IT'S NOT JUST DUST … It's Silica!

What you should know about silicosis in the ready mix industry

Illinois Onsite Safety & Health Consultation Program

dceo
Illinois Department of Commerce and Economic Opportunity

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Introduction

Introduction

Silicosis is an occupational disease caused by exposure to dust from crystalline silica, one of the most common minerals on our planet.

Silicosis isn't curable! Workers are still dying from the disease. **This condition is preventable.** The keys to prevention are straightforward:

❖identify workplace activities that produce crystalline silica dust and then

❖eliminate the dust or control it so that workers aren't exposed.

In the ready mix industry, you often use products or materials that contain crystalline silica and should be concerned about silicosis and crystalline silica hazards.

This workbook will inform you about the hazards in your industry so that you can control them.

About crystalline silica

What is it?

Crystalline silica is the scientific name for a group of *minerals* containing silicon and oxygen. *Crystalline* means that the oxygen and silicon atoms are arranged in a specific pattern.

Forms of crystalline silica

Crystalline silica exists in several forms, including *quartz*, *cristobalite*, and *tridymite*. Tridymite is the most potent, but least common form. Cristobalite, which occurs naturally in volcanic rock, is often found with quartz in the Pacific Northwest. Of these forms, quartz is the most common; in fact, it's the second most common mineral on the planet. (Feldspar is the most common.)

The cause of silicosis is linked to cancer

Crystalline silica causes silicosis, but it has also been linked to cancer. Any material that contains more than 0.1 percent crystalline silica must meet the labeling, information, and training requirements of the *Hazard Communication Standard, 29 CFR* 1910.1200).

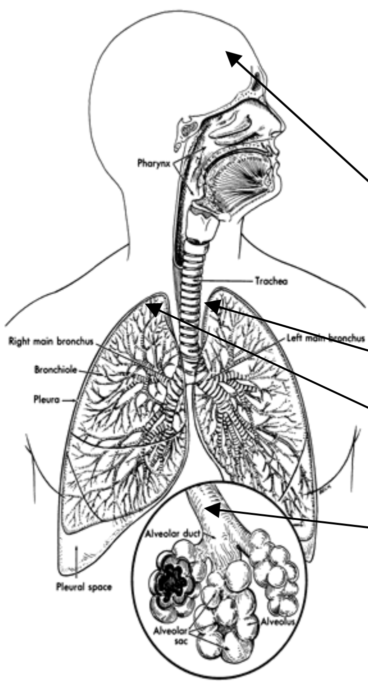
Silicosis

What is silicosis?

Silicosis is a progressive, disabling lung disease caused by breathing dust containing particles of crystalline silica — particles so small you can see them only with a microscope. The cause of silicosis has been known for centuries — the earliest cases of silicosis were recorded before the first century — yet workers continue to die every year from the disease.

Crystalline silica can cause silicosis only when we breathe it into our lungs as dust or a fine powder. Here's what happens:

- ❖ The silica particles become trapped in the lungs and damage the tissue.
- ❖ As a result, the lung tissue scars and forms small, rounded masses called nodules.
- ❖ Over time, the nodules grow, making breathing increasingly difficult.



The respiratory system consists of four main regions:

❖ **Nasopharyngeal** Nasal passages and pharynx

❖ **Tracheobronchi**—Wind pipe (trachea) and its main upper branches (bronchi)

❖ **Bronchioles**—Smaller branches called bronchioles

❖ **Alveoli**—The smallest branches in which the lung terminates

Though silicosis shows no symptoms at first, after a few years the victim eventually has trouble breathing and develops a severe cough. Other symptoms include fatigue, loss of appetite, chest pains, and fever. Only a complete work history, a chest X-ray, and a lung-function test will determine whether or not a worker has the disease. Those who think they may have silicosis should see a medical doctor who specializes in occupational medicine.

Concern

Who should be concerned?

Any worker exposed to dust containing crystalline silica — dust from crushed rock, soil, dirt, gravel, or sand, for example — should be concerned about silicosis.

Because crystalline silica is such a common mineral — so prominent in the products that we make and use — you should be concerned about working with any material that contains more than 0.1 percent crystalline silica.

Chronic silicosis

Silicosis can affect you in three ways. Most workers who get silicosis don't show any symptoms for 10 or more years. That's because their exposures to crystalline silica are fairly low, but frequent. They develop a condition called chronic silicosis.

Accelerated silicosis

As exposure levels increase, however, silicosis symptoms can appear much earlier. For example, those diagnosed with accelerated silicosis show symptoms within five to 10 years.

Acute silicosis

Workers exposed to extremely high levels of crystalline silica dust may develop acute silicosis, a condition that can show symptoms within only a few weeks of an initial exposure. Acute silicosis is most common among sand blasters because of the high levels of silica dust they breathe.

