

PLAINTIFF'S
EXHIBIT

FWS-24

FRANK W. SCHAEFER, INC.

INDUSTRIAL HYGIENE REPORT OF:

February 3, 1987 & February 9, 1987

0006 4516



Together, we can make
Ohio jobs safer.
DIVISION OF SAFETY AND HYGIENE
THE INDUSTRIAL COMMISSION OF OHIO
Richard I. Casella, Governor
246 N. High St., Col. O. 43215

Carl Schaefer
Frank W. Schaefer, Inc.
1500 Humphrey Avenue
Dayton, Ohio 45410

Dear Mr. Schaefer:

In response to your request to have employee exposure to dust, refractory ceramic fiber, and welding fume evaluated, Industrial Hygienists Roger Aber and I, visited your shop on January 27, 1987. After reviewing the processes, Holger Hille and I returned to conduct air sampling on February 3, 1987. I returned on February 9, 1987 to conduct additional air sampling and to conduct a noise survey. The results of these surveys are summarized in the attached data tables.

We found that employees were exposed to respirable dust containing quartz and cristobalite which are forms of crystalline free silica, above acceptable limits while operating the portable mixer and while installing refractory materials in a furnace. Total dust exposure during demolition activities were also above acceptable limits. Five of the six employees monitored for noise were exposed above the action OSHA level of 85 dBA (decibels, "A-weighted" scale); two were exposed above 100 dBA. Although samples were not collected, potential exposure to cyanide salts during demolition of heat treat tank lining is also discussed.

In this report we will discuss how the samples were collected and analyzed, how the results compare to established occupational health limits, and suggest methods for controlling employee exposure. Our goal is to assist you in preventing the incidence of occupational illness or injury in the workplace.

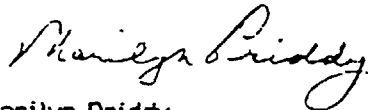
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Our report has been divided into the following sections:

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If you have any question or would like additional information, please call our office at (513) 898-3206. I appreciate the courtesy and assistance provided by Schaefer employees and yourself during my visit.

Sincerely,



Marilyn Priddy
Certified Industrial Hygienist

Frank W. Schaefer, Inc.
Section I -- Introduction

INTRODUCTION

The Occupational Safety and Health Administration (OSHA) has established permissible exposure limits (PEL) for several hundred chemicals. Most of the PELS are the same values as the 1968 Threshold Limit Values established by the American Conference of Governmental Industrial Hygienists (ACGIH). The current TLVS and existing NIOSH recommended exposure limits are also shown in the data tables. Before comparing the survey results to these values we should consider the following statement by the ACGIH:

"Threshold limit values 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 effect. Because of wide variation in individual susceptibility, however, a small percentage of workers may experience discomfort from some substances at concentrations at or below the threshold limit; a smaller percentage may be affected more seriously by aggravation of a pre-existing condition or by development of an occupational disease."

Please note that OSHA regulations on noise, hazard communication, and access to medical records require that employees be informed of exposure monitoring results.

DUSTS

Background Information

Breathing-zone samples were collected to determine employee exposure to dusts during routine fabrication of an industrial furnace, during manual cutting and installation of refractory ceramic blanket material, and during non-routine furnace wrecking. More specific information about the jobs performed during our survey is included in the following discussion. Additional evaluation will be needed to determine the effectiveness of local exhaust ventilation provided at the band saw located in the wood shop and the power saw located in a separate building. Neither of these saws which are used to cut refractory ceramic fiber materials was in use during our survey.

As mentioned in our cover letter we found that employees were exposed to excessive respirable dust containing crystalline free silica (quartz and/or cristobalite), during routine mixing and installation activities. During non-routine demolition project, high dust exposures occurred.

Inhalation of excessive dust containing crystalline free silica can cause silicosis, a pulmonary fibrosis. It is disabling, progressive and sometimes fatal. It is characterized by the formation of small, discrete, fibrous nodules in the lung. At this stage, there are usually no symptoms or detectable evidence of physical impairment. However, as the disease progresses, symptoms such as cough, difficulty breathing, wheezing, repeated non-specific chest illness, and decreased work capacity begin to occur. Clinical signs and symptoms tend to progress with or without continued exposure.

Unlike crystalline free silica which has been recognized as a health hazard for centuries, the health effects of long term exposure to refractory ceramic fibers are still being studied. I have included copies of a Los Alamos National Laboratory press release and final report concerning the

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recent completion of their seven-year study of rodents exposed to manmade mineral fibers. Until more information is available on the effects of exposure to these materials on humans, exposure levels should be kept as low as possible by following the work practices outlined by the manufacturers of these materials and by implementing engineering and other control measures.

Sampling and Analytical Methods

Respirable Dust

Breathing-zone samples were collected on pre-weighed PVC filters contained in 7 mm nylon cyclones. The cyclones were attached by Tygon tubing to Gillian pumps which were calibrated before and after use. The cyclones collect particles which are considered respirable, e. g. particles smaller than 0.5 microns (μ). After checking the calibration of the pumps, the filters were sent to an accredited industrial hygiene laboratory where weight gain was determined. Some samples were analyzed for percent quartz and percent cristobalite using x-ray diffraction.

Total dust

Breathing-zone samples were collected and analyzed as described above except the cassettes containing the PVC filters were not placed in cyclones.

Fibers

Breathing-zone samples were collected on 37 mm diameter mixed cellulose ester filters (0.8 micron pore size) contained in small cassettes. The cassettes were attached by Tygon tubing to Gillian pumps which were calibrated before use to pull 2 liters of air per minute. The cassettes were sent to an accredited industrial hygiene laboratory where the filters were analyzed by phase contrast microscopy. The results are reported as

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fibers per cubic centimeter of air (f/cc). Fibers are considered those particles which are greater than 5 microns (μ) in length, having a length to width ratio of at least 3:1.

For those samples marked by an asterick in Tables 2D, the NIOSH 7400 method was used. With this method, which is described in the recently promulgated federal asbestos standard (29 CFR 1910.1001, Appendix B), 25 mm diameter mixed cellulose ester filters are used. Neither of these methods distinguish the type of fiber present.

Exposure limits

The OSHA PEL for respirable dust containing quartz is determined by a formula: $10 / (\% \text{ quartz} + 2)$. Since quartz is in the denominator of this formula, the higher the percentage of quartz in the sample, the lower the PEL becomes. If a sample contains 100% quartz, the OSHA PEL is $10 / (100 + 2) = 0.1 \text{ mg}/\text{m}^3$. If a sample contains 50% quartz, the OSHA PEL is $10 / (50 + 2) = 0.2 \text{ mg}/\text{m}^3$.

Since cristobalite is considered more toxic than quartz, a lower PEL has been established. The OSHA PEL for respirable dust containing cristobalite is determined by taking half of the value determined for respirable dust containing quartz: $1/2 [10 / (\% \text{ quartz} + 2)]$.

The ACGIH threshold limit values (TLVs) for respirable dust containing quartz and/or cristobalite are somewhat simpler to understand. The TLV for quartz is 0.1 mg quartz per cubic meter of air, $0.1 \text{ mg}/\text{m}^3$. The TLV for cristobalite is 0.05 mg cristobalite per cubic meter of air, $0.05 \text{ mg}/\text{m}^3$. NIOSH recommends an exposure limit of $0.05 \text{ mg}/\text{m}^3$ for both silica and cristobalite.

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Discussion

Employee exposure to respirable dust and respirable cristobalite exceeded occupational exposure limits on the survey date. The following discussion of the employees sampled and the jobs they were performing may assist you in interpreting the attached data tables.

Table 2A, 2/3/87: Mr. Dave Allen was mixing materials required for insulating a furnace under construction. During the sampling period he opened six bags of LW120. Sample time was shortened because he left early. His exposure to respirable dust for the time sampled was 5.6 mg/M³, or 3.6 mg/M³ for 8 hours. The sample contained 1.2% quartz and 6.6% cristobalite. The PEL for dust containing 6.6% cristobalite is only 0.6 mg/M³. Since the sample contained both quartz and cristobalite, two different PELs apply. Using the formula: $\text{Conc}/\text{PEL} + \text{Conc}/\text{PEL} + \dots \text{Conc}/\text{PEL} = 1$, the PEL for dusts containing more than one kind of silica can be calculated. If the sum is more than one, the PEL is exceeded.

