting crystalline silica in coal dust) with reasonable inter-laboratory consistency when the principle interference (amorphous silica) is predictably removed or minimized. An alternative analysis, NIOSH Method 7500 (using x-ray diffraction or XRD), however, is a more widely applied analytical approach in occupational-crystalline-silica-exposure settings as it is less subject to silica polymorph interferences as a result of the phosphoric acid treatment applied with this method. Good inter-laboratory agreement exists with this method as well. In general, I am aware that XRD analysis (using NIOSH Method 7500) has become the most preferred analytical approach over the last 10 years or so and the one most applied when comparing to crystalline silica airborne exposure to workplace exposure limit standards.

Results: The analytical results show that crystalline silica concentrations, if present at all, generally fall at or below the detection limit of the analytical method used (Three of the four sample results reported at the 10 microgram detection limit of the analysis; one sample reported at 20 micrograms). More recent XRD analysis per NIOSH Method 7500 of air filter samples collected within the sand dunes of Oceano Dunes SVRA has shown similar below-detection limit-crystalline silica (quartz polymorph) results. Such consistent trace- or zero-detected levels strongly suggest the absence of a warranted crystalline silica risk in the coastal setting where the samples were collected.

It has been pointed out that while beach sand typically contains crystalline silica, the particle size is 100 or more times greater than the respirable size that is linked to human risk

(https://www.osha.gov/silica/Silica_FAQs_2016-3-22.pdf;
<https://www.cdc.gov/niosh/pdfs/silicax.pdf>).

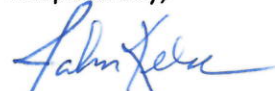
In my own professional experience, where for more than 50 years I have sampled for airborne crystalline silica particles in industrial settings, I've often been surprised at how little respirable quartz is recorded in mineral dust environments with high crystalline silica content (some upwards of 50%). I find this linked to how much energy it apparently takes to produce very fine quartz particulate.

In the reviewed analytical results, it's interesting that crystalline silica polymorphs (quartz, cristobalite and tridymite) are addressed separately. Generally, quartz is by far the most common form of crystalline silica encountered. I have rarely encountered cristobalite (typically linked to volcanic deposits in origin) and never tridymite. Nonetheless, it is beneficial to examine this breakdown, particularly in a new setting, so it is appreciated that the analysis has been performed. In the crystalline silica analytical method most commonly used (NIOSH Method 7500), the total silica content is reported, which includes polymorph content.

Standards: When reporting crystalline silica airborne particulate levels it is of obvious interest to compare these levels to some standard for "meaning." The current United States Occupational Safety and Health Administration (OSHA) permissible exposure limit (PEL) for respirable crystalline silica dust is 50 micrograms per cubic meter of air (0.05 milligrams per cubic meter of air) over an 8 hour workday, 5 days per week for 40 years. Some health researchers feel this limit is overly restrictive and argue that there is no evidence that compliance to the previous OSHA PEL (100 micrograms per cubic meter of air) was inadequately protective. These arguments are laid out in the OSHA rulemaking record (<https://www.federalregister.gov/documents/2016/03/25/2016-04800/occupational-exposure-to-respirable-crystalline-silica>).

Conclusion: Whether one puts faith in the reliability of the current occupational health standard for crystalline silica or not, my review of the presented analytical results render these questions essentially mute in my opinion. The analytical reports of the air filter samples collected at the CDF air monitoring station in April, May, and June 2017 offer no evidence of a realistic pulmonary (inhalation) risk with respect to crystalline silica.

Respectfully,



John Kelse

Attachments: Forensic Analytical Laboratories, Final Report to County Air Pollution Control District Project Manager, Report Number M184679, May 17, 2017.

Forensic Analytical Laboratories, Final Report to County Air Pollution Control Dist., Report Number M184678, June 30, 2017.

Crystalline Silica in Air with Gravimetry by Fourier Transform Infrared (FTIR) Spectroscopy

NIOSH Method 7603 / NIOSH Method 500/600 Modified

County Air Pollution Control Dist.
Project Manager
San Luis Obispo
3433 Roberto Ct.
San Luis Obispo, CA 93401

Client ID: 7240
Report Number: M184679
Date Received: 05/11/17
Date Analyzed: 05/17/17
Date Printed: 05/17/17
First Reported: 05/17/17

Job ID / Site: PO #51208 - CDF, 2391 Willow Rd, Arroyo Grande, CA
Date(s) Collected: 4/25/17 & 4/27/17

FALI Job ID: 7240
Total Samples Submitted: 2
Total Samples Analyzed: 2

Sample Number	Lab Number	Volume	Analyte	Result	Result Units	Reporting Limit*
PO111	30767521	990 L	Quartz	0.020	mg/m3	0.010
			Cristobalite	< 0.010	mg/m3	0.010
			Tridymite	< 0.010	mg/m3	0.010
			Total Silica	0.02	mg/m3	0.010
			Dust	< 0.2	mg/m3	0.2
PO108	30767522	990 L	Quartz	0.010	mg/m3	0.010
			Cristobalite	< 0.010	mg/m3	0.010
			Tridymite	< 0.010	mg/m3	0.010
			Total Silica	0.01	mg/m3	0.010
			Dust	< 0.2	mg/m3	0.2

* The reporting limit represents the lowest amount of analyte that the laboratory can confidently detect in the sample, and is not a regulatory level. The units for the reporting limit are the same as the units for the final results.



Lawrence E. Wayne, Applied Microscopy Supervisor, Hayward Laboratory

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Crystalline Silica in Air with Gravimetry

by Fourier Transform Infrared (FTIR) Spectroscopy

NIOSH Method 7603 / NIOSH Method 500/600 Modified

County Air Pollution Control Dist.
Karl Tupper
San Luis Obispo
3433 Roberto Ct.
San Luis Obispo, CA 93401

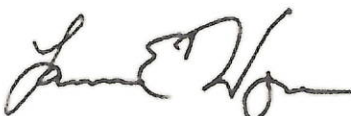
Client ID: 7240
Report Number: M186478
Date Received: 06/23/17
Date Analyzed: 06/30/17
Date Printed: 06/30/17
First Reported: 06/30/17

Job ID / Site: PO #51208, CDF, 2391 Willow Rd., Arroyo Grande
Date(s) Collected: 05/12/17 & 06/12/17

FALI Job ID: 7240
Total Samples Submitted: 2
Total Samples Analyzed: 2

Sample Number	Lab Number	Volume	Analyte	Result	Result Units	Reporting Limit*
PO109	30771942	1,224 L	Quartz	< 0.008	mg/m3	0.008
			Cristobalite	< 0.008	mg/m3	0.008
			Tridymite	< 0.008	mg/m3	0.008
			Total Silica	< 0.008	mg/m3	0.008
			Dust	< 0.05	mg/m3	0.05
PO129	30771943	1,004 L	Quartz	0.010	mg/m3	0.010
			Cristobalite	< 0.010	mg/m3	0.010
			Tridymite	< 0.010	mg/m3	0.010
			Total Silica	0.01	mg/m3	0.010
			Dust	< 0.05	mg/m3	0.05

* The reporting limit represents the lowest amount of analyte that the laboratory can confidently detect in the sample, and is not a regulatory level. The units for the reporting limit are the same as the units for the final results.



Lawrence E. Wayne, Applied Microscopy Supervisor, Hayward Laboratory

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