IN-DEPTH STUDY REPORT:

CONTROL TECHNOLOGY FOR CRYSTALLINE SILICA EXPOSURES IN CONSTRUCTION: WET ABRASIVE BLASTING

at

The Nokia Building Construction Site
Irving, Texas

REPORT WRITTEN BY:
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U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES
Public Health Service
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National Institute for Occupational Safety and Health
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PLANT STUDY SITE: Nokia Construction Site in Los Colinas

On the corner of Texas

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PLANT STUDY SITE:	**Nokia Construction Site in Los Colinas** **On the corner of Texas** **State Routes 114 and 161** **6000 Connection Drive** **Irving, Texas 75039**
BUSINESS OFFICE OF CONTRACTOR:	**Brock Andreola** **Andreola Restorations Company** **3606 Dividend Drive** **Garland, Texas 75042** **972-487-1919**
Abrasive Blasting Equipment Support:	**Judd Addcock** **Jody Addcock** **Keizer Technologies Americans Inc.** **10908 S Pipeline Road** **Euless, Texas 76040**
SIC CODE:	**1771**
STUDY DATES:	**March 30 - April 1, 1999** **April 13-16, 1999**
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ABSTRACT

Worker exposure to respirable crystalline silica was monitored during a wet abrasive blasting on the exterior walls of a parking garage. The abrasive blasting was done to remove 1/8- to 1/4-inch of concrete in order to expose the underlying aggregate. The abrasive was wet sand that contained 80 percent dry sand and 20 percent water. The geometric mean respirable quartz concentration was 0.2 mg/m^3 for workers conducting abrasive blasting and 0.06 mg/m^3 for helpers. When the workers were performing abrasive blasting in areas which apparently had reduced natural ventilation, dust exposures appeared to increase.

INTRODUCTION

The National Institute for Occupational Safety and Health (NIOSH), a federal agency located within the Centers for Disease Control and Prevention (CDC), under the Department of Health and Human Services, was established by the Occupational Safety and Health Act of 1970. This legislation mandated NIOSH to conduct research and education programs separate from the standard setting and enforcement functions conducted by the Occupational Safety and Health Administration (OSHA) in the Department of Labor. An important area of NIOSH research deals with methods for controlling occupational exposure to potential biological, chemical, and physical hazards.

The Engineering Control Technology Branch (ECTB) of the Division of Physical Sciences and Engineering (DPSE) has been given the lead within NIOSH to study the engineering aspects relevant to the control of hazards in the workplace. Since 1976, the ECTB has assessed control technology found within selected industries or used for common industrial processes. The ECTB has also designed new control systems where current industry control technology was insufficient. The objective of these studies has been to document and evaluate effective control techniques (e.g., isolation or the use of local ventilation) that minimize risk of potential health hazards and to create an awareness of the usefulness and availability of effective hazard control measures.

The survey at this site was conducted as part of a larger effort to evaluate the technical feasibility of controlling worker exposure to respirable crystalline silica. In addition, NIOSH's ECTB has been interested in evaluating new technologies which reduce worker exposure to hazardous air contaminants such as respirable crystalline silica. Abrasive blasting with a wet slurry is interesting because it may reduce dust exposures during abrasive blasting.

Abrasive blasting can generate much dust exposure and much exposure to respirable crystalline silica. Respirable dust concentrations as high as 55 mg/m^3 are reported for abrasive blasting of a ship hull.[1] Sandblasting with sand in the open can cause excessive exposures to respirable crystalline silica. The worker's respirable dust exposures in a steel fabrication yard were reported to average 37 mg/m^3 with a mean silica content of 84 percent.[2] In a steel fabrication yard, respirable crystalline silica concentrations have exceeded 0.1 mg/m^3 as much as 200 feet down wind of an abrasive blasting operation.[3] For the abrasive blasting of steel structures and bridges located outside, respirable crystalline silica concentrations of 200 $\mu g/m^3$ were reported inside a positive pressure supplied air blasting hood.[4-5]

Premature death from silicosis still occurs. In 1998, the deaths of two sandblasters from silicosis were reported.[6] In one case, a worker was diagnosed with progressive massive fibrosis after three years of experience as an abrasive blaster. He died of respiratory failure 11 years after his initial exposure. This worker was only 36 years old. In another case, a worker died of respiratory failure from silicosis at age 30. He worked as sandblaster from 1986 to 1990 and died in 1996. At the autopsy, the lungs of both workers had an extremely high silica content. From

1968 to 1992, about 10 workers between the ages of 15 and 44 died of silicosis each year.[6] These deaths were attributed to recent and intense exposure to crystalline silica. Frequently, dust masks and air purifying respirators are inappropriately used for abrasive blasting.[7,8]

Exposure Evaluation Criteria

As a guide to the evaluation of the hazards posed by workplace exposures, NIOSH field staff use exposure limits as evaluation criteria for assessment of a number of chemical and physical agents. These criteria are intended to suggest levels of exposure to which most workers may be exposed up to 10 hours per day, 40 hours per week, for a working lifetime without experiencing adverse health effects. Table 1 summarizes exposure limits for air contaminants which sampled at this site. It is important to note that not all workers will be protected from adverse health effects if their exposures are maintained below these levels. A small percentage may experience adverse health effects because of individual susceptibility, a preexisting medical condition, and/or a hypersensitivity (allergy).

Table 1. Relevant exposure limits (mg/m^3) as 8-hour time-weighted averages.

Air Contaminant	NIOSH REL[9] mg/m^3	OSHA PEL[10] mg/m^3	ACGIH TLV[11] mg/m^3
Respirable crystalline silica	0.05	Varies with amount of quartz in dust (see Equation 1)	0.05
Particulates, not otherwise classified - respirable		15	10
Particulates, not otherwise classified - inhalable		5	3

The current OSHA Permissible Exposure Limit (PEL) in mg/m^3 for respirable dust containing quartz is calculated from the following formula:

$$PEL = \frac{10}{\%\ silica\ +\ 2} \qquad (1)$$

The primary sources of environmental evaluation criteria in the United States that are used for the workplace are: (1) NIOSH Recommended Exposure Limits (RELs); (2) the American Conference of Governmental Industrial Hygienists' (ACGIH) Threshold Limit Values (TLVs); and (3) the U.S. Department of Labor (OSHA) Permissible Exposure Limits (PELs). The OSHA

PELs are required to consider the feasibility of controlling exposures in various industries where the agents are used; the NIOSH RELs, by contrast, are based primarily on concerns relating to the prevention of occupational disease. ACGIH Threshold Limit Values (TLVs) refer to airborne concentrations of substances and represent conditions under which it is believed that nearly all workers may be repeatedly exposed day after day without adverse health effects. ACGIH states that the TLVs are guidelines. It should be noted that ACGIH is a private, professional society, and that industry is legally required to meet only those levels specified by OSHA PELs.