The calculation works out to be 6.8. This means that his exposure was about 7 times higher than the PEL for this mixture. The mixture formula also applies to the TLVs. In this case, his exposure was about 5 times higher than the TLV for this mixture.

A generic material safety data sheet was provided for LW120. It is not possible from the MSDS to determine if this material contains quartz and/or cristobalite, or the percent which may be present. A bulk sample of the material showed it contained 1.9% quartz and 1.7% cristobalite.

Table 2B, 2/3/87: An area sample for total dust was collected in the vicinity of the portable mixers on this date. The results showed 2.8 mg/M³, quartz content 2.0%. This value cannot be compared to the PEL or TLV since it does not represent an employee's exposure; but, it does show that a significant amount of quartz-containing dust is released into the general area during operation of the mixer.

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Table 2B, 2/3/87: Mr. Ray Moorman was ramming mud in a furnace during assembly. His exposure to respirable dust for the time sampled was 2.5 mg/M^3 , or 1.7 mg/M^3 for 8 hours. The PEL for such dust is calculated to be 2.4 mg/M^3 , given its 2.1% dust content.

The TLV for respirable quartz is 0.1 mg/M^3 . His exposure to respirable quartz was 0.05 mg/M^3 for the time sampled, or 0.04 mg/M^3 for 8 hours. Therefore, on the survey date Mr. Mooreman's exposure was about 70% of the PEL for respirable dust containing quartz and was about 50% of the TLV for respirable quartz. This indicates that exposure to respirable dust containing quartz occurred while Mr. Mooreman was ramming of the "mud." Whether his exposure resulted from his activity or other activities in the general area, e.g. application of furnace insulation, mixing, etc. cannot be determined from this data. (The demolition of the furnace which we sampled did not occur on the same day that we sampled Mr. Mooreman so it is not a factor.)

Table 2C, 2/3/87: Brian Davis was sweeping floors in the morning and was banding pallets and driving a fork lift in the afternoon of this survey date. His exposure to respirable dust was 0.87 mg/M^3 ; the dust contained less than 5% quartz ($<0.025 \text{ mg quartz}$). Since, the quartz and cristobalite content of the sample could have been higher, depending on the material being swept, it is not appropriate to consider this merely a nuisance dust exposure. There is also potential exposure to refractory ceramic fibers during sweeping.

Table 2D, 2/3/87: Charlie Howard was cutting a refractory ceramic fiber blanket with a knife and installing it in an oven to be used in-house. We collected samples on eight separate filters to avoid overloading the filters with particulate. His time-weighted average exposure for the time sampled was 0.26 fibers per cubic centimeter (f/cc). As you know, both Babcox and Wilcox and Sohio Carborundum who manufacture refractory ceramic fiber products recommend an exposure limit of 2.0 f/cc.

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Table 2E, 2/9/87: Mr. Ross was tearing the lining out of a furnace using an air hammer. Determining Mr. Ross's exposure in terms of f/cc was not possible since the sampling filters would have been loaded too quickly with dust to allow analysis by phase contrast microscopy. Total dust samples were collected for Mr. Paul Ross. His time-weighted exposure was 13.3 mg/M^3 for the time sampled. The laboratory reported that this may be an underestimation of his actual exposure since the filters were so heavily loaded. This exposure level exceeds the TLV for nuisance dust which is 10 mg/M^3 .

There was so much dust on the filters that the laboratory determined quartz content by taking aliquots of the samples. The aliquots represented between 0.5% to 1% of the total sample. Less than 0.02% quartz was found in these aliquots. Although not detected in these samples, cristobalite is known to be formed from refractory ceramic fiber products after the products have been in service. We must emphasize here that the dust created during the demolition of the furnace, which are lined with a variety of materials including refractory ceramic fiber products, cannot be considered merely nuisance dust. Also, although asbestos is not used in the manufacture of the furnaces, it has been used as a patching material by some customers. As you know wrecking or repairing such equipment will result in employee exposure to asbestos unless precautions are taken.

Table 2F, 2/9/87: Kurt Voltee was applying refractory and insulating materials to a furnace under construction. He said he was using K-FAC SR, 423E Taylor, Super X, and Airlite. During the morning (215 minute sample time) he was exposed to 4.0 mg/M^3 respirable dust which contained 2.8 % cristobalite. The PEL for respirable dust containing this amount of cristobalite is 1.0 mg/M^3 . During the afternoon (194 minute sample time) he was exposed to 1.6 mg/M^3 respirable dust containing 21% quartz. Thus, by time-weighting these results and by using the mixture formula described above, we determined his exposure was about 3 times the PEL:
 $(215/480)(4/1) + 194(480)(1.6)(0.43) = 3.3$.

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His exposure was compared to the TLV in a similar manner. The morning sample contained 0.11 mg/M³ cristobalite. The TLV for respirable cristobalite is 0.05 mg/M³. The afternoon sample contained 0.31 mg quartz. The TLV for respirable quartz is 0.1 mg/M³. Therefore, his exposure was about 2 times the TLV:

$$(215/480)(0.11/0.05) + 194(480)(0.31/0.1) = 2.2.$$

Recommendations

A. Engineering Controls

1. General comments

Whenever possible engineering controls must be designed and installed to reduce employee exposure. Respiratory protection can be used as a control measure only during interim periods when such controls are being designed, when such controls are infeasible, or during emergencies. The problems of trying to achieve control by relying only on the use of respirators was observed during our surveys. The posted safety policy states, "Respirators are to be worn by all during the mixing of castables, refractory wrecking and the handling of insulation." We observed many several violations of this rule. One of the employees involved in the demolition project never did wear a respirator (or eye protection) because "he did not want to." As far as I could tell no one in supervision asked him to put one on.

2. Ventilation

During our 2/3/87 survey only one of three fans located in the high bay were operating. These fans are designed to provide general dilution

ventilation which can be effective for diluting vapors and gases. However, such systems are not effective in capturing dust. Local exhaust ventilation has been shown to be an effective dust control measure in many industries where bags of toxic dusts are opened and dumped into mixers or hoppers. An illustration from the ACGIH Industrial Ventilation Manual showing a system for asbestos bag handling is attached. Please note that there is a chute in which to place empty bags. This prevents any additional handling of the bags which can be a significant source of exposure to dust. The chute opening into which the material is dumped can be designed to fit your mixers.

We observed that exhaust from the air-powered equipment used during both wrecking and ramming "mud" kicked up dust. In addition to the control measures listed above, you may want to try connecting some extra air hose to the exhaust port of the equipment to pipe the exhaust air away from the immediate work area. This should also achieve some noise reduction.

3. Wet Methods

You mentioned that you are also considering using water spray as a dust control measure at the mixing operation. This may be effective, especially if combined with the local exhaust system referenced above

Although dust control by exhaust ventilation is probably not feasible during demolition jobs, significant reduction in exposure levels can be achieved by using wet methods. During the survey date we observed that water was poured onto the lining occasionally, however, there was still an excessive amount of dust created. The asbestos abatement industry uses special wetting agents such as Aqua-GRO* (50% polyoxyethylene ester and 50% polyoxyethylene ether) which allow water to more readily penetrate the insulation. Table IV in the attached article entitled "Worker Exposure to Asbestos During Removal of Sprayed Material and Renovation Activity in Buildings Containing Sprayed Material," shows the kind of exposure

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reduction which can be achieved by effective use of wetting techniques during demolition activity.

4. Isolation

Until engineering control of the mixing operation can be achieved we recommend that you conduct all mixing outside. This alone may not reduce employee exposure levels to acceptable levels, but it will prevent to some extent the contamination of work surfaces in the shop. This settled dust can become airborne during sweeping and other activities days later and continue to be an inhalation hazard. This also applies to demolition projects. In addition to contaminating work surfaces, wrecking furnaces inside the building increases the noise and dust exposure for employees working in adjacent areas. We recommend that demolition be conducted only outside, or in a separate, heated building. Cold stress is a factor to consider but measures can be taken to prevent adverse effects of exposure.