Work Activities

How do you determine if you have a problem?

Do you know what activities at your workplace expose workers to crystalline silica dust? Suspect any activity that produces dust from rock, soil, dirt, gravel, sand, or any product made from these materials. Obtain a material safety data sheet for the products you use to determine if they contain crystalline silicia. In ready mix operations, the employee who chips out the truck is usually at risk.

Material Safety Data Sheets

These sheets contain data for all materials or products containing hazardous substances that are used at a business in quantities greater than what a consumer would use.

If a material or product contains crystalline silica in quantities greater than 0.1%, there must be a safety data sheet for it.

Manufacturer's responsibility: obtain or develop a safety data sheet for each hazardous chemical they produce or import.

Employer's responsibility: ensure access to safety data sheets for all hazardous materials at the workplace.

Now that you suspect silica is being used and that it may be in the air, you need to know just how much is there.

An industrial hygienist can help you make that determination by sampling the air workers breathe and calculating a Permissible Exposure Limit (PEL).

Hazardous Quantity

How much crystalline silica is hazardous?

Unfortunately, this is not a simple answer that you can apply to every task or workplace. How much crystalline silica is hazardous depends on your exposure and on a calculated value called the permissible exposure limit. The permissible exposure limit (PEL) is the maximum amount of airborne crystalline silica dust that a worker can be exposed to during a full work shift.

Measuring the Amount of Airborne Silica
In order to find out the silica concentration level, two things need to happen:

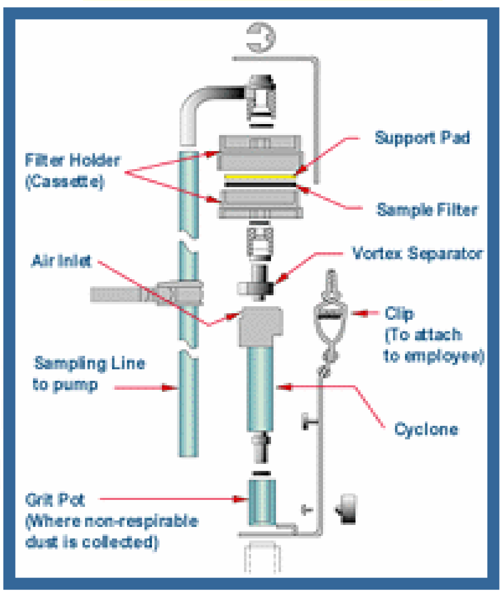
- ❖Collection of a sample
- ❖Laboratory analysis of that sample

A trained specialist such as an industrial hygienist can determine whether a worker is overexposed by sampling the air a worker breathes and calculating a permissible exposure limit. Here's how an industrial hygienist makes the determination:

First, the hygienist will collect an air sample in the worker's breathing zone using a cyclone assembly. She'll have a laboratory analyze the sample to determine the weight of the dust present and the percentage of free crystalline silica in the sample.

Then she'll use the percentage of free silica in an equation to calculate a value for the permissible exposure limit. She'll compare the permissible exposure limit value with the weight of the respirable dust from the sample. If the weight of the respirable dust is greater than the permissible exposure limit, the worker is overexposed to crystalline silica. The following example describe these calculations in more detail.

Cyclone Assembly



Determining the PEL for crystalline silica quartz—an example

A key term
The Permissible Exposure Limit (PEL) is the maximum average amount of airborne crystalline silica dust that one can be exposed to during a full work shift.

This example highlights the calculations an industrial hygienist might use to determine if a worker was exposed to unsafe levels of crystalline silica quartz dust. The permissible exposure limit (PEL) for respirable crystalline silica quartz is based on the following equation and is expressed in milligrams per cubic meter (mg/m3).

$$\text{PEL} = \frac{10 \text{ mg/m3}}{[\% \text{ Silica}] + 2}$$

Assume the hygienist sampled air in the employees breathing zone during a chipping operation. She had a laboratory analyze the sample to determine the weight of respirable dust and the percentage of free silica quartz. The laboratory reported the following results:

Lab Report

What was sampled	Value
Weight of respirable silica dust	0.45 mg/m3
Percentage of free silica quartz	**25.00%**

She plugged 25 percent into the PEL equation and calculated a value of 0.37 mg/m3, as shown below.

$$\text{PEL} = \frac{10 \text{ mg/m3}}{25 + 2} = 0.37 \text{ mg/m3}$$

Results

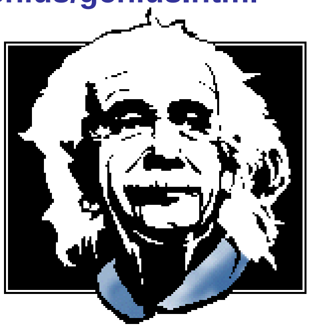
The weight of airborne respirable dust in the sample = 0.45 mg/m3
The calculated PEL value = 0.37 mg/m3
0.45 mg/m3 is greater than 0.37 mg/m3
Therefore, the worker is overexposed.