Site Description

The study site included two three-story parking garages. For the purposes of this study, these garages are called the east and the west garages. The west garage was located closest to Texas State Route 161. Each garage was 180 feet x 310 feet. Each garage had three levels of parking. For each level, the outside wall was a four-foot high wall. The exterior concrete surface was smooth. The abrasive blasting was done to remove about 1/8 inch of the cured concrete in order to expose the underlying aggregate. This was done to improve the appearance of the building (see Figure 1). During this study three workers were blasting the concrete off of the building. One or two workers stood on the ground and blasted the ground-level barrier level (see Figure 2). One or two workers stood on elevated platforms. One or two workers tended the blasting machines. The workers wore disposable respirators (3M Model 8210). This is an N95 respirator.

A **torbo®** Wet Abrasive Blasting System (model 320, Keizer Technologies North America, Euless, Texas) was used. Grade 3 blasting sand (Texblast, Tex Minerals, Dallas, Texas) was charged into the mixing tank (see Figure 3). To fill the mixing tank with sand, sixteen 100-pound bags of sand were emptied into the vessel which is filled with water. A metering system feeds the wet sand and additional water into a system for fluidizing the water and additional sand. The feed rate for the wet sand was 6 lpm. The wet sand is 80 percent sand and 20 percent water. During some of the data collection, an additional 3 lpm of water was added to the wet sand mixture in an effort to reduce dust generation. Air pressure is then used to transport the water and sand to the blasting nozzle which had a diameter of approximately 1.5 inches.

PROCEDURES

The study was conducted to evaluate the exposures to crystalline silica and to identify exposures associated with the operation of the abrasive blasting equipment. The workers' exposures to dust and crystalline silica was measured. Video exposure monitoring was conducted to evaluate the extent to which work practices contributed to exposures.

At the study site, the worker's exposure to total dust, respirable dust, total crystalline silica and respirable crystalline silica was measured. During abrasive blasting operations, air samples for total and respirable dust were collected as described by NIOSH methods 0500 and 600.[12,13] This involved mounting two sampling trains on each worker. Total dust samples were collected by

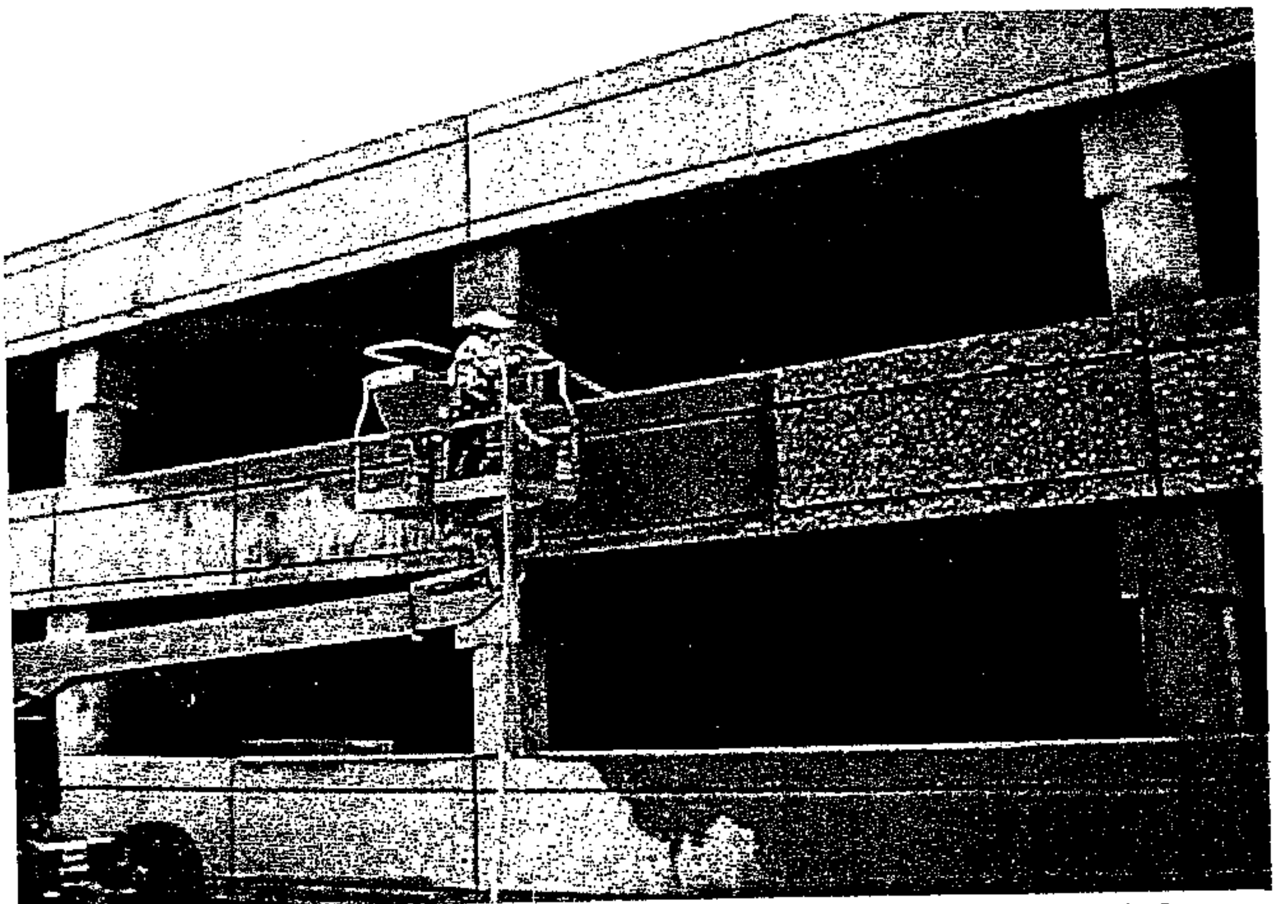

Figure 1. Worker performing abrasive blasting on a concrete wall from an elevated platform. The worker is removing about 1/8 to 1/4 inch of concrete in order to expose the aggregate.