B. Medical Surveillance

We recommend you establish a medical surveillance program for all employees who are potentially exposed to crystalline free silica, dust from refractory ceramic fiber products and other man-made mineral fibers. The NIOSH/OSHA recommendations from the attached "Occupational Health Guidelines for Crystalline Silica" should be followed. The physical evaluation of respirator users (as required by OSHA regulation 29 CFR 1910.134 and described in the attached ANSI publication) should be included in this program.

C. Personal Protective Equipment

1. Respiratory Protection

Effective respiratory protection is needed. You need to make sure that employees understand why they are being required to wear respirators and

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then make sure that they do. The proper respirator must be selected. 3M 8710 masks are approved for silica dust only when exposures are within 10 times the PEL. On our survey dates employee exposures were 3 times the PEL during mixing and 7 times the PEL during the installation of material. These exposure levels could easily have been higher, given the range of silica content in the materials used. Therefore, we do not feel confident that the masks provided are adequate. Full facepiece air-purifying respirators equipped with high efficiency filters can be used when exposures are up to 50X the PEL. See attached 3M selection guidelines. Since several of the 3M respirators cannot be used for asbestos at any concentration, they probably should not be used for other fibers which are suspected of being carcinogens.

The 3M 8710 respirators are definitely inadequate for demolition jobs. We did not determine employee exposure in terms of f/cc during the demolition which occurred on 2/9/87. However, since the total dust exposure was in excess of the nuisance dust TLV, we can project that the concentration also exceeded the 50 f/cc level. At this level, the manufacturer recommends full-facepiece Type C supplied-air respirators or their equivalent. Use of supplied-air respiratory equipment is standard practice during demolition of materials containing toxic dusts.

When supplied-air respirators are provided, special precautions are needed to make sure the air supply is of breathing quality. If compressors are used, special filters and carbon monoxide alarms are required. Bottled air certified as Grade D may be more appropriate in your case. (Do not confuse bottled air with bottled oxygen, the latter must never be used with air supplied respirators.) Equipment is available which heats/and or cools the air supply. Safety equipment distributors can provide additional information.

We have included three attachments concerning respirators which detail OSHA/ANSI requirements. Please note you are lacking some of the minimum requirements including a written program, medical evaluation,

and fit testing.

2. Eye and skin protection

Employees involved in demolition must have adequate eye protection. Again, even though the written safety policy states "eye protection is to be worn at all times at all sites while work is in progress," we noted during our survey that some of the workers involved in the demolition project were not wearing eye protection, although it was quite apparent that material was flying up into their faces from the use of air hammers.

Employees mentioned that fogging of the faceshields was a problem. Also they said they had trouble wearing both goggles/and or glasses and the dust mask at the same time. We think this is a valid concern. Employees are already in somewhat of a precarious position in that they are jackhammering away the surface they are trying to stand on. Reduced visibility is an additional hazard. Use of full-facepiece supplied air respirators which have impact resistant visors should solve this problem. The visors can be treated with an anti-fogging compound. An eye wash which has a capacity of at least 15 minutes should also be provided in the shop in the event of eye contact with these materials.

Skin protection is also needed. Sohio Carborundum recommends gloves, hats, and full body clothing to prevent skin contact with refractory ceramic fibers and/or fiberglass. These man-made mineral fibers are slightly to moderately irritating to the skin. Skin protection is needed to prevent skin contact with other materials, too. The PreKrete C-17 contains calcium oxide which can draw moisture out of the skin and is capable of causing skin rash or burns. The attached article entitled "Chromate dermatitis from a boiler lining" discusses severe dermatitis from exposure to hexavalent chrome from refractory lining.

If disposable clothes are not used, work clothes should be kept separate from clothes worn home. We observed jackets which were hung up in work

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area were contaminated with dust during the furnace wrecking job. Such articles should be stored in separate lockers in a dust-free area of the shop. Contaminated clothes should be laundered separately and the washing machine rinsed thoroughly after use. In order for you to make sure that your employees are not contaminating their families clothing with refractory ceramic fibers and other materials, we recommend that you either provide a uniform service, informing the launderer of the problem, or provide disposable clothing.

You may wish to consider taking advantage of Sohio/Carborundum's training video which discusses safe handling procedures for refractory ceramic fiber products. Also attached is a pamphlet from Babcock & Wilcox entitled "Safety and Health Aspects of Refractory Ceramic Fibers" which discusses health effects and recommends work practices for reducing exposure.

D. General Sanitation

1. Hygiene practices

We observed a problem with employees smoking while handling the refractory ceramic fiber materials. Having food, drinks, or tobacco products in the work areas where toxic materials are used is prohibited by OSHA. The material safety data sheet for Fiberfrax states specifically that ingestion may cause gastrointestinal disturbances with symptoms such as irritation, nausea, vomiting, and diarrhea. Separate lunch room facilities should be provided.

2. Housekeeping

A bulk sample taken of the dust from sweeping out the area where the new bake-out oven was being built was collected on 2/3/87 to determine if quartz was present, possibly from the fire brick which had been used in the area. The results showed quartz content was less than 1%.

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We noted that a bag of unidentified spilled material was allowed to remain on the floor of the shop for the entire survey day.

We recommend that, in situations like this where the content of the dust is either not known and/or when toxic dusts are known to be present, a HEPA-filtered vacuum be used for spill cleanup and for housekeeping activities. Dry sweeping should be prohibited. Sweeping with a dust suppressant is not nearly as an effective control measure as a HEPA-filtered vacuum.

E. Hazard Communication Involving Non-routine Tasks

It is very important to check history of furnace lining and previous use prior to repair or demolition. In addition to exposure to dust from the refractory materials and forms of crystalline free silica, there is potential exposure to residues in the furnace from its previous use. One example that we are aware of and which we are very concerned about is the repair and/or demolition of heat treat tanks which have contained molten cyanide salts. This activity was not occurring during our survey.

Employees said they used a air hammer to remove the linings from Robbins & Meyers' heat treat tanks. These tanks are used in a molten cyanide salt heat treat system. Other than use of a respirator (either a 3M 8710 or a full facepiece air-purifying respirator equipped with R-11 cartridges approved for dust, mist, and fume) there appeared to be no control measures, special protective clothing, or training provided for this job.

Cyanide salts can be inhaled if dust or aerosols are generated, they can be ingested if food, drink, or tobacco products are contaminated, and they can be absorbed through skin contact. It is not an exaggeration to project that given the lack of control measures, significant residual cyanide salt in a heat treat tank could result in death or serious injury.

We urge you to thoroughly study and implement the recommendations as

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described in the attached recommendations from the NIOSH publication "NIOSH criteria for a recommended standard...occupational exposure to hydrogen cyanide and cyanide salts (NaCN , KCN , and $\text{Ca}(\text{CN})_2$)". These recommendations and first aid procedures are attached. Antidote kits are available commercially. One source we know of is Eli Lilly Pharmaceutical Co., Indianapolis Indiana, (M-76 CN Antidote Package/NDC 0002-2385-01).

We recommend that you prepare a written plan to discuss how wrecking of these heat treat tanks will be conducted to prevent employee exposure to possible cyanide salt residue. As a minimum, the plan should describe how the following elements will be implemented:

- Medical surveillance of workers
- Antidote kits -- location and training
- Labeling or other warning signs
- Employee hazard awareness training
- Personal protective equipment -- Type C- supplied air respirators and full-body suits
- Work practices and control measures
- Waste disposal and storage
- Sanitation requirements -- prohibiting eating, drinking, smoking
- Monitoring
- Recordkeeping

Additional information on cyanide from a reprinted Monitor article is also enclosed. We will be happy to assist you in preparing a plan. We cannot overemphasize the importance of addressing this matter before the next repair or wrecking project is scheduled on such equipment.

* Mention of trade name does not imply our endorsement

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Attachments:

- Tables 2A-2F
- Los Alamos National Laboratory news release dated 10/30/86
- Smith, et al, "Long-Term Health Effects in Hamsters and Rats Exposed Chronically to Man-made Vitreous Fibers"
- Diagram of local exhaust ventilation system for asbestos fiber bag opening, VS-1001, from 18th edition of ACGIH Industrial Ventilation Manual, p. 5-125.
- "Worker Exposure to Asbestos during Removal of Sprayed Material and Renovation Activity in Buildings Containing Sprayed Material" AIHA Journal, 5/83.
- "Occupational Health Guidelines for Occupational Exposure to Crystalline Silica," NIOSH/OSHA Publication 81-123, 1981
- "Respiratory Protection" OSHA pamphlet #3079
- Minimum Requirements of a Respirator Protection Program
- ANSI standard on physical qualifications for respirator users
- "Imposing Questions Require Straightforward Answers," Monitor, 5/84.
- "3M Respirator Selection Guide for Asbestos"
- "Chromate dermatitis from a boiler lining," Contact Dermatitis, 3: 1977.

