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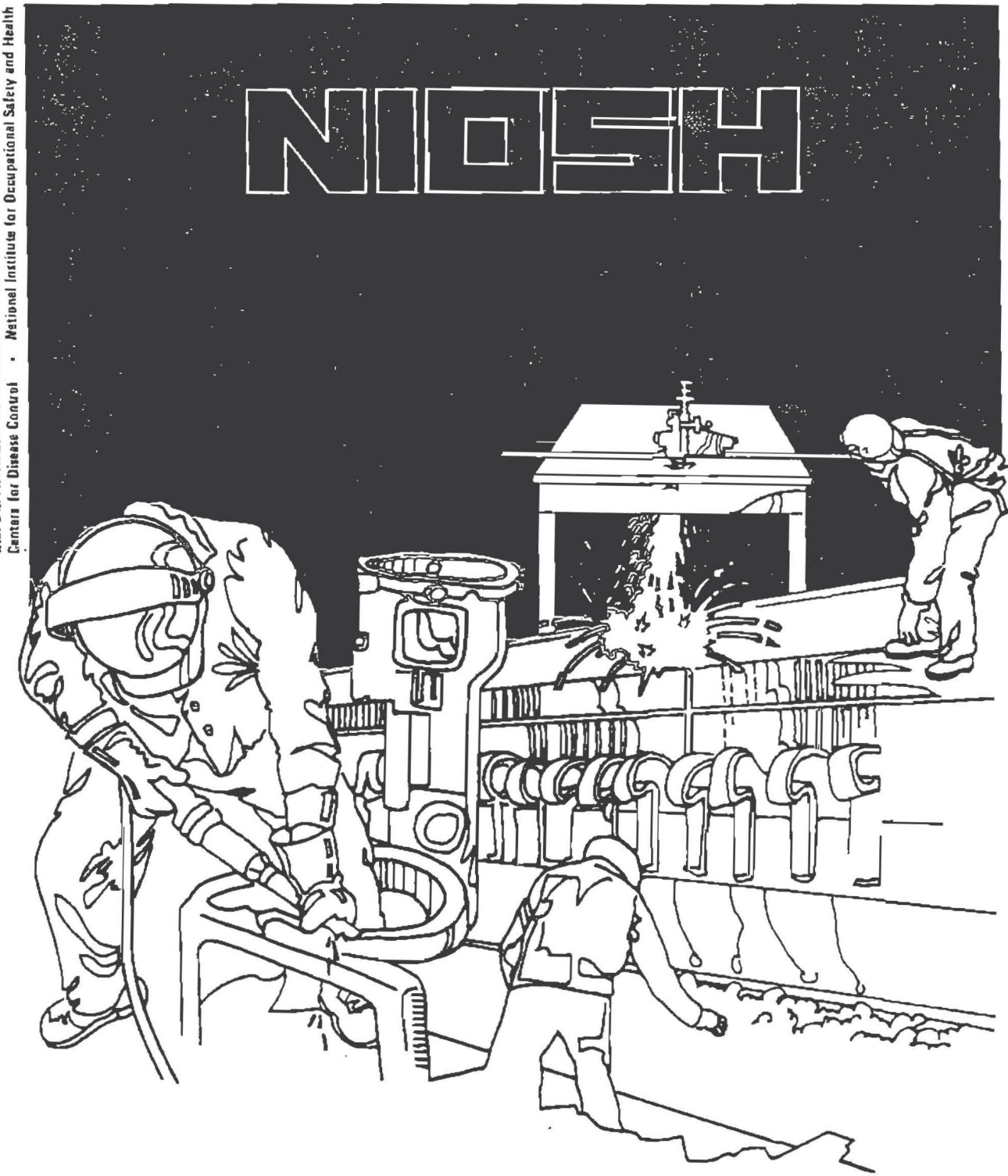

Health Hazard Evaluation Report

80-19-765

PREFACE

The Hazard Evaluations and Technical Assistance Branch of NIOSH conducts field investigations of possible health hazards in the workplace. These investigations are conducted under the authority of Section 20(a)(6) of the Occupational Safety and Health Act of 1970, 29 U.S.C. 699(a)(6), which authorizes the Secretary of Health and Human Services, following a written request from any employer or authorized representative of employees, to determine whether any substance normally found in the place of employment has potentially toxic effects in such concentrations as used or found.