Figure 2. Worker performing abrasive blasting at ground level.

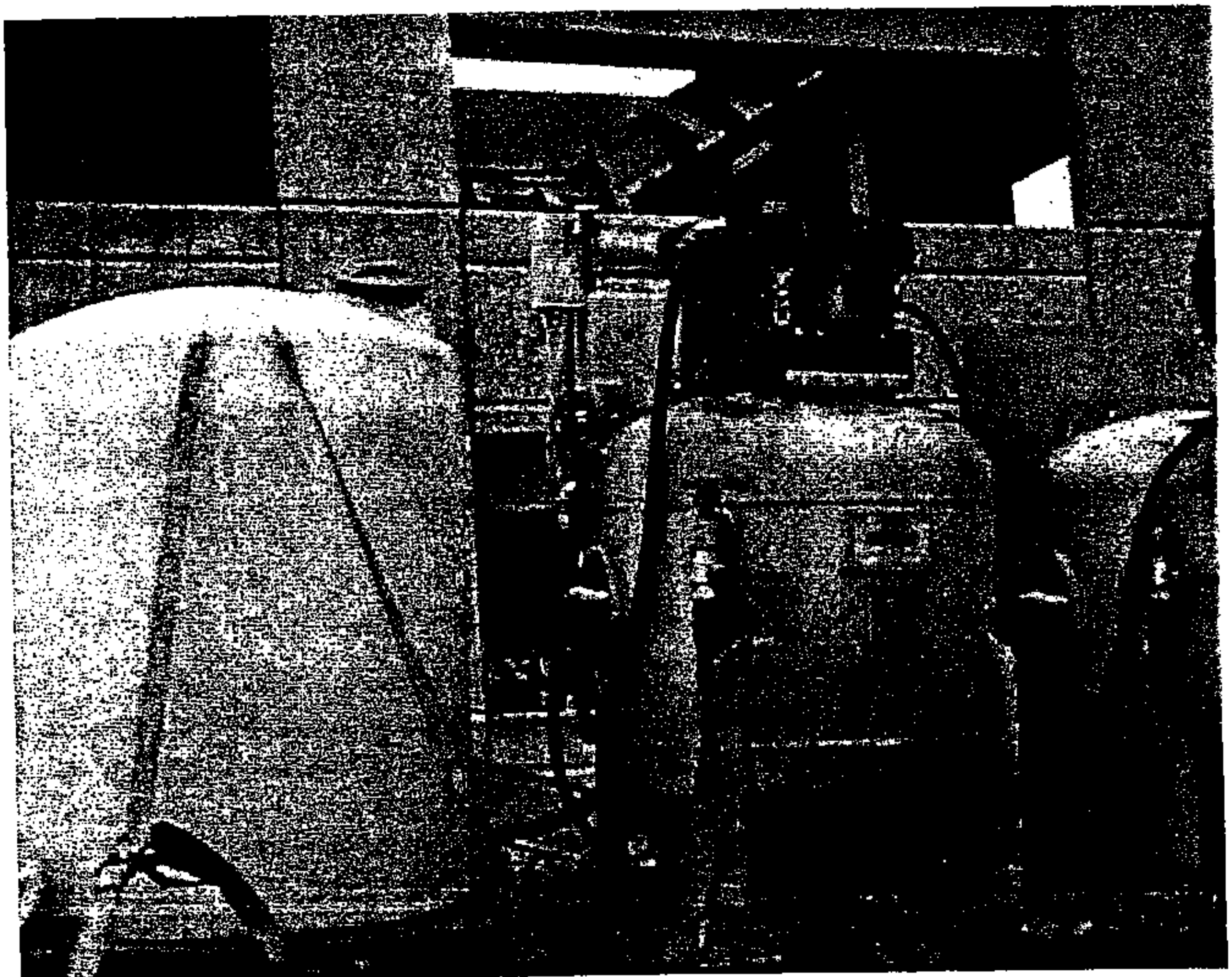

Figure 3. Water and abrasive vessel. This vessel is filled with sand and water. Water pressure forces the sand out of this mixing vessel.

mounting a 37-mm closed face cassette on the worker's shirt collar and using a calibrated battery-operated pump to draw a known volume of air through the cassettes. Respirable dust samples were collected by mounting a 10-mm cyclone on the worker. The outlet of the cyclone is attached to the inlet of a 37-mm filter holder. A calibrated sampling pump draws 1.7 lpm of air through the cyclone. These samplers were turned off during the daily 30 minute lunch break. This job site involved two classes of workers: abrasive blasters and helpers. When one of the workers doing abrasive blasting was relieved by a helper, the workers traded sampling trains. Thus, the sampling conducted at this site is task-based.

Bags of sand weighing 100 pounds were emptied into the vessels shown in Figure 3. Two workers dumped the bags of sand into the vessels. During this task, short-term respirable dust samples were collected at a flow rate of 4.2 lpm. Instead of using the 10-mm nylon cyclone specified in NIOSH Method 0600, a stainless steel cyclone (BGI-4 High Flow Respirable Dust Cyclone, BGI Inc., Waltham, Massachusetts) was used to conduct respirable dust sampling at 4.2 lpm.

At the end of the sampling period, the sampling time was recorded and the plugs were placed back into the cassettes. The samples were analyzed for total weight gain per NIOSH Methods 0500 and 0600. Then, the samples were analyzed for crystalline silica by x-ray diffraction using NIOSH method 7500.[14] The following modifications were used in the sample analysis:

1. Filters were dissolved in tetrahydrofuran rather than being ashed in a furnace.
2. Standards and samples were run concurrently and an external calibration curve was prepared from integrated intensities.