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- "Fiberfrax Ceramic Fiber Video Program" with excerpt from 1/7/86 Job Safety and Health Report, p. 6 entitled "Consolidated Edison Accused of Failing to Train Workers Handling Possible Carcinogens."
- Babcock & Wilcox "Health and Safety Aspects of Refractory Ceramic Fibers"
- Recommendations from "NIOSH Criteria for a Recommended Standard ... Occupational Exposure to Hydrogen Cyanide and Cyanide Salts (NaCN, KCN, and $\text{Ca}(\text{CN})_2$)", 10/76.
- "Industrial Use of Cyanide Requires Strict Guidelines," Monitor, 4/83.

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Ohio

TABLE 2-A

2-3-87

NAME/SHIFT SAMPLED	POSITION/ OPERATION	CONTAMINANT	SAMPLED (MINUTES)	CONCENTRATION DETERMINED	OSHA PEL	NIOSH REL.	ACGIH TLV
Dave Allen	Mixing - opened 6 bags LM120 (Went home early)	Respirable Dust 1.2% quartz & 6.6% cristobalite	310	for time sampled: 5.6 mg/M ³ for 8 hours: 3.6 mg/M ³ Using mixture formula: 6.8-1	-	-	-
		Respirable cristobalite	310	for time sampled: 0.37 mg/M ³ for 8 hours: 0.24 mg/M ³	-	-	0.05 mg/M ³
		Respirable quartz	310	for time sampled: 0.06 mg/M ³ for 8 hours: 0.04 mg/M ³	-	-	0.1 mg/M ³
		Mixture formula for above	310 480	8 e.g.	-	-	-

TWA - Time-weighted Average
TLV - Threshold Limit Value
REL - Permissible Exposure Limit
REL - Recommended Exposure Limit
ACGIH - American Conference of Governmental Industrial Hygienists
OSHA - Occupational Safety and Health Administration
NIOSH - National Institute for Occupational Safety and Health

Ppm - Parts per Million
mg/M³ - Milligrams per Cubic Meter of Air
dBA - Decibels A-Weighted
N.D. - None Detected
(STEL) - Short-Term Exposure Limit
N.A.S. - Not Applicable Standard

OSHA Standard 29 CFR 1910.20 requires that air sampling and other employee exposure information be made available to employee representatives upon request. We recommend that employees in the areas sampled be provided with a copy of this sampling data.

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TABLE 2-8

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NAME/BLTS SAMPLED	POSITION/ OPERATION	CONSTITUENT	SAMPLED (MINUTES)	CONCENTRATION DETERMINED	OSHA PEL	NIOSH REL	ACGIH TLV
Area Sample	Near portable mixers	Total dust Quartz content was 2.0%	352	2.8 mg/M ³	H.A.S.	N.A.S.	N.A.S.
Ray Mooreman	Ramming "mud" in furnace	Respirable dust	331	For time sampled: 2.5 mg/M ³	-	-	-
		2.2% quartz		for 8 hours: 1.7 mg/M ³	2.4 mg/M ³	-	-
		Respirable quartz	331	for time sampled: 0.05 mg/M ³ for 8 hours: 0.03 mg/M ³	-	0.05 mg/M ³	0.10 mg/M ³

TWA - Time-weighted Average
TLV - Threshold Limit Value
REL - Recommended Exposure Limit
ACGIH - American Conference of Governmental Industrial Hygienists
OSHA - Occupational Safety and Health Administration
NIOSH - National Institute for Occupational Safety and Health

ppm - Parts per Million
mg/M³ - Milligrams per Cubic Meter of Air
dBA - Decibels A-Scale
N.D. - None Detected
(STEL) - Short-Term Exposure Limit
N.A.S. - No Applicable Standard

OSHA Standard 29 CFR 1910.20 requires that air sampling and other employee exposure information be made available to employees or employee representatives upon request. We recommend that employees in the areas sampled be provided with a copy of the sampling data.

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2-3-87

TABLE 2-C

NAME/SITE SAMPLED	POSITION/ OPERATION	CONTAMINANT	SAMPLED (MINUTES)	CONCENTRATION DETERMINED	OSHA PEL	NIOSH REL	ACGIH TLV
Brian Davis	Sweeping in a.m. Banding pallets & driving fork truck	Respirable Dust	338	0.87 mg/M ³ <0.025 mg/M ³ quartz	-----See	-----Report	-----

TLV - Time-Weighted Average
 PEL - Threshold Limit Value
 REL - Recommended Exposure Limit
 ACGIH - American Conference of Governmental Industrial Hygienists
 OSHA - Occupational Safety and Health Administration
 NIOSH - National Institute for Occupational Safety and Health

OSHA Standard 29 CFR 4910.20 requires that air sampling and other employee exposure information be made available to employees or employee representatives upon request. We recommend that employees in the areas sampled be provided with a copy of the sampling data.

ppm - Parts per Million
 mg/M³ - Milligrams per Cubic Meter of Air
 dbA - Decibels A-Scale
 N.D. - None Detected
 (STEL) - Short-Term Exposure Limit
 N.A.S. - No Applicable Standard
 < - Less than

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 Dayton, Ohio

2-3-87

TABLE 2-D

NAME/SITE SAMPLED	POSITION/ OPERATION	CONTAMINANT	SAMPLED (MINUTES)	CONCENTRATION DETERMINED	OSHA PEL	NIOSH REL.	ACGIH TLV
Charlie Howard	Cutting fiber blanket to insulate in-house oven	Refractory Ceramic Fibers	40	0.26	N.A.S.	N.A.S.	N.A.S.
			67	0.10	Manufacturers of ceramic fibers recommend an exposure limit of 2f/cc		
			57	0.63			
			30	1.2			
			54 *	0.10			
			68 *	<0.01			
			53 *	0.11			
			24 *	0.02			
			393	0.26, TWA			

TWA - Time-Weighted Average
 TLV - Threshold Limit Value
 PEL - Permissible Exposure Limit
 REL - Recommended Exposure Limit
 ACGIH - American Conference of Governmental Industrial Hygienists
 OSHA - Occupational Safety and Health Administration
 NIOSH - National Institute for Occupational Safety and Health

OSHA Standard 29 CFR 4910.20 requires that air sampling and other employee exposure information be made available to employees or employee representatives upon request. We recommend that employees in the areas sampled be provided with a copy of the sampling data.

* NIOSH 7400 Method

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Dayton, Ohio

TABLE 2-E

2-9-6

NAME/SITE SAMPLED	POSITION/ OPERATION	CONTAMINANT	SAMPLED (MINUTES)	CONCENTRATION DETERMINED	OSHA PEL	NIOSH REL	ACGIH TLV
Paul Ross	Demolition	Total dust Quartz content of an 1180 μ g aliquet of sample was less than 25 μ g ($<0.02\%$)	233 *	13.3 mg/ M^3 may be an underestima- tion	Nuisance not applic- able See Report p. 2-6		
* Sample time from 12:02 - 2:48 not included. This cassette fell out into furnace and was replaced by Mr. Ross. Weight gain was 35mg/ M^3 for this filter.							

TWA - Time-Weighted Average
TLV - Threshold Limit Value
PEL - Permissible Exposure Limit
REL - Recommended Exposure Limit
ACGIH - American Conference of Governmental Industrial Hygienists
OSHA - Occupational Safety and Health Administration
NIOSH - National Institute for Occupational Safety and Health

ppm - Parts per Million
mg/ M^3 - Milligrams per Cubic Meter of Air
dBA - Decibels A-Scale
N.D. - None Detected
(STEL) - Short-Term Exposure Limit
N.A.S. - No Applicable Standard

OSHA Standard 29 CFR 4910.20 requires that air sampling and other employee exposure information be made available to employee or employee representatives upon request. We recommend that employees in the areas sampled be provided a copy of a sampling data.