Mention of company names or products does not constitute endorsement by the National Institute for Occupational Safety and Health.

HE 80-19-765
NOVEMBER 1980
JEANNETTE GLASS COMPANY
JEANNETTE, PENNSYLVANIA

NIOSH INVESTIGATORS:
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I. SUMMARY

On November 5, 1979 NIOSH received a request from the American Flint Glassworkers of North America, Local 535, for a health hazard evaluation at the Jeannette Glass Company, Jeannette, Pennsylvania. According to the request the 35 employees working in the Mix and Melt Area and the batchhouse were exposed to various compounds, including arsenic trioxide, selenium, and silicaflour.

During a site visit in February, 35 workers exposed to arsenic trioxide and 38 non-exposed controls were interviewed and examined by a NIOSH consultant dermatologist. Samples of venous blood, urine and pubic hair were obtained. The interviews and examinations revealed no arsenic-related health complaints or symptoms and no arsenic-related skin disorders. All blood samples had arsenic levels below the detectable limit of 1 ug/100 g. The urine and pubic hair samples were not analyzed due to a laboratory accident.

Environmental sampling for arsenic trioxide, selenium, quartz and respirable dust was performed in April. The eight personal samples for arsenic trioxide had levels of arsenic indicating an exposure of approximately 2-11 ug/M^3 and were all in excess of the NIOSH recommended standard of 2 ug/M^3. All eight personal samples for selenium indicated exposures below the OSHA standard of 200 ug/M^3. The personal samples for respirable dust indicated exposures of 0.14-0.99 mg/M^3. The quartz content of bulk dust samples was 10%.

All environmental samples for arsenic trioxide (8/8) exceeded the NIOSH recommended standard. On the basis of these results, it was determined that, at the time of the investigation, there did exist a health hazard due to arsenic trioxide in the areas surveyed. However, the results of clinical examinations, interviews and blood sample analysis did not reveal any acute, subacute or chronic health effects due to arsenic trioxide.

Since June 1980, the manufacturing process has been modified and arsenic trioxide is no longer used at the plant.

Incorporated in this report are recommendations regarding information to, and medical surveillance of, previously arsenic-exposed workers. Recommendations are also made regarding environmental monitoring for respirable silica and measures to reduce concentrations of dust in specific areas of the plant.

KEYWORDS: SIC 3229 (pressed Tableware and Household Products) silica dust, arsenic, selenium, arsine

II. INTRODUCTION

Under the Occupational Safety and Health Act of 1970, NIOSH investigates the toxic effects of substances found in the workplace. The American Flint Glassworkers of North America, Local 535, requested on November 5, 1979 that NIOSH investigate a possible health hazard at the Jeannette Glass Company, Jeannette, Pennsylvania. According to the request the 35 employees working in the Mix and Melt Area and the batchhouse were exposed to various compounds. The main concern was exposure to arsenic trioxide. The other compounds mentioned in the request were cobalt, selenium, barium, sodium silicaflouride, sodium sulfate and barytes.

III. BACKGROUND

Jeannette Glass Company manufactures glass table-and housewares.

The bulk materials are brought in by rail or truck and screw conveyed into holding bins in the batchhouse. As needed, the materials are weighed and dropped into the mixer located in the basement. Materials that are needed in small quantities are manually weighed out from bins into buckets and dumped via surge bin mixer. Following the mixing cycle the material is dumped into bins. The bins are conveyed to the mix and melt area where they are emptied by a vibrating pan feeder onto an elevator and then into the feeding tank. The material is gravity fed into the furnace. Approximately 35 batches are mixed per 8-hour shift. The furnaces operate at 2700°F. Subsequent steps in the manufacturing process involve pressmolding and firepolishing. At the time of the investigation, arsenic trioxide, the purpose of which is to improve the color of the glass, was being weighed together with other compounds in the batchhouse and used only in one of the three furnace-tanks, #9.

