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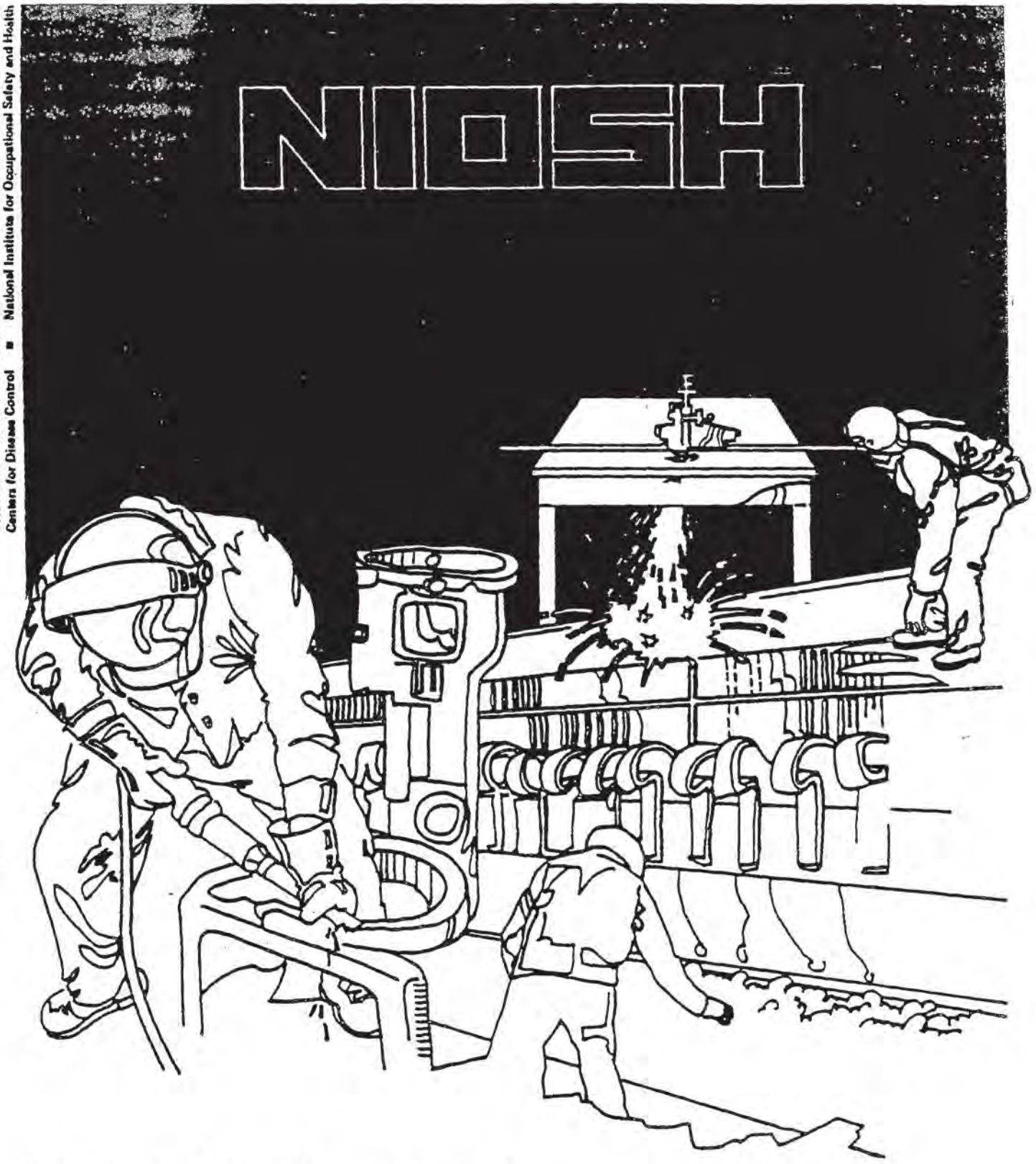

Health Hazard Evaluation Report

HETA 82-289-1496
SCHLEGEL CORPORATION
ROCHESTER, NEW YORK

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. 669(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.