Because the weight of the airborne breathable dust in the sample (0.45 mg/m3) is greater than the calculated PEL value (0.37 mg/m3), the hygienist concludes that the worker is overexposed.

GENIUS

www.osha.gov/SLTC/etools/silica/compare_to_limit/genius/genius.html

OSHA's silica e-tool will do calculations for you!



Guidelines

The Guidelines for preventing silicosis

⇒ Identify work areas, tasks, and equipment that expose workers to crystalline silica dust

⇒ Use materials that don't produce crystalline silica.

⇒ Work wet and use dust-containment systems to control dust.

⇒ Ventilate to keep work areas dust free.

⇒ Use personal protective equipment when necessary.

⇒ Monitor the air to determine worker exposure levels.

⇒ Give exposed workers regular medical exams.

⇒ Practice good personal hygiene.

⇒ Educate workers about silica-dust hazards and silicosis; train them how to control their exposure.

⇒ Label products that contain crystalline silica.

Industrial Hygiene Study

IRMCA Industrial Hygiene Study

In 1997, the Occupational Safety and Health Administration (OSHA) implemented a special emphasis program (SEP) which focused on employee exposure to silica in general industry and in the construction industry. The SEP involved increased OSHA compliance inspections at facilities that had potential employee exposure to silica. The SEP was intended to address concerns regarding health problems associated with the lung disease silicosis, as identified by the Center for Disease Control (CDC).

In response to the OSHA special emphasis program on silica, the Illinois Ready-Mixed Concrete Association (IRMCA) took a proactive approach by requesting the assistance of the Illinois OnSite Consultation Program to evaluate employee exposure to silica in ready-mixed concrete facilities. This study covered the time period October 1997 through June 1999.

Workstations at five separate ready-mixed concrete companies were evaluated to determine employee exposure to silica:

Yardman This employee moves material around the facility usually in material handling equipment with an enclosed cab.

Driver In addition to driving the concrete truck, the driver also periodically removes dried concrete from inside the concrete truck mixer drum using a hammer and a pneumatic chipper.

Batch loader This employee's workstation is usually inside a booth or office. They monitor the material as it is being mixed and/or dispensed into the trucks.

CONCLUSIONS

Sampling results indicated that the yardman and batch loader were not over exposed to silica. Silica concentrations were either undetectable or well below the OSHA Permissible Exposure Limits (PEL).

In contrast, **drivers were found to be exposed to levels of silica which exceeded the OSHA PELs** when chipping out dried concrete from the truck drum mixer.

In addition to silica exposures, employee exposures to calcium hydroxide and to noise were evaluated during truck drum cleaning. Employee exposures to calcium hydroxide did not exceed the OSHA PEL. Employee exposures to noise exceed the OSHA PEL.

Employees working at ready-mixed concrete facilities have the potential for exposure to occupational noise, total particulates containing silica and respirable particulates containing silica that significantly exceed the OSHA PELs during concrete truck drum cleaning procedures.

The use of a pneumatic chipper with an attached water spray nozzle that is used diligently by the employee cleaning the drum will maintain employee exposure to air contaminants below the OSHA PELs and eliminate required use of respiratory protection by employees. The water spray wets the silica dust at the point of dust generation and does not allow it to become airborne and enter the employee's breathing zone.

Validation

2006 Validation of Initial Study

In 2006, personal air sampling for exposure to particulates containing silica was conducted to verify that the method described in the initial IRMCA Silica Study was still effective. The new sampling survey coincides with the video coverage provided in the Webcast and Video Conferencing Session held February 22, 2006 through the Illinois Department of Commerce and Economic Opportunity.

Test results showed that these employees can **perform drum cleaning for up to 6 hours** without being exposed to particulates containing silica which exceed the OSHA Permissible Exposure Limit (PEL). The level of particulates containing silica in the tests were either undetectable or less than half the level of the OSHA PEL.

Use of the water spray nozzle on the chipper reduced employee exposure to total dust with silica by 85% and reduced exposure to respirable dust with silica by 70%.

Controls

Engineering Controls

A. Methods/procedures to minimize dried concrete buildup in mixers

Employee exposure to higher concentrations of silica occurred due to heavy build-up of concrete inside the drum mixer. Rinsing the drum mixer with water immediately after each load will minimize dust exposure.

The amount of build-up of concrete depends on the rinse procedure used by the driver. Some drivers who practice good rinsing procedures have minimal build-up of dried concrete in their trucks. Other drivers with poor rinsing procedures have significant build-up of dried concrete.