IV. EVALUATION DESIGN AND METHODS

A. Medical

All arsenic-exposed workers were interviewed and examined by a NIOSH consultant dermatologist. Information was sought concerning prevalence of dermatitis and other arsenic-related skin disorders, both in the past and at the time of the examination. An examination of all skin was performed, and all subjects were also examined with a nasal speculum to determine prevalence of nasal septum ulcerations and perforations. Interviews were also conducted to gather information regarding demographic characteristics, employment history, and current and past general health history, particularly past and present systemic signs and symptoms of arsenic exposure. Venous blood, pubic hair and urine samples were obtained.

A non-exposed control group, selected by representatives from the requesting union and management, was interviewed, examined and sampled in an identical manner.

The blood samples were analyzed using the hydride generation method, which is considered to be the most sensitive method and which has a detection level of 1 ug of arsenic per 100 g whole blood.

B. Environmental

Two bulk dust samples were collected in the batchhouse. Following preparation, these samples were analyzed for their quartz content by NIOSH Method P&CAM 259.

Following the evaluation of the relative toxicities of the materials used in the batchhouse and No. 9 Melt Tank Area, it was determined that environmental sampling would be performed for total and respirable dust, arsenic trioxide and selenium. The environmental evaluation was performed on April 8-9, 1980.

Employee exposure to total and respirable dust was evaluated using personal air sampling equipment. Breathing zone samples were collected on pre-weighed PVC filters. The dust concentrations were calculated from the results of the gravimetric analysis. Following the gravimetric analysis of the total dust samples, they were wet ashed in nitric and perchloric acids and heated with sulfuric acid to remove nitric and perchlorid acids. These samples were then analyzed by hydride generation following the methods of Pierce, et. al[1]. for selenium and arsenic. The limits of detection were 25 nanograms per sample for each of these metals.

Bulk air samples for arsine were taken using charcoal tubes adjacent to the No. 9 furnace. These samples do not represent exposures and were taken only to determine if arsine was an environmental contaminant. The samples were analyzed by the Pierce et. al[1]. method.

V. EVALUATION CRITERIA

For this evaluation the criteria used to determine the presence of health hazards to workers were selected from three sources:

NIOSH - Criteria for Recommended Standard...Occupational Exposure to (1) Inorganic Arsenic.

Threshold Limit Values (TLV) - Guidelines for airborne exposures recommended by the American Conference of Governmental Industrial Hygienists (ACGIH) for 1979.

OSHA Standard - The air contaminant standards enforced by the U.S. Department of Labor - Occupational Safety and Health Administration (29 CFR 1910.1000 and 1910.1029).

Environmental Evaluation Criteria

Current Recommended and Mandated Standards for Silica-Containing Dust, Crystalline Silica, Inorganic Arsenic and Selenium

	Total Dust	Respirable Dust	Crystalline Silica	Inorganic Arsenic	Selenium
NIOSH			50 ug/M^3	2 ug/M^3	
OSHA	$\frac{30 \text{ mg/M}^3}{\%\text{quartz}+2}$	$\frac{10 \text{ mg/M}^3}{\%\text{quartz}+2}$		10 ug/M^3	200 ug/M^3
TLV	$\frac{30 \text{ mg/M}^3}{\%\text{quartz}+3}$	$\frac{10 \text{ mg/M}^3}{\%\text{quartz}+2}$		200 ug/M^3	200 ug/M^3

Medical Evaluation Criteria

Mixed dust

Mixed dust pneumoconiosis[2] refers to the lung disorder caused by exposure to a mixture of crystalline silica and non-fibrogenic dusts. Such a mixture may for instance occur in foundries, the non-fibrogenic dust being iron oxides. Mixed dust pneumoconiosis is distinguished from silicosis by the infrequency of the characteristic silicotic nodules and the presence, instead, of irregular fibrotic lesions. The chest x-ray appearence in the early stages, and the lung function impairment and symptoms of more advanced stages, however, are similar to those found in cases of silicosis.