When an excessive amount of material was collected on the filter, the samples were treated as bulk samples. A 2-milligram portion was removed from the material collected on each sample and the mass of crystalline silica in the 2-milligram portion was measured. The percent of crystalline silica in this 2-mg bulk was reported. For these samples, the mass of crystalline silica was the product of the gravimetric analysis conducted under Methods 0500 and 0600 and the fraction of crystalline silica in the bulk sample obtained from the filter cassette.

Video Exposure Monitoring

Video exposure monitoring was used to evaluate how specific worker tasks affect dust exposure.[15] An aerosol photometer (HAM, PPM Inc. Knoxville, Tennessee) was mounted on the worker's chest. Air is drawn through the sensing chamber of this instrument by a battery-operated pump at 2 lpm. The dust in the sensing chamber scatters light emitted from a light-emitting diode. The scattered light is detected by a photomultiplier tube. The analog output of the aerosol photometer is proportional to the amount of light detected by the photomultiplier tube. Because the amount of light scattered by the aerosol varies with the particle's size and optical properties, the analog output of the aerosol photometer is a measure of relative concentration. The HAM's were used with a one second time constant and their analog output was recorded every second by a data logger (Metrologger dl 3200, Metrosonics, Rochester, New York). While the output of the HAM was recorded on the data logger, the worker's activities were concurrently recorded on videotape. The videotapes and the analogy output were reviewed to evaluate the extent to which work practices affected exposure.

RESULTS

Individual air contaminant concentrations are listed in Appendix I for respirable crystalline silica, respirable dust, total dust, and total crystalline silica. The worker's exposure to respirable crystalline silica is the hygienically significant exposure. The summary statistics for the respirable crystalline silica concentrations are listed in Table 2.

Table 2. Respirable crystalline silica concentrations - summary statistics.

Description of Work	n	Geometric Mean (mg/m^3)	Geometric Standard Deviation	Range (mg/m^3)
Abrasive blasting at ground level	7	0.22	1.59	0.12-0.43
Abrasive blasting from an elevated platform	9	0.13	2.25	0.04-0.41
Helper	8	0.06	2.08	less than 0.02-0.12

During the conduct of this study, there was concern over the apparently excessive dust concentrations which were noticed. During the first visit, the additional water application rate was increased from 0 to 3 liters per minute on April. Unfortunately, the workers continually changed the additional water application rate back to 0 lpm sometime during the day. During the second sampling effort on April 14 and 15, the extra water application rate was maintained at 3 lpm.

All of the data was analyzed to evaluate whether the worker's task, the water application rate, and an interaction between water application rate and work task affected concentration. The statistical analysis was performed on the logarithms of the concentrations. The independent variables (worker task, water application rate) were treated as qualitative variables. The worker tasks are the tasks listed in Table 2. The water application rate had three levels: 0.0 lpm, 3 lpm and intermediate for the third day of sampling during the first trip. The SAS General Linear Models procedure was used to perform analysis of variance (anova).[16] Table 3 lists the probabilities obtained by applying the analysis of variance to the measured values of concentrations. The probabilities are the probability observing such large differences occurring due to chance. When the probabilities are less than 0.05, one concludes that the independent variable affected dependent variable, concentration. The worker's task has a significant affect upon exposure and increasing the water application did not.

Table 3. Probability (probability >F) that independent variables affected the measured concentration.

Variables	Respirable Dust	Respirable Crystalline Silica	Total Dust	Total Crystalline Silica
Water	0.08	0.75	0.137	0.53
Worker activity	0.02	0.05	0.0001	0.0059
Worker activity-water interaction	0.27	0.59	0.11	0.07
Geometric standard deviation from anova	1.79	2.05	2.64	3.71

The effect of worker task upon respirable dust concentrations and respirable crystalline silica concentrations are shown in Tables 4 and 5. The column labeled "grouping" in these tables is the result of a multiple comparison test (Tukey's studentized range) used to evaluate the differences in the geometric means. Multiple comparison tests are conducted at an overall level of confidence of 95 percent. The helper is exposed to significantly less respirable dust and respirable crystalline silica than the workers who were performing abrasive blasting at ground level.

Table 4. Geometric mean respirable dust concentrations for different work activities.

Worker Activity	Geometric Mean (mg/m^3)	Multiple Comparison Test[a]
Blasting at ground level	0.93	a
Blasting on elevated platform	0.60	b
Helper	0.34	b

[a] Geometric means with different code letters differ significantly.

Table 5. Geometric mean respirable quartz concentrations at different work activities.

Worker Activity	Geometric Mean (mg/m³)	Multiple Comparison Test[a]
Blasting at ground level	0.22	a
Blasting on elevated platform	0.13	ab
Helper	0.06	b

[a] Geometric means with different code letters differ significantly.

Although, the anova indicated that water application rate did not significantly affect concentrations, water application rates may have reduced respirable dust concentrations by a factor 2-2½ for the workers performing abrasive blasting. Table 6 compares geometric mean respirable dust concentrations for the three worker activities. The geometric mean respirable dust concentrations are lower at a water application rate of 3 lpm. However, the observed reduction in concentration is small in relationship to the data's variability. Thus, these results are

respirable dust concentrations for the three worker activities. The geometric mean respirable dust concentrations are lower at a water application rate of 3 lpm. However, the observed reduction in concentration is small in relationship to the data's variability. Thus, these results are
considered to be inconclusive.

Table 6. Geometric mean respirable dust concentrations (mg/m³) for different water application rates and the probability that the difference could be explained by chance.

Activity	Additional Application Rate of 3 lpm	Additional Water Application Rate of 0 lpm	Probability >|t|
Blasting from elevated platform	0.30	0.52	0.23
Blasting at ground level	0.65	1.62	0.08
Helper	0.28	0.34	0.69

Figures 4-7 present the HAM outputs during video exposure monitoring. None of the work practices appeared to affect exposure. Wind and location probably affect exposure. In Figures 4-7, exposure peaks appear to be caused by abrasive blasting in areas which are isolated from the ambient wind which would dilute exposures. Figure 8 is a picture of a worker sandblasting below ground grade in a poorly ventilated area on the leeward side of the building.