Good drum rinsing procedures included a rinse after each load is delivered and a triple rinse at the end of each work shift.

When a driver has a slower pour which can result in excess concrete build-up in the drum, a load of ¾ inch aggregate can be loaded into the drum and rotated for 30 minutes to scour the drying concrete from the inner surface of the drum.

Employees must be trained on the importance of monitoring the dust level generated during chipping.

If dust levels begin to increase, rewet the entire surface, ensure water is continuously spraying while chipping at the point where the chisel meets material.

It is also important for supervisors to ensure proper procedures are followed throughout the chipping process.

B. Methods/procedures to follow to maintain employee exposure to silica below the OSHA Permissible Exposure Limit (PEL) while chipping out a drum.

1. Hatch open
2. Place box fan horizontally in hopper
3. Set on high speed and exhaust the air flow out of the drum
4. Use chipping hammer equipped with water spray nozzle
5. Initially spray the entire inner surface of the drum with water
6. Adjust the water spray so that it is aimed at the point of the chisel
7. Ensure water sprays at all times when the chipper is in operation
8. If during the cleaning procedure, concrete surfaces dry to the point that dust is being generated while chipping, the surface should be re-sprayed with water.

MODIFIED CHIPPER WITH WATER SPRAY NOZZLE

List of items

- 1/4" ID hydraulic line 10 to 12 feet long with compression fittings and screw fittings on each end. The hydraulic line like the one used for the hydraulics at the chute will work.
- Chapin #6-4824 7 piece nozzle pack or only order the ¼ gallon per minute nozzle.
- Water shut-off valve and coupling.
- Reducer coupling to transition from the hydraulic line to standard garden hose.
- Duct Tape

The spray tip is screwed onto the end of the hydraulic line. The water shut-off valve and coupling to connect to the water hose is screwed on the other end of the hydraulic line or can be connected with a quick connect coupling.

The spray tip is wrapped with duct tape to prevent the tip from unscrewing. Then the tip can be duct taped to the collar of the chipper. The spray nozzle should be pointed as much as possible toward the tip of the chisel and should not extend much beyond the collar of the chipper.

Tape the hydraulic line either to the top side of the chipper handle or below the handle taking care that the line will not interfere with the trigger.

The operator should turn on the water and wet down the general area where they will be chipping and then begin to the chipping procedure. Use eye protection and a face shield to protect the operator's face from concrete chips and water spattering.

Protect lights used in the drum with a clear cover to minimize the possibility of the bulb breaking from water spray or concrete chips.

All electrical cords connected to lights or fans near the drum should be approved for use in wet conditions and **must** be plugged into a ground fault circuit interrupter .

Noise Results

Noise

Personal noise monitoring was conducted on employees during the truck drum cleaning process. Employees wore Quest Micro 15 noise dosimeters to determine average noise exposures during the cleaning procedure. Exposure to an eight hour time weighted average noise level of 90 decibels on the "A" scale (dBA) can result in hearing loss.

The average noise level readings during the cleaning procedure ranged from 113 dBA to 115 dBA. Exposure to noise at this level exceeds the OSHA PEL and requires employees to be included in a hearing conservation program. Additionally, adequate hearing protection must be worn at all times during the drum cleaning process. Adequate hearing protection at these noise levels requires the use of double hearing protection. That is the use of ear plugs in addition to muffs such that the combined effectiveness of the hearing protection is adequate to reduce the employee's noise exposure below 90 dBA.

Essential elements of a hearing conservation program include conducting annual hearing tests for all employees involved in the truck drum cleaning process, instructing them on when to use hearing protection and the proper use and care of the hearing protection, and training on the effects of noise on the ear.

OSHA mandates that employers look for economically feasible engineering controls to reduce employee exposure to occupational noise. There does not appear to be much on the market in terms of adequate control measures to reduce noise levels while chipping inside drum mixers. An investigation into silencers for the pneumatic chippers used during the drum cleaning process did not identify any products that would make a significant impact on reducing noise levels during the process.

One control measure that was used to reduce noise levels outside the drum during the cleaning process was a polypropylene tarp typically used to protect wet concrete from weather related elements. It was draped over the entire exterior surface of the mixer drum. This reduced noise levels outside of the drum by as much as 10 decibels. This control measure could be used to reduce noise exposures for employees working in the near vicinity to the truck during the cleaning process and could be a reasonable method to reduce noise levels that cross the facility's property line in residential neighborhoods.