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 .ton, Ohio
 2-9-87

TABLE 2-F

NAME/ID	POSITION/ OPERATION	CONTAMINANT	EMPLED (MINUTES)	CONCENTRATION DETERMINED	OSHA PEL	NIOSH REL	ACGIH TLV
Kurt Vultee	Installing refractory materials in furnace	Respirable dust	215	4.0 mg/M ³	1.0 mg/M ³	-	-
		2.8% cristobalite (a.m.)					
		Respirable dust	194	1.6 mg/M ³	0.43 mg/M ³	-	-
		21% quartz (p.m.)					
		Mixture formula for above	409			-	-
		Respirable cristobalite	215 (a.m.)	0.11 mg/M ³	-	0.05 mg/M ³	0.05 mg/M ³
		Respirable quartz	194 (p.m.)	0.31 mg/M ³	-	0.05 mg/M ³	0.1 mg/M ³
		Mixture formula for above	409		-	-	

TLV - Time-Weighted Average
 PEL - Threshold Limit Value
 REL - Recommended Exposure Limit
 NIOSH - American Conference of Governmental Industrial Hygienists
 OSHA - Occupational Safety and Health Administration
 NIOSH - National Institute for Occupational Safety and Health

OSHA Standard 29 CFR 4910.20 requires that air sampling and other employee exposure information be made available to employees or employee representatives upon request. We recommend that employees in the areas sampled be provided with a copy of a sampling data.

Los Alamos

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or Jeff Schwartz

Dave Smith

For Immediate Release

SEVEN YEAR, \$2.5 MILLION HEALTH STUDY

LOS ALAMOS, N.M., Oct. 30, 1986 -- Asbestos is known to cause both cancerous and non-cancerous health problems -- diseases which have raised questions about the safety of other fibrous materials.

Now, a \$2.5 million Los Alamos National Laboratory health study has found no cancerous-tumor or unusual-disease patterns following prolonged lung exposure to six widely used manmade mineral fibers.

"This is the largest, most comprehensive study of its kind ever conducted," says experimental pathologist Dave Smith, who announced the findings at an international medical conference in Denmark.

Results will be provided to the U.S. Environmental Protection Agency and the Thermal Insulation Manufacturer's Association.

The seven-year-long study examined the effects of inhaling four types of fibrous glass, one refractory ceramic fiber, and one mineral wool fiber. These non-asbestos fibers are commercially available products commonly used in homes, businesses, and industry as insulating agents, composite materials, soundproofing material, and more.

"We simulated 'worst-case scenario' all the way," says Smith.

The study's unique experimental design allowed for well-defined fibrous aerosols to be produced and controlled at extremely elevated exposure levels. Two test groups of rodents were involved. The Lab's Lawrence W. Ortiz and Ruben F. Archuleta were instrumental in develop-

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LOS ALAMOS NATIONAL LABORATORY

SEVEN YEAR, \$2.5 MILLION HEALTH STUDY

Page 2:

ing a special inhalation technique that allowed for long term, "nose only" exposure experiments -- an important research achievement that enhanced aerosol exposures, minimized external airborne contaminants, and reduced stress as an experimental factor.

The aerosols contained fibers ranging in diameter from 0.45 to 6.1 microns, or millionths of a meter. By comparison, a human red blood cell is 7 microns, a human hair about 70 microns.

The test groups were exposed to the special aerosols, or fiber-containing clouds, at levels ranging from 10 to 1,500 times more than currently allowed in the workplace.

Recovery assays by Neil F. Johnson played an important role in the study -- confirming that fine-diameter fibers were deposited in the lung and determining what health effects, if any, they caused.

As expected, researchers found macrophages -- scavenger cells that help cleanse the lung of foreign materials -- around sites where fibers were deposited. But statistical analysis revealed no increased disease risk from airborne exposure to these manmade materials. The study concluded that no increase in cancer, tumors, lesions, or other unusual illnesses was seen in test groups exposed to the six selected manmade vitreous fibers.

"This research demonstrated that disease risks posed to laboratory animals by long-term exposure to these certain fibers were insignificant," say Ortiz and Smith.

Remarkably, groups exposed to the manmade fibers lived longer

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LOS ALAMOS NATIONAL LABORATORY

SEVEN YEAR, \$2.5 MILLION HEALTH STUDY

Page 3:

natural lives than comparison groups -- why remains uncertain, but lifespan differences probably represent a combination of the minimal risk posed by fiber exposure and the extraordinary care given laboratory groups.

Study results were presented to a World Health Organization/International Agency for Research in Cancer (IARC) symposium on the "Health Effects of Man-Made Mineral Fibers on the Workplace," in Copenhagen, Denmark. The research was funded by the Thermal Insulation Manufacturers' Association (TIMA).

Los Alamos National Laboratory is operated by the University of California for the Department of Energy.

WELDING

Background Information

Generally six to seven welders are employed in the shop to fabricate furnace structures. Welders also repair furnaces at customer job sites, but no attempt was made to monitor these working conditions. In the shop, there are two adjoining bays, a low bay where most of the welding is done and a high bay. There are three fans located near the roof in the high bay and there are windows along the side wall of the high bay which can be opened. The overhead back door at the rear of the high bay is opened frequently during warm weather. The low bay lacks these general ventilation features.

Much of the welding is on mild steel using stick electrodes. Stainless steel is welded occasionally. The welders currently are using 3M 9910 disposable respirators for fume and 3M 8710 respirators for dust.

Sampling and Analytical Methods

Welding fume

Breathing-zone samples were collected on mixed cellulose ester filters (0.8 micron) contained in small cassettes. The cassettes were attached by Tygon tubing to Gilian pumps which were calibrated before use to pull 2 liters of air per minute. We attempted to keep the cassette containing the filter under the welders' helmets. The calibration of the pumps were checked before the samples were submitted for analysis. The filters were sent to an accredited industrial hygiene laboratory where they were analyzed by routine atomic absorption spectroscopy.

Frank W. Scheefer, Inc.
Section 3, -- Weiding

Fluorides

Breathing-zone samples were collected on sodium-formate coated millipore filters contained in small cassettes. The cassettes were attached by Tygon tubing to Gilian pumps which were calibrated before use to pull 2 liters of air per minute. As with the saamples for metal fume, we attempted to keep the cassette containing the filter under the welders' helmets. The calibration of the pumps were checked before the samples were submitted for analysis. The filters were sent to an accredited industrial hygiene laboratory where they were analyzed by ion selective electrode methods.

Total dust

See Section 2 of this report.

Discussion

As shown in Table 3A, iron oxide, manganese, chromium, nickel, and flouride exposures were all within the current PELs and TLVs. The NIOSH (National Institute for Occupational Safety and Health) classifies certain nickel and chromium compounds as potential carcinogens and has therefore recommended lower exposure limits, 0.015 mg/M^3 for nickel and 0.025 mg/M^3 for noncarcinogenic Cr VI compounds such as chromium oxide. During our survey Mr. Nelson Smith welded on stainless steel for about an hour and a half. Sample results indicate that had he welded for most of the day on stainless steel, his exposure would probably have exceeded the NIOSH recommended limits.

Table 3B, 2/9/87: Several employees mentioned concern about effectiveness of for local exhaust for the chop saw which is located along the side wall of the low bay. Although a MSDS was not available for the chop saw blade, the dust generated from cutting mild steel is probably mostly iron oxide. A total dust sample collected during the period when the saw was is in showed a weight gain of 4.2 mg/M^3 . Less than 0.025 mg

of quartz was detected in the sample.

As discussed previously, area sample results cannot be compared to the PEL or TLV since they do not represent an employee's exposure. This result does indicate that even though local exhaust ventilation is provided for this operation, a significant amount of dust is being released into the air outside the hood. The local ventilation system provided is of less than optimum design: Leaks in the hood for the chop saw; the long runs of ductwork required by the use of the same system for the table saw, band saw, and chop saw; the T-shaped entries into the main branch; and fan placement all increase air flow resistance. The system could be improved to more effectively capture dust (see attachment), but reducing dust exposure from mixing operations should be given higher priority. Some dust control can be achieved at the chop saw simply by eliminating the use of compressed air to clean off the work table.