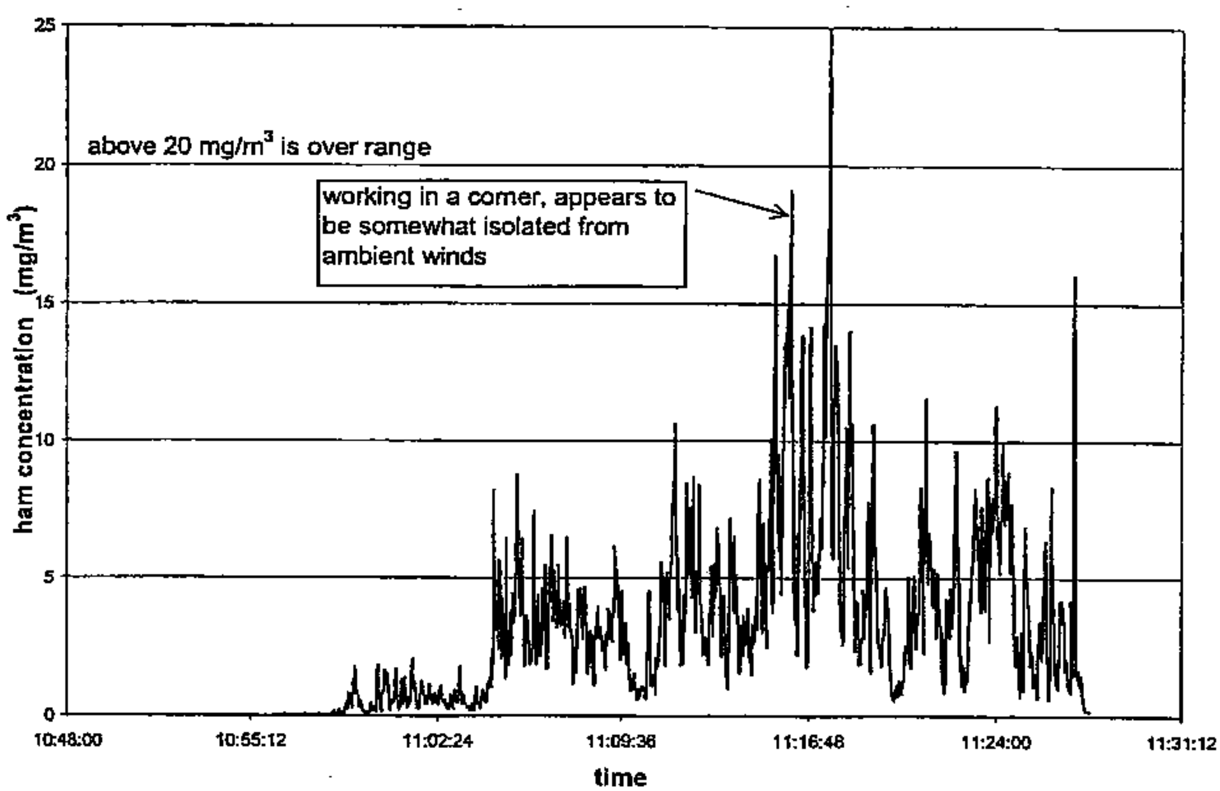

Figure 4. Worker sandblasting on west wall of east garage, near the retaining wall.

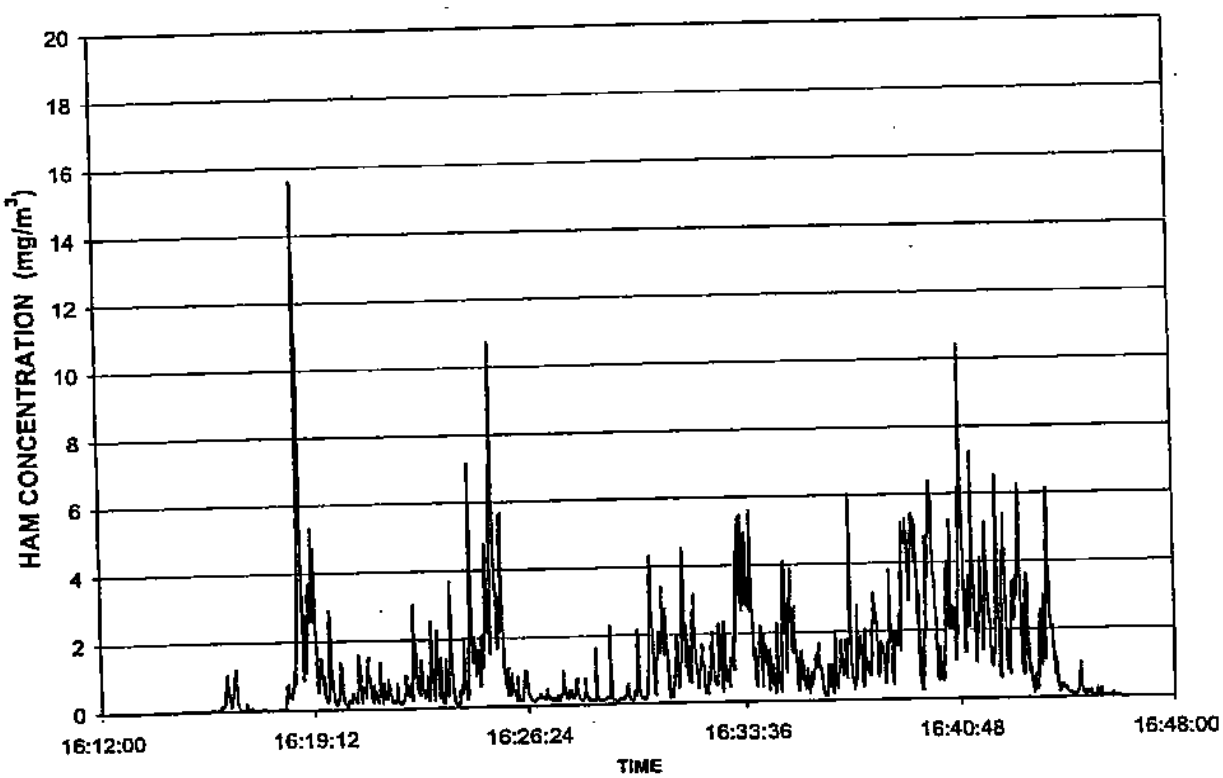

Figure 5. Blasting north wall of west garage. The ambient wind appeared to be blowing the dust away from the work. The wind appeared to come from the east.