Silica

Silicosis[2,5] is a lung disorder caused by the repeated inhalation of crystalline silica particles. The characteristic lesions of silicosis are fibrotic nodules in the lungs. Unless exposure is extremely intense, several years of exposure precede any evidence of the disease. In its early stages silicosis is manifested by the appearance on the chest x-ray of small rounded opacities, usually appearing first in the upper parts of the lungs. It is not until the advanced stages that substantially diminished lung capacity is caused and shortness of breath occurs, although a slight decrease in lung capacity has been demonstrated epidemiologically in the early stages of the disease, even prior to x-ray changes.

Arsenic trioxide

Arsenic trioxide[2,3,4] is one of the most toxic of industrially used arsenical compounds and is excreted very slowly from the body. Arsenic has been shown to cause epidermal cancer and lung cancer and there are also indications that arsenic may cause other forms of cancer. In addition to being a mucous membrane irritant, it also causes arsenical dermatitis, hyperpigmentation of the skin and hyperkeratosis of palmar and plantar surfaces. Arsenic can also cause ulceration and performation of the nasal septum. Apart from skin and mucous membrane disorders, chronic arsenic intoxication is characterized by weakness, anorexia, gastrointestinal disturbances and peripheral neuropathy. In industrial practice, however, skin disorders are considered the most commonly occurring sign of arsenic intoxication. Inhalation of arsenic-containing dust is the usual means of entry into the body.

About 80% of absorbed arsenic is stored in the body; excretion takes place in feces and urine. Arsenic is stored in keratin where it can be detected in samples of hair and nail clippings many months after it has disappeared from urine and feces. It is recommended that both past and present exposure to arsenic be determined by analysis of urine and pubic hair samples, the latter since other body hair and nail clippings are at greater risk of exogeneous arsenic contamination. Blood is considered to be a less reliable specimen for assessment of arsenic exposure.

Selenium

Selenium compounds[3] cause irritation of the skin, mucous membranse, eyes and upper respiratory tract. The compounds can be absorbed by inhalation and ingestion and can also enter the body through intact skin. Absorbed selenium can cause various systemic effects such as pallor, lassitude, irritability, indigestion and giddiness. A characteristic symptom of selenium absorption is a metallic taste in the mouth. Hazards due to both acute and chronic exposure to selenium compounds have been demonstrated.

Arsine

Arsine[2] is an extremely toxic gas that can be fatal if inhaled in sufficient quantities. The main toxic effect is massive hemolysis which leads to discoloration of the urine, jaundice and ultimately renal failure. If exposure is low symptoms may be restricted to tiredness, pallor, breathlessness and palpitations as would be expected in severe secondary anemia.

VI. RESULTS AND DISUCSSION

A. Medical

Seventy-three workers were examined, sampled and interviewed after giving signed informed consent. Of these, 35 were currently working in the mix and melt department of the plant, where they were regularly exposed to respirable arsenic. The remaining 38 constituted a control group which, to the knowledge of the individuals and of management, never had been occupationally exposed to arsenic. All exposed workers were male, as were 34 of the 38 non-exposed No attempt to age-match the controls and exposed workers was made.

The age range of the exposed group was 24-58 years with a median of 36 years. Their duration of exposure ranged from 6 months to 28 years with a median of 11 years. The non-exposed workers had a similar age range and median.

The dermatological and general health questionnaires revealed low prevalences of various health problems and symptoms, none of which could be related to arsenic exposure. The exposed group had, on the average, the same prevalence of health problems and symptoms as the non-exposed group.

The dermatologic and nasal examination revealed no cases of arsenical dermatitis or other arsenic-related cutanous disorders. No cases of nasal septum perforation or ulceration were found.

Four of the 73 workers were found to be suffering from oil-acne, and several were found to be afflicted with various, presumably non-occupational skin disorders. All these subjects received information, advice and recommendations concerning treatment, prevention and (if necessary) referral from the NIOSH consultant dermatologist.

Blood samples were obtained from 72 workers, and pubic hair samples from 73. All participants were given urine containers and asked to supply the investigators with first morning specimen of urine. Urine specimens were submitted by 47 workers.