Recommendations

1. Local exhaust ventilation to remove welding fume and gases at the their source is the preferred method of controlling employee exposure to these contaminants. Since each furnace fabricated is unique in design and welds required, it would be difficult (not impossible) to design an effective system. We recommend that general ventilation be improved in the low bay, or that welding be confined to the high bay which has much better general ventilation.

2. A local exhaust ventilation system is feasible for a work table such as that used by Mr. Nelson Smith. Such a system is recommended since he does fabricate smaller stainless steel parts at his work table. Such welding in the absense of local exhaust ventilation is likely to exceed NIOSH recommended exposure limits for nickel and chromium.

Hoods that pull welding fume away from the welder's breathing zone are preferred over canopy hoods which pull the fume through the welder's breathing-zone. Diagrams from the ACGIH Industrial Ventilation Manual

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Section 3 -- Welding

which give general specifications for such systems are attached. You may wish to contact our engineering section (513) 898-3206 for additional consultation on ventilation matters.

3. Another recommendation is to make sure that the welders are using the welding shields that have been provided. Use of these shields will protect the eyes of employees in adjacent areas and employees who are passing by the welding operations from the ultraviolet light of the welding arc.

4. Implementation of a respirator program, including fit testing, medical surveillance, and training is required when you provide respirators to reduce employee exposure levels. 3M literature for a new welding fume and ozone respirator is attached, not as our endorsement, but for your information.

5. Noise is discussed in more detail in Section 5 of this report. Given the job-shop nature of the operation, noise levels will fluctuate during the day and from day to day depending on the jobs performed. In this case, noise monitoring was conducted on a day when a demolition project was occurring in the rear of the high bay. Therefore, noise exposures reported for the welders in Table 5A may be higher than average. However, as shown in Table 5B, welders are also exposed to high noise levels during ramming and grinding activities which occur much more routinely than demolition projects. Therefore, we feel it is important to include welders in a hearing conservation program. If you are concerned that the results are not representative, we can make arrangements to conduct additional monitoring.

Attachments

- Tables 3A, 3B
- ACGIH Industrial Ventilation Manual, VS-401, Cut-off saw
- ACGIH Industrial Ventilation Manual, VS-416, VS-416.1, Welding bench
- 3M literature for a new welding fume and ozone respirator

Frank M. Schaefer, Inc.
Dayton, Ohio
2-3-87

TABLE 3-A

NAME/STREET SAMPLED	POSITION/ OPERATION	CONTAMINANT	SAMPLED (MINUTES)	CONCENTRATION DETERMINED	OSHA REL.	NIOSH REL.	ACGIH TLV
Nelson Smith	Welding stainless in a.m. (347)	Nickel	88 a.m.	0.026	1 mg/M ³	0.015 mg/M ³ possible carcinogen	1 mg/M ³
		Chromium	88 a.m.	0.071	1 mg/M ³	0.025 mg/M ³	1 mg/M ³
	Mild Steel Later	Iron Oxide	301	0.88	10 mg/M ³	-	5 mg/M ³
		Manganese	301	0.070	5 mg/M ³ ceiling	-	1 mg/M ³
	Welding mild steel; 6010 & 7024	Iron Oxide	339	1.5	10 mg/M ³	-	5 mg/M ³
Lonnie Stevens		Manganese	339	0.058	5 mg/M ³ , ceiling	-	1 mg/M ³

TWA - Time-Weighted Average
TLV - Threshold Limit Value
REL - Permissible Exposure Limit
REL - Recommended Exposure Limit
ACGIH - American Conference of Governmental Industrial Hygienists
OSHA - Occupational Safety and Health Administration
NIOSH - National Institute for Occupational Safety and Health

ppm³ - Parts per Million
mg/M³ - Milligrams per Cubic Meter of Air
dBA - Decibels A-6 Scale
N.D. - None Detected
(STEL) - Short-Term Exposure Limit
- or N.A.S. - No Applicable Standard

OSHA Standard 29 CFR 1910.20 requires that air sampling and other employee exposure information be made available to employees or employee representatives upon request. We recommend that employees in the areas sampled be provided with a copy of a sampling data.

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Lorain, Ohio

2-3-87

TABLE 3-A

EMP/SITE SAMPLED	POSITION/ OPERATION	CONTAMINANT	SAMPLED (MINUTES)	CONCENTRATION DETERMINED	OSHA PEL	NIOSH REL.	ACGIH TLV
B111 McNabb	Welder; Chop Saw Operator	Iron Oxide Manganese	406 406	1.2 0.086	10 mg/M ³ 5 mg/M ³	-	5 mg/M ³ 1 mg/M ³
Luther Morris	Welder Working in furnace for short time in p.m. (10 min.)	Iron Oxide Manganese	412 412	1.3 0.11			

TLV - Time-Weighted Average
 PEL - Threshold Limit Value
 REL - Recommended Exposure Limit
 REL - Recommended Exposure Limit
 ACGIH - American Conference of Governmental Industrial Hygienists
 OSHA - Occupational Safety and Health Administration
 NIOSH - National Institute for Occupational Safety and Health
 ppm - Parts per Million
 mg/M³ - Milligrams per Cubic Meter of Air
 dBA - Decibels A-Scale
 N.D. - None Detected
 (STEL) - Short-Term Exposure Limit
 N.A.S. - No Applicable Standard

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 Dayton, Ohio
 2-9-87

TABLE 3-B

8-hr TWA

8-hr TWA

NAME/SHIFT SAMPLED	POSITION/ OPERATION	COMPLAINANT	SAMPLED (MINUTES)	CONCENTRATION (MINUTES) DETERMINED	OSHA REL.	NIOSH REL.	ACGIH TLV
Luther Morris	Welder	Fluorides, inorganic	421	$< 0.002 \text{ mg/M}^3$ ($< 0.002 \text{ ppm}$ hydrogen fluoride)	2.5 mg F/M^3	2.5 mg F/M^3	2.5 mg F/M^3
Lonnie Stevens	Welder	Fluorides, inorganic	419	$< 0.002 \text{ mg/M}^3$ ($< 0.002 \text{ ppm}$ hydrogen fluoride)			
Area Sample	Chop Saw	Total dust	210	4.2 mg/M^3 0.025 mg quartz	N.A.S.	N.A.S. See p. 3-	N.A.S. report,

TWA - Time-Weighted Average
 TLV - Threshold Limit Value
 PEL - Permissible Exposure Limit
 REL - Recommended Exposure Limit
 ACGIH - American Conference of Governmental Industrial Hygienists
 OSHA - Occupational Safety and Health Administration
 NIOSH - National Institute for Occupational Safety and Health

ppm - Parts per Million
 mg/M^3 - Milligrams per Cubic Meter of Air
 dBA - Decibels A-scale
 N.D. - None Detected
 (STEL) - Short-Term Exposure Limit
 N.A.S. - No Applicable Standard
 L - Less Than

OSHA Standard 29 CFR 4910.20 requires that air sampling and other employee exposure information be made available to employees or employee representatives upon request. We recommend that employees in the areas sampled be provided with a copy of a sampling data.

BAKE-OUT

Background Information

After the fabrication and lining of the furnace is completed, the entire structure is heated over a period of several hours or days to around 1500 degrees C. Smaller pieces, e.g. doors may be baked-out in ovens custom built of fire brick and other refractory materials for this purpose. Natural gas is used as the fuel. Bake-out is necessary to drive out any residual moisture which might otherwise crack the refractory material upon first heat after being put into service. During our our initial visits there were several inquiries about what is released into the air during bake-out. Some employees complained of eye and upper respiratory tract irritation during bake-out, especially during initial stages. Some employees were also concerned about what was contained in the liquid run-off.

Although not always the case, it often works out that bake-out of a large furnace will begin on Friday and be completed the following Monday. Thus, employees are not exposed to outgassing during the weekend.

During our 2/3/87 survey, we learned that the large furnace under construction would probably be baking out the following Monday. This furnace had been lined primarily with 931 castable materials. The material safety data sheet for this product stated that phosphoric acid, an irritant, could be released during bake-out.

Sampling and Analytical Methods

Phosphoric acid

Area samples were collected around a large furnace during bake-out on 2/9/87. Using Gillian pumps calibrated at 1 lpm, air was bubbled through two midget impingers, each containing approximately 10 milliliters of deionized water. The samples were analyzed by ion chromatography. A similar method using a different reagent (sodium bisulfite) was used to

Frank W. Scheefer, Inc.
Section 4 -- Bake-out

delonized water. The samples were analyzed by ion chromatography. A similar method using a different reagent (sodium bisulfite) was used to sample formaldehyde during bake-out, but the sample was broken in transit.