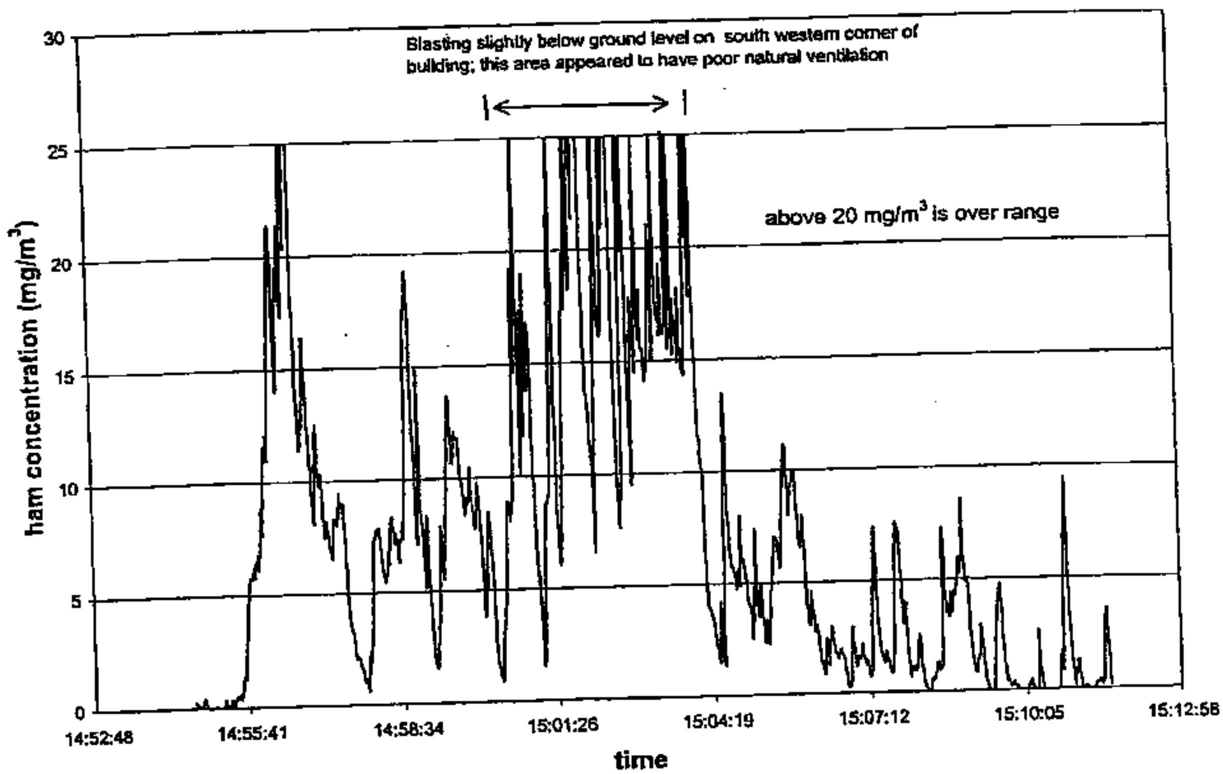

Figure 6. Worker was abrasively blasting on west wall of the west garage. The area was slightly below ground grade as shown in Figure 8. This position appeared to be on the leeward side of the building.

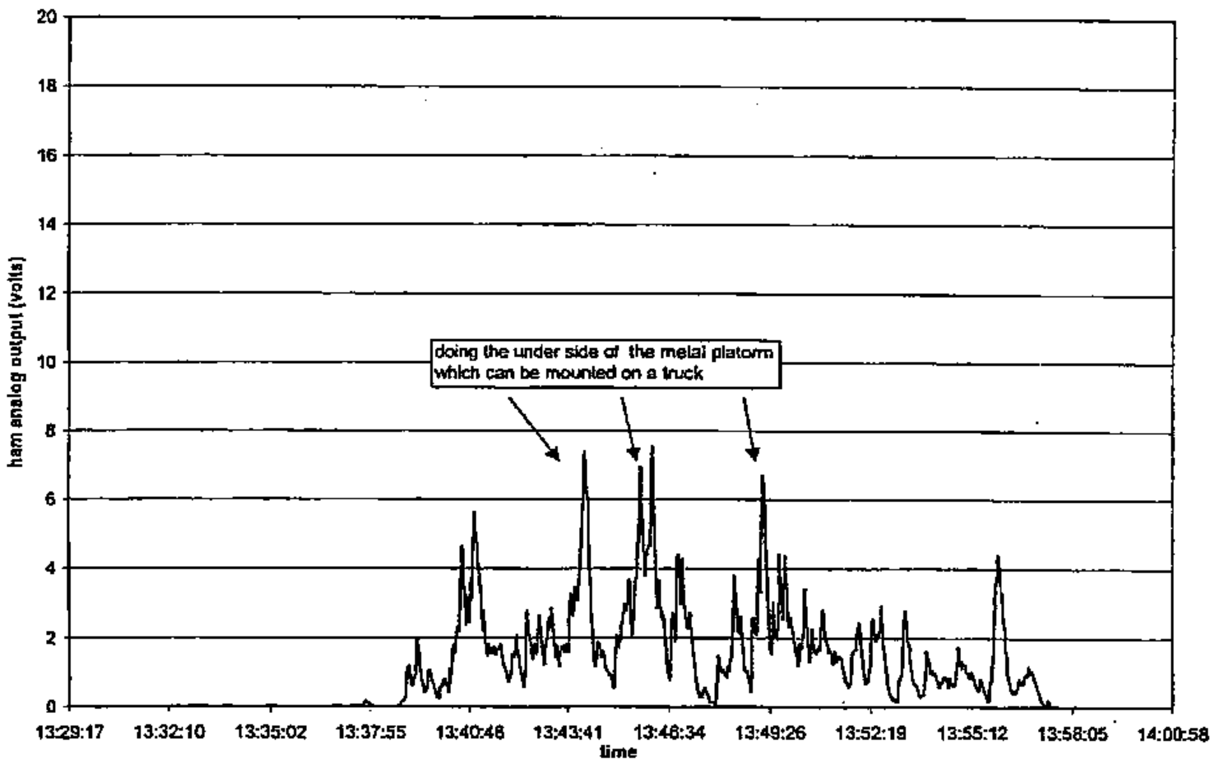

Figure 7. Blasting a steel structure at the Keizer Technologies Americas Facility in Euless, Texas. There appears to be less dust than when blasting on a concrete wall.