Control Methods

Effectiveness of Various Control Methods

A	Hatch closed and no fan (no controls)	With the drum hatch closed and no fan moving air into or out of the drum, personal air monitoring to determine the employee's exposure to total particulates containing silica and respirable silica was conducted while the driver removed dried concrete from the walls of the drum. A significant amount of dust was generated inside the drum during chipping. This was due in part because of poor circulation of air inside the drum. The employee's exposure to total particulates exceeded OSHA's Permissible Exposure Limit.
B	Hatch closed and box fan at hopper exhausting air from drum	This sampling was performed with the hatch closed and a box fan placed at the opening of the hopper to exhaust air out from the drum. This testing resulted in a much lower employee exposure to both total particulates containing silica and respirable silica. Providing air movement throughout the drum during chipping proved to be somewhat effective in reducing dust exposures.
C	Hatch closed and using flexible exhaust duct in drum	With the hatch closed, a flexible 12-inch duct equipped with a one-third horse power ramfan was routed through the hopper and positioned in the mixer drum. In order for the ramfan to effectively and consistently exhaust air contaminants, the opening of the duct must be placed as close as possible to the point of dust generation. The positioning and continual repositioning of the duct to assure it was close enough to the point of dust generation was difficult for the employee during the cleaning process. Air sampling results indicated the employee's exposure to total particulates containing silica exceeded OSHA's PEL.
D	Hatch open and using flexible exhaust duct in drum	With the hatch open, a 12-inch duct equipped with a ramfan was placed inside the drum similar to Section C to capture air contaminants as close as possible to the point of dust generation. Again, this method proved to be ineffective due to the handling and positioning difficulties of the duct while the employee was chipping. However, air monitoring results indicated the employee exposure levels for both total particulates containing silica and respirable silica to be below OSHA's PEL. The farther away the duct is from the point of dust generation, the less effective the system becomes in removing air contaminants. Having the hatch open reduced the buildup of airborne dust in the drum during the cleaning procedure.
E	Hatch open and box fan at hopper end blowing air into the drum	A box fan was placed at the hopper, blowing air through the drum mixer and out the open hatch. The air movement in the drum helped to carry the dust out of the drum. However, when the employee was working at the hopper end inside the drum, the dust was blown into his breathing zone. This method resulted in the employee's exposure being slightly below OSHA's PEL.

F	Hatch open, pedestal fan outside hatch blowing air into drum and box fan at hopper exhausting air out from drum	A pedestal fan was placed at the hatch opening, blowing air into the drum through the hatch. A box fan was positioned at the hopper end allowing air to be exhausted out from the drum. Most of the cleaning occurred at the hatch end. Exposure to total particulates containing silica was very high. We believe that the elevated exposures were the result of dust blowing into the employee's breathing zone during the cleaning process. The mixer fins move the air in a cyclonic turbulence that significantly contributes to the amount of dust being blown into the employee's breathing zone.
G	Combination (1) Hatch open and box fan at hopper end blowing air through the hatch and into the drum when the employee was working in the front and middle sections of the drum. (2) Hatch open and box fan at hopper end exhausting air out of drum when worker at hopper end of drum	(1) This sample produced much higher results above OSHA's PEL than any other method conducted excluding the method where the fan was placed at the hopper and exhausting air out of the drum mixer. Again, part of the reason is the cyclonic turbulence described in Section F. In addition, it was discovered during this sampling period that a lot of the dust was coming from the core of the concrete rather than the surface of the material. As the driver chipped into the core of the concrete, the dust would shoot back into the employee's breathing zone, thus increasing the likelihood of exposure to silica above the PEL. (2) Concentrations of respirable silica were not detected during this sampling. This truck had minimal build-up of concrete residue unlike the first truck. This could very well explain why the concentration of respirable silica was undetectable. However, concentrations of total particulates with silica exceeded the OSHA PEL. One possible reason these results were much higher may have been related to a larger water tank on this truck as opposed to a much smaller water tank used on the first truck. The larger water tank may facilitate more effective rinsing of the drum by the driver after a load is delivered. Additionally, the exhaust being pulled through the truck mixer via fan at the hatch could have been overpowered by strong winds on that day, resulting in minimal exhaust of dust from the mixer.
H	Same as G. but interior of drum sprayed with water prior to chipping	To reduce the generation of dust from the surface of the dried concrete in the drum during chipping, the interior of the drum was sprayed with water and allowed to soak. There was little effect in reduction of silica dust exposures. When the chipper would chip a hole in the dried concrete, the dust was blown out of the hole and into the employee's breathing zone.