Other gases

A Drager pump and detector tubes were used to periodically measure other potential air contaminants including carbon monoxide, carbon dioxide, nitrous gases, formaldehyde, sulfur dioxide, and hydrogen sulfide.

Discussion

The results are summarized in Tables 4A and 4B. Phosphoric acid concentrations were below detectable limits in both area samples. The lab noted a significant amount of sulfate was present in one of the samples.

The results indicate that small amounts of several gases are being released into the workroom, in this case, the high bay, during bake-out. Gases detected were carbon monoxide (CO), carbon dioxide (CO₂), sulfur dioxide (SO₂), formaldehyde (HCOH) and oxides of nitrogen (NO and NO₂). Concentrations were measured primarily at the vents of the furnace and would be expected to be diluted by general room ventilation before reaching employee breathing zones. Carbon monoxide levels dropped from 20 - 25 ppm to about 5 ppm after side windows were opened mid-morning.

It does not appear that the amounts released would result in employee exposure in excess of recommended exposure limits with perhaps the exception of the NIOSH recommended exposure limit for sulfur dioxide. the NIOSH recommended limit for sulfur dioxide is quite low, 0.5 ppm, which is one-tenth of the PEL and TLV for sulfur dioxide. Both sulfur dioxide and formaldehyde are well known to cause eye and upper respiratory tract irritation at levels below the PEL and TLV in some individuals.

Frank W. Schaefer, Inc.
Section 4 -- Bake-out

We feel that additional monitoring is needed to evaluate employee exposure during furnace bake-out. There are many factors, including temperature, and the type and amount of material used in the furnace, which will determine what contaminants will be released, when they will be released, and in what concentrations. It will be difficult to evaluate each contaminant. We would like to repeat the monitoring which we conducted on 2/9/87 during another bake-out cycle, preferably during cold weather.

We would also like to suggest that you establish a log to help us identify those materials which are related to complaints. The log, on which employees can enter complaints of eye and/or respiratory irritation or other symptoms should include at least the following information:

- date
- symptoms
- time symptoms first noticed
- time bake-out began
- an identifying feature of the furnace being baked out so that the materials which were used in the furnace can be identified later
- ventilation conditions, e.g. hot, humid, fans on/off, doors open/closed

We do not have enough information at this time to make specific recommendations concerning bake-out. It appears that most of the gases will be driven off during the early stages of bake-out. Therefore, we recommend you continue your attempts to schedule bake-out to begin at the end of the shift on Fridays. All fans should be operating during the bake-out cycle. You may want to consider exhausting the furnace vents via flexible ductwork through a side window.

The pH of a sample of liquid run-off from the furnace during bake-out was determined by pH electrode. The sample was essentially neutral, pH 7.2.

Attachments: Tables 4A, 4B

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Day: Ohio

J-2 4-A

3-9-87

NAME/SITE SAMPLED	POSITION/ OPERATION	CONTAMINANT	SAMPLED (MINUTES)	CONCENTRATION DETERMINED	OSHA REL.	NIOSH REL.	ACGIH TLV
Area Sample	Large furnace bake-out	Phosphoric acid	80	0.0099	1 mg/N ³	-	1 mg/N ³
PH of Liquid run-off from large furnace during bake-out was 7.2 PH of water = 7 PH of acids < 7 PH of bases > 7							

TLV - Time-weighted Average
TLV - Threshold Limit Value
REL - Permissible Exposure Limit
REL - Recommended Exposure Limit
ACGIH - American Conference of Governmental Industrial Hygienists
OSHA - Occupational Safety and Health Administration
NIOSH - National Institute for Occupational Safety and Health

ppm³ - Parts per Million Parts of Air
mg/M³ - Milligrams per Cubic Meter of Air
dBA - Decibels A-Scale
N.D. - None Detected
(STEL) - Short-Term Exposure Limit
N.A.S. - No Applicable Standard

OSHA Standard 29 CFR 1910.20 requires that air sampling and other employee exposure information be made available to employees or employee representatives upon request. We recommend that employees in the areas sampled be provided a copy of a sampling data.

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Frank W. Schaefer, Inc.
Section 4 -- Bake-out

Table 4B Detector Tube Measurements during Furnace Bake-out

<u>Time</u>	<u>Contaminant</u>	<u>Concentration</u>	<u>Location of Measurement</u>
8:08 a.m.	CO	20 - 25 ppm	at vent of furnace during bake-out
8:18 a.m.	HCOH	0.5 ppm	- - -
8:20 a.m.	H ₂ S	N. D.	- - -
8:22 a.m.	NO _x	3 ppm	- - -
8:30 a.m.	CO	20 ppm	- - -
8:32 a.m.	CO ₂	1000 ppm	- - -
8:43 a.m.	HCOH	0.5 ppm	- - -
10:20 a.m.	CO	5 ppm	weld area adjacent to bake-out
10:22 a.m.	NO _x	< 1 ppm	- - -
10:25 a.m.	HCOH	N.D.	- - -
11:15 a.m.	H ₂ S	N.D.	area of furnace demolition by open back door
- -	CO	5 ppm	- - -
- -	SO ₂	0.2 ppm	- - -
12:30 p.m.	SO ₂	0.5 ppm	at vent of furnace during bake-out
1:30 p.m.	CO ₂	1000 ppm	- - -

ppm = parts per million

N.D. = none detected

Frank W. Schaefer, Inc.
Section 4 -- Bake-out

<u>contaminant</u>	<u>formula</u>	<u>PEL</u> 8-hr TWA in ppm	<u>NIOSH</u> 10-hr TWA in ppm	<u>TLV</u> in ppm
carbon monoxide	CO	50, 8-hr TWA	35, 8-hr TWA	50, 8-hr TWA
carbon dioxide	CO ₂	5000, 8-hr TWA	10,000, 8-hr TWA	5000, 8-hr TWA
formaldehyde	HCOH	3, 8-hr TWA 5, ceiling 10, peak	lowest feasible limit, possible carcinogen	1, 8-hr TWA 2, STEL suspect carcinogen
hydrogen sulfide	H ₂ S	20, ceiling 50, peak	10, ceiling	10, 8-hr TWA 20, STEL
nitrogen dioxide	NO ₂	5, ceiling	1, ceiling	3, 8-hr TWA 5, STEL
nitric oxide	NO	25, 8-hr TWA	25, 10-hr TWA	25, 8-hr TWA
sulfur dioxide	SO ₂	5, 8-hr TWA	0.5, 10-hr TWA	5, 8-hr TWA

ppm = parts per million

TWA = time-weighted average

STEL = short term exposure limit

NOISE

Background Information

During our surveys we found employees were exposed to unacceptably high noise levels. Much of the noise was from the use of air hammers, grinders, and chippers. Noise exposures were higher than usual due to the non-routine demolition task being performed during our survey. However, since grinders, chippers, and other power tools, including air hammers to "ram mud" are used routinely during fabrication, we expect that high noise levels are quite common in the shop.

Excessive noise can produce partial and/or permanent hearing loss, a health hazard common to many industries. Excessive noise also affects non-auditory bodily functions. Studies have shown that workers exposed to excessive noise may develop fatigue and headache. Speech interference, psychosomatic illness, nervousness, and disruption of rest, relaxation, and sleep may also result from excessive exposure to noise. Noise induced hearing loss and stress can be prevented through a combination of engineering controls and an effective hearing conservation program.

Sampling and Analytical Methods

Employee exposure to noise was evaluated using Quest M-7B dosimeters which were calibrated before and after use. The dosimeters continuously integrate sound pressure measurements during the period that they are worn by the employee. The results shown in Table 5A represent the employee's average exposure to noise for the time sampled, plus or minus two decibels.

Sound pressure measurements were also taken with a Type 2232 B & K sound level meter. The measurements were taken near employees' ears who were conducting the various activities listed. The results are shown in Table 5B.