Figure 8. Worker performing abrasive blasting in an area with poor natural ventilation. The area was somewhat below ground level in sloping terrain. The dust exposure is obscuring the view of the abrasive blasting.

DISCUSSION

The crystalline silica exposures for the workers performing abrasive blasting ranged between 0.04 and 0.4 mg/m^3 or respirable crystalline silica with a geometric mean of 0.2 mg/m^3. Although these exposures are excessive in terms of the NIOSH REL and the current OSHA PEL, these exposures are less than the exposures to respirable crystalline silica reported elsewhere.[4,3] The exposures are less than five times the OSHA PEL for crystalline silica and less than 10 times the OSHA PEL for crystalline silica. For this level of exposure an air purifying respirator with N100 filter cartridges would be appropriate level of respirator usage. For other abrasive blasting operations reported in the literature, worker exposures as much as 25 mg/m^3 outside of supplied air respirator and exposures inside of a supplied air blasting helmet of 0.2 mg/m^3 respirable crystalline silica are reported.[3,4] Thus, the use of Turbo Blasting Equipment does appear to reduces the exposures to respirable crystalline silica sufficiently that air purifying respirators are a possible control option.

The sand used for blasting appeared to be very coarse and it appeared to contain minimal fines. This may also explain the relatively low respirable crystalline silica exposures. Based upon the data obtained in this study, one does not the extent to which the exposures were reduced by the presence of water or by the apparent absence of fine material in the sand.

Review of the videotapes and the analog output of the HAMs indicate that work practices do not affect exposure. However, abrasive blasting in areas which are isolated from ambient air motion can increase worker exposure to crystalline silica.

The concrete substrate may be the source of much of the crystalline silica exposure. The abrasive blasting which was done on the steel structure resulted in relative concentrations in Figure 6 that were lower than the results presented in Figures 4-5 and 7. This apparent difference could be due to wind or the absence of a much substrate to remove on the steel structure shown in Figure 9 (a picture of a steel structure being abrasively blasted). Furthermore, the mass fraction of crystalline silica in the in the respirable dust samples was ratio of respirable crystalline silica to respirable dust was 0.22±0.04. Typically, concrete aggregate is 20 percent silica.[17] In contrast, the material safety data sheet for the abrasive stated a crystalline silica content of better than 90 percent. This is consistent with the hypothesis that the substrate itself is the source of the crystalline silica exposures.

The workers' exposures to respirable crystalline silica summarized in Table 2 exceed the NIOSH REL of 0.05 mg/m^3. During abrasive blasting with this wet sand process, respiratory protection is needed. Worker protection during abrasive blasting with the equipment at this site would require the use of respirators with an assigned protection factor of 10. The workers also needed to contend with high-velocity grains of sand striking their face, causing discomfort. Perhaps, full-face piece respirators or full-face piece powered air purifying respirators equipped with P100 filters could be used to protect the worker's faces and provide enhanced respiratory protection. The assigned protection factors and respirator class are listed below:

Respirator	Assigned Protection Factor[18]
Half facepiece, air-purifying respirator	10
Powered air-purifying respirator with a face shield	25
Tight-fitting full facepiece, air-purifying, or powered air-purifying respirator	50