The blood samples all had arsenic levels below the detection limit of 1 ug/100 gr whole blood. The urine and pubic hair samples were not analyzed due to a laboratory accident. Pubic hair and urine analysis are the methods of choice to determine arsenic exposure[4]. The absence of such analyses constitutes a deficiency in this study.

At the time of the investigation plans to reduce the arsenic content in the glass were implemented, and since June 1980 arsenic is no longer used at the plant. Because of this, and because of the negative results of interviews and clinical examinations, it was concluded that additional biological sampling at a time when arsenic was no longer used would not contribute usefully to the determination of the possible presence of hazardous concentrations of respirable arsenic at the time of the initial sampling when arsenic was still being used. Consequently, no further biological sampling has been performed.

B. Environmental (The results of the environmental sampling are summarized in Tables I and II)

Silica

The quartz content of the bulk dust samples was 10 percent.

Respirable Dust

Concentrations of total dust were 0.57 - 2.4 mg/M^3.
Respirable dust concentrations were 0.14 - 0.99 mg/M^3.

Arsenic

Arsenic trioxide (as As) environmental concentrations ranged from 2 to 10 ug/M^3. All eight samples were above the NIOSH recommended standard and one was above the OSHA standard.

Selenium

Environmental samples collected for selenium ranged from 0.04-7.9 ug/M^3 and were all below the OSHA standard.

Arsine

Four general air samples for arsine gas were collected at the No. 9 furnace. NIOSH has issued a Current Intelligence Bulletin[8] stating that appropriate work practices be implemented to reduce the risk of worker exposure to arsine gas. The concentrations found during this evaluation ranged from 190-280 nanograms per sample. Employee exposures would probably be less as the samples were collected just five feet from a furnace opening.

During the visit of February 26-28, 1980 NIOSH made recommendations concerning the design of the local exhaust ventilation system, housekeeping, material handling and other workpractices. These recommendations had been implemented by the time environmental sampling was performed (April 8-10, 1980).

VII. RECOMMENDATIONS

During the visit of April 8-10, 1980 it appeared that the previously recommended controls were adequate. The results of the environmental samples indicate that there was spillage from the open tote bins and the vibratory pan feed causing the surrounding area to be contaminated with the substances unloaded into the bins.

The following recommendations contain specific measures to reduce dust exposure. Recommendations are also made regarding environmental monitoring, medical surveillance and information to previously arsenic-exposed workers.

1) The areas around the vibratory pan feed should be cemented or have a periodic oil cover to facilitate dust removal.

2) All cemented roads should be wet swept periodically.

3) Environmental monitoring of respirable silica should be performed regularly in accordance with NIOSH recommendations[5].

4) Previously arsenic exposed workers should be informed that they may be at increased risk of developing skin and lungcancer. A medical screening program for the above diseases, especially skincancer should be considered.

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IX. DISTRIBUTION AND AVAILABILITY

Copies of this Report are currently available upon request from NIOSH, Division of Technical Services, Information Resources and Dissemination Section, 4676 Columbia Parkway, Cincinnati, Ohio 45226. After 90 days the report will be available through the National Technical Information Service (NTIS), Springfield, Virginia. Information regarding its availability through NTIS can be obtained from NIOSH, Publications Office at the Cincinnati address.

Copies of this report have been sent to:

1. Jeannette Glass Corporation, Jeannette, Pennsylvania
2. American Flint Glassworkers of North America
   Local 535
   Local 91
   Local 82
3. NIOSH, Region III
4. OSHA, Region III

For the purpose of informing the 35 employees of the results of the Jeannette Glass Corporation survey, the employer shall promptly "post" for a period of 30 calendar days this Report in a prominent place(s) near where employees work.

IX. REFERENCES

1) NIOSH Manual of Analytical Methods, Volume 1, (NIOSH) Publication #77-157A, 1977.

2) Occupational Diseases: A Guide to Their Recognition, USPHS, CDC, NIOSH, Publication #77-181, Revised June 1977.

3) Hygienic Information Guide, #59, Commonwealth of Pennsylvania, Department of Health, Division of Occupational Health.