I	Combination	
	(1) Hatch open and box fan at hopper end blowing air into the drum when the employee was working at the front and middle sections of the drum.	(1) To reduce the generation of dust in the drum during chipping, the interior of the drum was sprayed with water and allowed to soak. The employee sprayed water periodically inside the truck but not at the chisel point. This method was not effective in reducing dust levels inside the truck mixer. Due to the similar situation as described in Section H, spraying water on the surface of the material was not enough to significantly reduce employee exposures to silica. The dust exposure was coming directly from the chisel point area during the chipping.
	(2) Hatch open and box fan at hopper end exhausting air out of the drum when worker at hopper end of drum.	(2) (2) Exhausting air at the hopper end was intended to reduce the dust being blown into the employee's breathing zone similar to the situation described in Section E. This configuration did not achieve the desired effect. When the employee was working at the hopper end, in addition to #2, a flexible duct was used to route air from the hatch to the work site to minimize air turbulence in the drum. Again, employee exposures were not significantly reduced.
J	Pre-sprayed general surface with water and continuously sprayed water at chisel point during chipping.	Pre-spraying the entire interior surface of the drum mixer with water and spraying water continuously at the chisel point achieved exposures to silica that were below OSHA's Permissible Exposure Limits.
K	Using a water spray nozzle attached to the chipper	A pneumatic chipper was modified to include a water supply hose and spray nozzle to allow the employee to periodically spray the general interior surface of the drum and have a continuous water spray directed at the chisel point during chipping. The flow rate or the amount of water spraying at the chisel point can be adjusted by the employee. Employees were very comfortable using the chipper equipped with the spray nozzle. In fact, all drivers noticed a significant reduction in dust being generated inside the drum mixer during chipping. As noted in the executive summary of this report, the use of the water spray nozzle on the chipper reduced employee exposure to total dust with silica by 85% and reduced exposure to respirable dust with silica by 70%. While using this tool, it is important to always have any electrical items in the drum plugged into a ground fault circuit interrupter (GFCI). (See Attachment I to this report for items needed to modify your pneumatic chipper.)

IRMCA Study

Data Tables from Original Study October 1997 through June 1999

IRMCA DRUM CLEANING AIR SAMPLING SUMMARY DATA

	RESPIRABLE PARTICULATES						TOTAL PARTICULATES									
TEST	SAMPLE CONC.	SILICA (QUARTZ)	EXP. TIME	TWA*	% SILICA	RESPIRABL % OF PEL	SAMPLE CONC.	SILICA (QUARTZ)	% SILICA	% OF PEL	HATCH	FAN IN	FAN OUT	EXH. DUCT	WATER	COMMENT
1B	10.6	0.753	140	2 HRS	7.1	241	2.37	0.404	17	37	open	hatch	hopper	-	-	Sm WT/wk at Hatch end/sign. bldup
2B	N.D.	N.D.	160	2 HRS	-	0	41.5	1.54	3.7	197	open	-	hopper	-	-	Lg WT/1 trk hopper end/2trk min bldup
3B	5.65	0.356	80	2 HRS	6.3	118	44.6	1.76	3.9	219	open	hopper	-	-	partial	all srfc wetted initially then periodically during chipping
4B	10.8	0.955	68	2 HRS	8.8	292	85.7	3.2	3.7	407	open	-	hopper	-	partial	all srfc wetted initially then periodically 'during chipping - wk at hopper end
5C	1.02	0.107	237	3 HRS	11	33	16	0.759	4.7	89	open	hopper	-	-	-	
6C	10.9	1	194	2 HRS	9.2	306	196	1.99	1	490	open	-	hopper	-	-	Different employee and truck than 5C
7C	5.27	0.741	86	2 HRS	14	210	49.1	3.31	6.8	360	open	hopper	-	-	partial	Drum presoaked, all srfc wetted initially and periodically during chipping
8E	1.83	0.176	121	2 HRS	9.6	53	34	4.46	13	425	open	hatch	hopper	-	-	Most of work at hatch end.
9E	2.09	0.455	97	2 HRS	22	124	87.8	3.64	4.1	446	open	hatch	hopper	-	-	Most work at hach end.
10E	12.9	1.97	65	2 HRS	15	548	121	9.45	7.8	988	open	hopper	-	-	-	Work at hatch end.
11E	11.7	1.7	64	2 HRS	15	480	161	11.7	7.3	1248	open	-	iopper/tan	-	-	Working in center of truck. Operator commented that dust conc. was greater.
12E	0.584	0.045	130	2 HRS	7.8	14	5.81	N.D.	0.7	13	open	hopper	-	-	yes	All srfc prewetted and water used during all jack hammer use at chisel pt.
13V	0.645	N.D.	91	2 HRS	10	19	5.54	0.72	13	69	closed	-	hopper	-	-	
14V	1.43	0.109	117	2 HRS	7.6	34	20.5	0.76	3.7	97	closed	-	-	-	-	
15V	2.14	N.D.	172	2 HRS	1.6	19	15	0.54	3.6	70	open	-	-	-	-	
16V	2.01	0.09	267	2 HRS	4.5	33	32.4	0.61	1.9	105	closed	-	-	yes	-	Flexible exhaust duct 1/3 hp. RAMFAN
17R	1.89	0.165	96	2 HRS	8.8	51	12.3	0.931	7.6	98	open	-	-	yes	-	Minimal bldup/used 12" duct w/RAMFAN
18R	1.12	N.D.	90	2 HRS	5.8	22	16.8	0.74	4.4	89	open	50% hoppe 50%hatch	-	-	-	Wk at hatch end w/fan blwng in from hopper.
19v	4.25	0.258	1.3	2 HRS	6.1	54	12.1	0.488	4.1	38	open	hopper	-	-	yes	Wk at hopper end w/fan blwng in from hatch. (For 18R Min. Bldup.)
20v	1.81	0.079	1.6	2 HRS	4.4	23	4.78	0.256	5.4	24	open	hopper	-	-	yes	(For tests 19v, 20v and 21c, the modified chipper with water spray was used as in 12E.)
21c	0.667	0.179	11.7	2 HRS	27	42	6.03	1.05	17	83	open	hopper	-	-	yes	