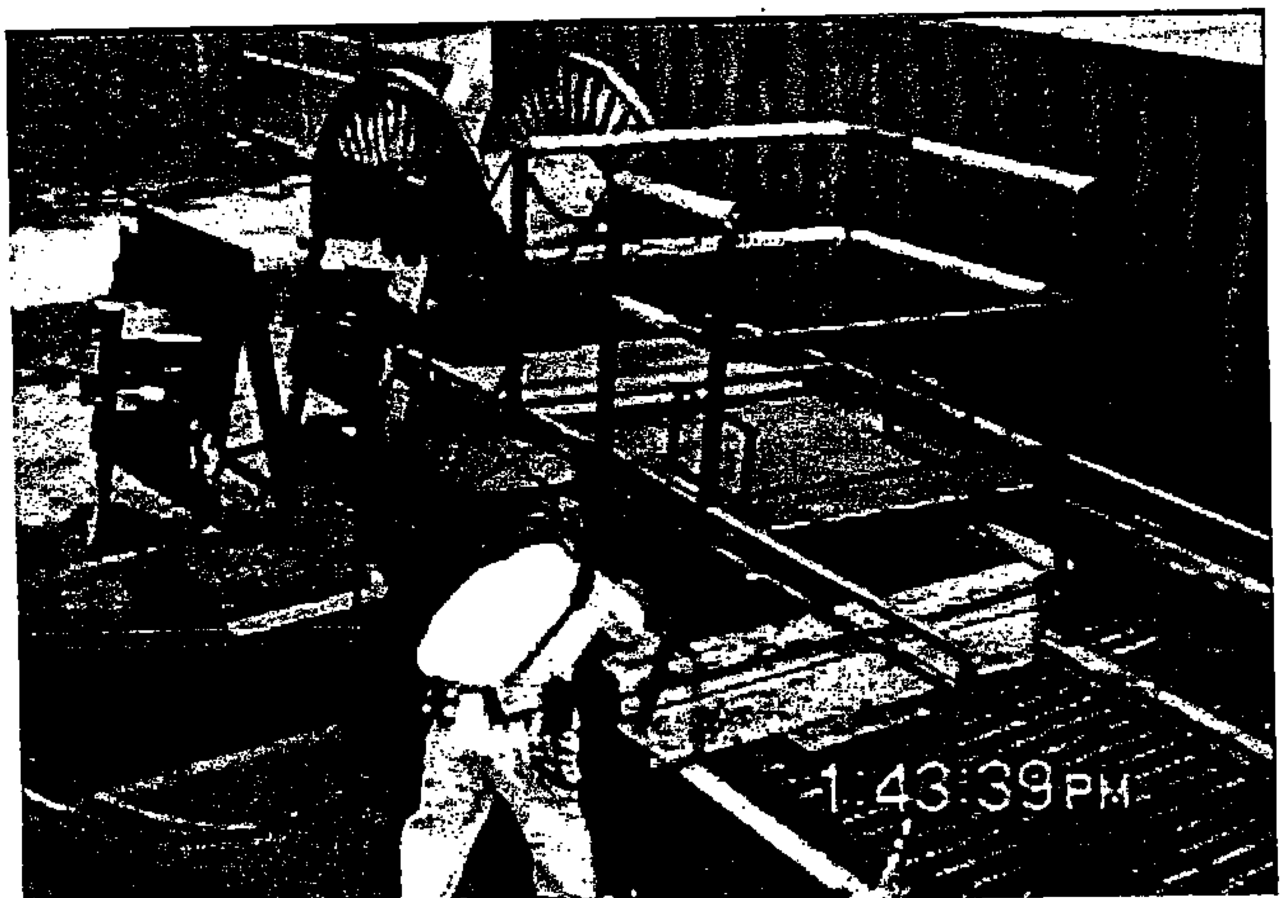

Figure 9. Worker performing abrasive blasting of a metal structure.

These respirators should be equipped with P100 filters. Regardless of the respirator used, a comprehensive respirator program is needed to insure that the respirators continue to protect the workers. Poor respirator maintenance and poor respirator can cause one to falsely have confidence in the protection provided by the respirator. Thus, compliance with the OSHA respirator standard, 29CFR1910.134, is needed to ensure that the workers are actually protected.

CONCLUSIONS

The wet abrasive blasting system used at this site sufficiently reduced respirable crystalline silica exposures so that air purifying respirators could be used to control worker exposure to crystalline silica. This assumes that the sand, used for blasting, contains minimal fines and the presence of adequate natural ventilation.

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TOTAL DUST AND TOTAL SILICA CONCENTRATIONS

position	building	worker position	sampling time (minutes)	flow rate (lpm)	dust concentration (mg/m³)	silica concentration (mg/m³)
04/14/99	west garage	elevated platform	436	2.0	3.12	0.37
04/14/99	east garage	elevated platform	364	2.0	13.46	4.85
04/14/99	east garage	ground	205	2.0	29.00	1.10
04/14/99	east garage	helper	231	2.0	0.61	0.35
04/15/99	east garage	elevated platform	461	2.0	11.65	10.48
04/15/99	east garage	ground	469	2.0	27.43	9.60
04/15/99	east garage	helper	442	2.0	0.57	0.15
03/30/99	west garage	elevated platform	440	2	1.60	0.51
03/30/99	west garage	helper	440	2	2.17	0.56
03/30/99	west garage	ground	454	2	23.19	8.81
03/30/99	west garage	helper	443	2	0.53	0.19
03/30/99	west garage	ground	360	2	5.49	1.42
03/31/99	west garage	elevated platform	483	2	11.12	3.22
03/31/99	west garage	elevated platform	239	2	0.29	0.06
03/31/99	west garage	ground	483	2	29.92	11.07
03/31/99	west garage	helper	368	2	1.56	0.79
03/31/99	west garage	helper	229	2	0.94	0.37
03/31/99	west garage	blasting low -real time- short term sample	72	2	4.17	1.39
03/31/99	west garage	ground	458	2	21.53	17.65
04/01/99	west garage	elevated platform	462	2	129.65	90.76
04/01/99	west garage	helper	448	2	0.81	0.37
04/01/99	west garage	helper	335	2	1.19	0.28
04/01/99	west garage	ground	443	2	25.94	1.79
04/01/99	west garage	elevated platform	452	2	14.35	9.18

RESPIRABLE DUST AND RESPIRABLE QUARTZ CONCENTRATIONS

position	building	worker activity	sampling time (minutes)	flow rate (lpm)	dust concentration (mg/m^3)	silica concentration (mg/m^3)
04/14/99	west garage	elevated platform	436	1.7	0.18	0.04
04/14/99	east garage	elevated platform	364	1.7	0.26	0.11
04/14/99	east garage	ground	205	1.7	0.34	0.18
04/14/99	east garage	helper	231	1.7	0.33	0.08
04/15/99	east garage	elevated platform	461	1.7	0.56	0.14
04/15/99	east garage	elevated platform	465	1.7	0.30	0.10
04/15/99	east garage	ground	469	1.7	1.23	0.26
04/15/99	east garage	helper	338	1.7	0.23	0.03
14 and 15 April 1999		Bag dumping	39	4.2	0.43	0.12
14 and 15 April 1999		Bag dumping	45	4.2	0.16	nd
03/30/99	west garage	helper	440	1.7	0.53	0.09
03/30/99	west garage	helper	443	1.7	0.25	0.07
03/30/99	west garage	elevated platform	440	1.7	0.25	0.04
03/30/99	west garage	ground	441	1.7	0.88	0.13
03/30/99	west garage	ground	454	1.7	2.85	0.43
03/31/99	west garage	helper	229	1.7	0.15	ND
03/31/99	west garage	ground	459	1.7	1.64	0.27
03/31/99	west garage	ground	376	1.7	1.72	0.28
03/31/99	west garage	elevated platform	239	1.7	1.06	0.39
03/31/99	west garage	elevated platform	483	1.7	0.51	0.13
03/31/99	west garage	helper	414	1.7	0.60	0.12
04/01/99	west garage	elevated platform	462	1.7	2.37	0.41
04/01/99	west garage	helper	448	1.7	0.42	0.09
04/01/99	west garage	helper	335	1.7	0.47	0.10
04/01/99	west garage	ground	443	1.7	0.76	0.12
04/01/99	west garage	elevated platform	452	1.7	0.86	0.16
March 31 and april1		bag dumping	63	4.2	0.30	0.08
March 31 and april1		bag dumping	63	4.2	0.19	0.11