4) NIOSH Criteria For A Recommended Standard, Occupational exposure to Inorganic Arsenic, 1973.

5) NIOSH Criteria For A Recommended Standard, Occupational exposure to Crystalline Silica 1974.

6) Threshold Limit Values (TLV) - Guidelines for airborne exposures recommended by the American Conference of Governmental Industrial Hygienists (ACGIH) 1979.

7) OSHA Standard - The air contaminant standards enforced by the U.S. Department of Labour - Occupational Safety and Health Administration (29 CFR 1910.1000, 1910.1029).

8). NIOSH Current Intelligence Bulletin, #32, 1979.

TABLE I
Jeannette Glass Corporation
Jeannette, Pennsylvania
HHE No. 80-19

Date	Sample No/Type	Operations	Time	Concentrations Total Dust mg/M³*	Respirable Dust*** mg/M³	Arsenic ug/M³**	Selenium ug/M³
4/9/80	FW 5938	Batch Driver	7:10-13:32	2.39		5.39	0.14
	FW 5465				0.17		
	FW 5284	Material Handler	7:13-13:34	1.71		3.94	0.16
	FW 5457				0.66		
	FW 5941	Mixer	7:17-13:30	1.10		2.52	4.26
	FW 5951				0.21		
	FW 5011	No. 9 Furnace Operator	7:30-13:46	0.57		4.92	0.45
	FW 4823				0.45		
4/10/80	FW 4717	Batch Driver	6:19-13:14	1.22		2.13	6.09
	FW 5933				0.27		
	FW 5006	Mixer	6:21-13:07	2.23		4.64	2.90
	FW 5027				0.14		
	FW 4688	Material Handler	6:24-13:06	1.75		8.10	0.04
	FW 4689				0.18		
	FW 5009	No. 9 Furnace Operator	6:29-13:13	1.70		10.77	7.92
	FW 5029				0.99		

*mg/M^3 denotes milligrams of air contaminant per cubic meter of air sampled.
**ug/M^3 denotes micrograms of air contaminants per cubic meter of air sampled.
*** Quartz Content 10%.

	Applicable Criteria		
	NIOSH	OSHA	ACGIH
Arsenic	2** Ceiling (15 Min)	10**	500** As Arsenic (200-Intended Change)
Selenium		200**	200**
Quartz Containing Dust			

1. Occupational Health Standard promulgated by U.S. Department of Labor - Federal Register July 1, 1975, Volume 39, Title 29, Part 1910, sub-part 7, Section 1000, the silica standard for quartz in respirable dust is calculated by dividing 10 mg/M^3 by the % quartz + 2 for dust with more than 5 percent $Si\ O_2$ or 5 mg/M^3 meter for respirable dust with 1 percent or less $Si\ O_2$.
2. The NIOSH 1974 Criteria Document recommends respirable free silica exposure should not exceed 0.05 mg/M^3.

Table II
Jeannette Glass Corporation
Jeannette, Pennsylvania
OSHA Results of Operator's Breathing Zone and General Air Exposure to Arsenic

Date	Sample Number	Area/Operation	Time (Min.)	TWA Concentration ($\mu g/M^3$)	Remarks
11/15/78	D 472	Mixer	364	9.86	B.Z.
	D 473	Pill Room	251	4.24	G.A.
	D 474	Desk, Pill Room	249	3.53	G.A.
	D 475	Conveyor, Pill Room	183	228.5	G.A.
3/5/79	D 582	Mixer	406	36.37	B.Z.
	D 583	Material Handler	401	18.38	O.E.
	D 584	Batch Driver	391	6.60	O.E.
	D 585	Electric Tank Operator	408	280.5	O.E.
3/29/79	D 624	Mixer	421	27.19	B.Z.
	D 625	Material Handler	421	10.53	B.Z.
	D 626	Batch Driver	422	31.65	O.E.
	D 627	Electric Tank Operator	419	81.18	O.E.
	D 628	Laborer	417	52.99	B.Z.
	D 629	Outside Batch	410	8.46	G.A.
	D 630	Conveyor Belt	417	199.81	G.A.

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