* TWA exposure was calculated using sample concentration for # of hours indicated as estimated exposure time and remaining hours of workshift with no exposure to silica

Validation Study

Data Tables from 2006 Study

RESPIRABLE PARTICULATES CONTAINING SILICA

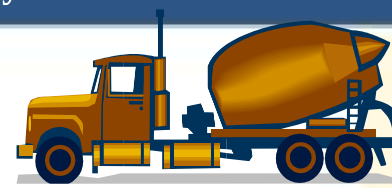
TEST	SAMPLE CONC.	SILICA (QUARTZ)	EXP TIME	PEL	TWA*	% SILICA	% OF PEL	WATER	COMMENTS
23P	N.D.	N.D.	34	5	2 HOURS	-	0	Used modified chipper, presoaked and wetted during chipping	Fan in hopper exhausting dust
24P	0.6	0.6	67	5	2 HOURS	-	0	Used modified chipper, presoaked and wetted during chipping	Fan in hopper exhausting dust
25P	1.1	0.28	123	0.98	2 HOURS	8.2	29	Used modified chipper, presoaked and wetted during chipping	Fan in hopper exhausting dust

Time Weighted Average (TWA) was calculated using sample concentration for # of hours indicated as estimated exposure time and remaining hours of work shift with no exposure to silica.

PEL = Permissible Exposure Limit

N.D. = None Detected

Conc. = concentration



Ready Mix Truck Mixer Entry Procedures for CHIPPING or INSPECTION

Truck mixers are equipped with rotating drums for the mixing of concrete before and during delivery to construction sites. The rotating drums on the mixers are periodically entered for cleaning by chipping or inspection. Retrieval lines and harnesses generally required are impractical for use in truck mixers because the internal configuration and their interior baffles would prevent rescuers from pulling out workers.

The truck mixer meets OSHA's definition for permit-required confined space [PRCS]. While entry operations present many different hazards, the hazard that defines the truck mixer as "permit required" is the possibility of having the drum start turning while an employee is inside. This is a recognized hazard in the industry.

This space can be reclassified as a non-permit space as there are no actual or potential atmospheric hazards (note that silica is a chronic health hazard and as such is not covered under the Permit Entry Confined Space Standard) **and if all the other hazards within the space are eliminated without entry into the space**.

Entry can then be made without a permit, attendant or entry supervisor. ***A certification record must be completed prior to each and every entry.***

Entry & Lockout Procedures

Step	**Hazard**	**Procedure/Protection**
Preparation for Mixer Entry	Mechanical hazards (struck or caught by) may exist during entry into the mixing drums for maintenance operations, including truck movement, rotation of the drum and injuries from the use of tools and other equipment.	Move truck to a safe location. Prior to entry, implement full lockout/tagout procedures to ensure control of hazardous energy sources such as electrical (remove key), hydraulic or pneumatic (bleed if applicable) and kinetic (block and secure).

Lockout

1. Notify all who are affected by your work (i.e. unit driver) that lockout procedures are in effect.
2. Empty mixing drum of all loose materials and park in a safe area. Note: Any vehicle or mechanical equipment capable of having parts of its structure elevated near energized overhead lines must be operated so that a clearance of 10 feet is maintained.
3. Set brakes and chock wheels.
4. Position drum hatch where convenient for work to be performed if applicable.
5. Place drum control lever in neutral position so drum remains stationary.
6. Remove key from ignition and keep in pocket.
7. Roll up cab windows and lock doors.
8. Disconnect battery cables.
9. Place “Out of service” signs on both doors and windshield. Sign should be appropriate for activity, i.e. A Person Working in Drum. Do Not Start Drum or Rotate Mixer.
10. Relieve air pressure, if applicable.
11. Double check to make sure Control Valve Arm is in neutral position.
12. Remove nut and lockwasher on control valve arm.
13. Remove control valve arm and place safety lockout with tag in splined hole of control valve arm.
14. Tag all controls.
15. Open hatch, if applicable, and secure drum in position to prevent movement, i.e. using load tie downs, wedge assembly or angle iron wedges. Additional blocking of the drum may be required to prevent the drum from slipping due to excess concrete build-up and removal of the concrete with excessive pounding or use of pneumatic tools.