Discussion

Dosimeter results showed employee exposure to noise ranged from 81 to 101 dBA (decibels, A-weighted scale). With one exception, all exposures measured were 89 dBA or higher. At these levels OSHA requires a hearing conservation program. The basic elements of the program are monitoring, audiograms, hearing protection, training, and recordkeeping:

1. initial monitoring of employee exposure to noise must be conducted and monitoring must be repeated when changes occur that would affect the exposure levels. The measurements taken during our survey are your initial monitoring results.
2. Annual audiograms must be given to all employees exposed to noise above 85 dBA. The audiograms are compared to the first audiogram (baseline) to identify hearing problems and standard threshold shifts. (A standard threshold shift is defined as an average shift in either ear of 10 decibels or more at 2,000, 3,000, and 4,000 hertz.) Any employee who experiences a standard threshold shift is required to wear hearing protection.
3. A selection of various kinds of hearing protection must be provided to employees who work in areas where noise is above 85 dBA. The use of hearing protection in areas where noise is above 90 dBA must be enforced. In your case, hearing protection should be required whenever employees are using, or working in the same area as an employee who is using, an air hammer, chipping or grinding tool, power saw, or similar equipment.
4. Annual employee training in the hazard of noise, the use of hearing protection, and the purpose and procedures of audiograms is required. The Division of Safety and Hygiene has noise training resources available. Sometimes, companies provide this training at the same time audiograms are given. A list of companies providing audiometric testing services in this area is attached.

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5. Recordkeeping requirements include keeping the noise monitoring data for two years and the audiograms for the length of the employee's employment. Specific information required to be included with the audiograms include the name and job classification of the employee, the date, the examiner's name, the date of the audiometric testing equipment was calibrated, the background sound pressure levels in the testing facility, and the employee's most recent noise exposure measurements.

The OSHA regulation requires feasible engineering and/or administrative control of noise when employee exposure exceeds 90 dBA. Enforcement of the regulation has depended, in part, upon how the term "feasible" is interpreted. In any case, it is better practice to try to reduce the noise levels as much as is feasible rather than to have to depend solely upon hearing protection. If you are interested in determining what noise reduction methods may be applicable in your facility, you can call our office for engineering assistance.

The attached pamphlet describing the hearing conservation program requirement and the OSHA noise regulation provide more detailed information.

Attachments:

- Tables 5A, 5B
- List of companies Dayton area who perform audiometric tests
- OSHA pamphlet #3074, "Hearing Conservation"
- 29 CFR 1910.95 and Appendices

2 LEVEL SURVEYS

TABLE 5-A

NAME LOCATION Frank W. Schaefer
 SURVEYOR Marilyn Priddy, CIH

Min.

DATE OF SURVEY 02-09-87
 MODEL Quest Model M-78

MONITOR SERIAL NUMBER	WORK AREA	NAME OF EMPLOYEE	CALIBRATION READINGS START-FINISH	TIME ON	TIME OFF	ELAPSED TIME	115 DB EXCEEDED YES/NO	READING AT END OF DAY	EQUIVALENT CONTINUOUS SOUND LEVEL (dBA)	COMMENTS EMPLOYEE PERFORMING NORMAL DUTIES	108 REMARKS (IF TRUE)
5409	Tear-out	Brian Gabbard	1.83/1.83	12:03	3:22	354	Y	352.1	101	Operating Jackhammer	
5376	Tear-out	Dave Allen	1.87/1.73	12:00	3:21	407	Y	500.04	103	Operating Jackhammer	
1063	Bolting Tiles On	Don Mercer	1.79/1.76	12:06	3:30	370	N	111.3	93	Adjacent to Tear-out	
4788	Welder	Bill McNabb	1.85/1.86	12:02	3:17	405	Y	72.4	89		
3689	Welder	Nelson Smith	1.87/1.82	12:04	3:17	412	N	77.1	89		
4790	Tool Room	Ken Davis	1.78/1.77	12:04	3:19	354	N	20.96	81		

OSHA Standard 29 CFR 1910.95 requires that noise sampling data be made available to employees. We recommend employees in the areas sampled be provided with a copy of noise sampling data.

* dBA = 90 + 16.61 log (Dose in % / 12.5 X time in hours)

0000 1251

Table 5B Sound Level Meter Measurements

<u>Operation</u>	<u>dBA</u>
2/3/87	
grinding edge of steel elbow	103
ramming "mud in furnace"	>95
welding table in high bay during above activity	94-95
2/9/87	
two air hammers operating during furnace demolition	105-106
opposite end of shop from back door during above activity	96-97
welding table in high bay during above activity	93
fabricating area in low bay during above activity	93
fabricating area in low bay when air hammer use stopped	75
wood shop area	80-85
portable mixer	80-81

Additional comments

Air sampling

Results of a 258-minute sample collected using a 3M organic vapor monitor on 2/9/87 showed 3.5 ppm, as hexane. The cleaning solvent being used to clean paint filter cones contained 32% hexane, 1% toluene, and 0.7% glycol ether. The 8-hour time-weighted average TLV for n-hexane is 50 ppm.

While reviewing material safety data sheets we noted that diglycidal ether of Bisphenol A was present in a Rexnord resin product and MDI, methylene bis (4-cyclo hexyl isocyanate), was present in a Rexnord rubber repair base product. We will be happy to evaluate employee exposure to these chemicals if you will notify us of their use.

Safety concerns

The following observations made during our industrial hygiene survey relate to safety matters. Our survey was not meant to be a thorough safety inspection of your facility, but we would like to make you aware of the following concerns. We recommend that you continue to work with Division Industrial Consultants in implementing an effective safety program.

1. We learned that painting is conducted in the open area of the high bay during second shift. This would qualify as a "spraying area" as defined in OSHA regulation 29 CFR 1910.107. Please note the requirements for isolation of electrical equipment and other sources of ignition as discussed in this standard.
2. We discussed the MSDS for RTR rubber repair activator which contains 5% aryl mercurial 5% MDA, 55% 1,4-butanediol, 35% polyol. This mercury containing material is very toxic and can be readily absorbed through the skin. You mentioned that although the data sheet was included with your other data sheets, the material had not yet been ordered. There were also

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Section 6- Additional Comments

several small containers of other cementing material marked "Poison" stored along the back wall. We recommend that less toxic materials be substituted for these products whenever possible.

3. In general we observed poor housekeeping and many tripping hazards during our survey, especially in the fabricating area. We also noted that sparks from the chop saw could ignite sawdust accumulation on floor behind the saw.
4. Hard hats should be required in the shop where materials are moved overhead by crane. We have already discussed the need for eye protection.
5. Eyewash stations are needed not only for refractory ceramic fiber materials, but also for other materials which can cause eye irritation such as Precrete, Devon Hardener, which are severe skin and eye irritants. Eyewash bottles do not meet the OSHA requirements for eye flushing stations. These must provide at least 15 minutes of continuous flow.
6. We observed that lacquer thinner stored in non-safety cans was used to clean paint off filter cones. When such flammable liquid is used in the shop, even in small quantities, it should be contained in an approved safety can.
7. Natural gas lines providing fuel for bake-out should be barricaded to prevent truck or other equipment from running into them.
8. Employees are exposed to vibratory hand tools for several hours per day while ramming mud and/or wrecking furnace linings. Some control measures are outlined in the attachment entitled "Suggested Work Practices for Workers Using Vibratory Hand Tools." This summary was written by Dr. Wasserman, a world authority on the effects of mechanical vibration on humans and a member of the ANSI committee on human vibration. Also included is a copy of NIOSH Current Intelligence Bulletin #38, "Vibration Syndrome." You may wish to contact our Ergonomics Section for more information on this topic.

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Attachments:

- OSHA regulation 29 CFR 1910.107
- "Suggested Work Practices for Workers Using Vibratory Hand Tools."
- NIOSH Current Intelligence Bulletin #38, "Vibration Syndrome."

RECORDS CERTIFICATION

I, the undersigned, an employee of the Bureau of Workers' Compensation, do hereby certify that the microfilm images on this reel of microfilm or microfiche are complete and accurate reproductions of the original records of the SAFETY + HYGIENE as accumulated during the regular course of business, and that it is the established procedure of this department to microfilm its records for permanent file and to dispose of the original records after microfilm reproductions have been made.

William D. Koye
SUPERVISOR, Microfilming Unit

John Tracy
Name (Camera Operator)

11/20/87
Date

11-20-87
Date