At this point, the confined space is reclassified to a non-permit space as all hazards have been eliminated. A hazardous atmosphere does not exist based on previous history and air monitoring data. **Complete the certification record.**

CERTIFICATION RECORD
RECLASSIFICATION OF PERMIT-SPACE TO NON-PERMIT ENTRY
I certify that all hazards have been eliminated prior to entry.
DATE: ______________________
LOCATION:
____
____

☐No problems were encountered during entry
SIGNATURE OF PERSON: ______________________________________

Step	Hazared	Procedure/Protection
Mixer Entry	Slips and falls when entering	♦ Inspect ladder for defects prior to use. ♦ Use three points of contact when climbing. ♦ Secure portable ladders.
Chipping	Falling Material	♦ Wear Class A hard hat (ANSI Z89.1-1986 or later.) ♦ Wear safety shoes (ANSI Z Z41-1991 or later.) ♦ Arm Protection
	Eye and face injury from flying and falling materials	♦ Wear eye protection with side shields suitable for industrial use (ANSI Z87-1989 or later.) **AND** ♦ Wear full face shield over the eye wear. Note: Wearing a face shield does not eliminate the need
	Inhalation of airborne silica created from chipping operations	Use wet methods 1. Open hatch. 2. Place box fan horizontally in hopper 3. Set on high speed and exhaust the air flow out of the drum 4. Use chipping hammer equipped with water spray nozzle 5. Initially spray the entire inner surface of the drum with water 6. Adjust the water spray so that it is aimed at the point of the chisel 7. Ensure water sprays at all times when the chipper is in operation 8. If during the cleaning procedure, concrete surfaces dry to the point that dust is being generated while chipping, the surface should be re-sprayed with water.

Note: If employee has to work at hopper end and needs to face toward hopper, the fan should be turned over to exhaust air out of the mixer. Wear respiratory protection such as two strap disposable respirator for dust (N95) or half-mask respirator with HEPA filters

Step	Hazard	Procedure/Protection
	Noise levels in excess of 100 dBA	Wear two sets of hearing protectors - inserts as well as ear muffs.
	Heat stress	Drink plenty of water; take frequent breaks.
	Electrical shock from faulty equipment	➢Inspect electrical prior to use. ➢Use ground fault circuit interrupters (GFCI.)
	Hand-arm vibration syndrome (if activities take more than one continuous hour)	➢Minimize power and weight of tool. ➢Use heavily padded gloves. Use vibration-damping material on the tool handle.
	Optional Items	• Tyvek Suit for employee to prevent dust from getting on clothing. • Rag to wipe off face shield periodically • Light either on the helmet or on a clamp with a clear covering to protect the bulb from water splashes and concrete chips.

STARTUP PROCEDURE:

1. Remove all tools and materials from area.
2. Remove load tie-downs or wedge assembly from the rear
3. Replace all covers and guarding devices
4. Check that all personnel are in a safe area out from any hazards
5. Remove lockout and reattach control valve arm
6. Restore energy sources
7. Restart equipment and verify operation
8. Notify all affected employees that lockout has been completed

Note: At this point, the mixer again becomes a Permit Entry Confined Space. When entering, start over again. See page 17.

Help

Getting Help

Consultation Program – this is a free consultation service largely funded by OSHA where employers can: find out about potential hazards at their worksites; improve their occupational safety and health management systems; and even qualify for a one-year exemption from routine OSHA inspections.

The service is delivered by state governments using well-trained professional staff. Most consultations take place on-site, though limited services away from the worksite are available. The program is primarily targeted for smaller businesses and is completely separate from the OSHA inspection effort. In addition, no citations are issued or penalties proposed. Your name, your firm's name, and any information you provide about your workplace, plus any unsafe or unhealthful working conditions that the consultant uncovers, will not be reported routinely to the OSHA inspection staff. Your only obligation will be to commit yourself to correcting serious job safety and health hazards -- a commitment which you are expected to make prior to the actual visit and carry out in a timely manner. Because consultation is a voluntary activity, you must request it. Your telephone call or letter sets the consulting machinery in motion.

In Illinois, call 1-800-972-4216

For other states, find the consultation project near you by going to the OSHA website at www.OSHA.gov. In the right hand margin, under “Cooperative Programs”, click on “consultation”.