The Hazard Evaluations and Technical Assistance Branch also provides, upon request, medical, nursing, and industrial hygiene technical and consultative assistance (TA) to Federal, state, and local agencies; labor; industry and other groups or individuals to control occupational health hazards and to prevent related trauma and disease.

HETA 82-289-1496 - REVISED
AUGUST 1984
SCHLEGEL CORPORATION
ROCHESTER, NEW YORK

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I. SUMMARY

In July 1982, the National Institute for Occupational Safety and Health (NIOSH) received a request to evaluate occupational exposure to stainless steel and carbon graphite fibers from the production of electrostatic brushes.

On October 26-28, 1982, NIOSH investigators conducted a preliminary environmental and medical evaluation at the plant during the production of stainless steel brushes. Total particulate air concentrations for the stainless steel operation ranged from 0.04 to 0.56 mg/m^3 for personal samples and from 0.02 to 0.05 mg/m^3 for area samples. The arithmetic mean diameter of the stainless steel fibers was 0.6 X 10^{-6} meters (0.6 um) diameter and the mean length was 3.6 um. Fiber counts, as measured by electron microscopy (EM), ranged from 0.01 to 0.04 fibers per cubic centimeter (fibers/cc). Pre- and post-shift skin wipe samples were analyzed by EM and did not reveal the presence of stainless steel or carbon graphite fibers.

On November 29-30, 1983, NIOSH investigators conducted a follow-up environmental and medical evaluation during production of carbon graphite brushes. Concentrations of total airborne particulate ranged from 0.14 to 0.31 mg/m^3 for personal samples and from 0.06 to 0.31 mg/m^3 for area samples. Generally, the mean diameter of carbon graphite fiber was approximately 6 to 7 um diameter and 80 to several hundred um length. The fiber counts were less than 0.02 fibers/cc.

Medical interviews were conducted with 22 employees during the 1982 survey and with 20 during the 1983 survey. During the 1982 survey, when stainless steel was predominantly used, 12 (59%) of 22 workers reported skin irritation, five (24%) reported eye irritation, four (18%) reported skin rash, and two (9%) reported throat irritation. During the 1983 survey when carbon graphite was predominantly in use, all 20 workers reported skin irritation, six (30%) reported eye irritation, 11 (55%) reported skin rash, and eight (40%) reported throat irritation.

Based on these results, we concluded there were no acute respiratory problems due to inhalation of stainless steel or carbon graphite fibers during the production of electrostatic brushes at the Schlegel Corporation in Rochester, New York. However, results of the medical survey indicated that both stainless steel and carbon graphite fibers are very irritating to the eyes and skin. Therefore, appropriate local exhaust ventilation, personal protective equipment including respirators and disposable coveralls, and work practice should be used to reduce worker exposure. Recommendations for reducing exposure are contained in Section VII of this report.

KEYWORDS: Electrostatic Brushes, Carbon Graphite Fibers, Stainless Steel Fibers SIC 2299 (Miscellaneous Textile Goods, not elsewhere classified).

II. INTRODUCTION

In July 1982, the National Institute for Occupational Safety and Health (NIOSH) received a request from an authorized representative of the Local 3T, Amalgamated Clothing and Textile Workers Union to perform a health hazard evaluation (HHE) at the Schlegel Corporation in Rochester, New York. The purpose of this HHE was to evaluate dermatitis and possible respiratory effects resulting from exposure to stainless steel and carbon graphite fibers resulting from the production of electrostatic brushes. A NIOSH industrial hygienist and medical investigators conducted a preliminary evaluation at the plant on October 26-28, 1982. During this preliminary evaluation, stainless steel brushes were being produced. An interim report, which summarized the results of the preliminary study, was sent to the company and union in November 1983.

On November 29-30, 1983, a follow-up environmental and medical evaluation was conducted to evaluate exposure to carbon graphite fibers in an area of the plant where only carbon graphite brushes were produced.

III. BACKGROUND

The yarn is prepared for the assembler. The yarn is assembled to the base. Several finishing operations are required (punching, deburring and trimming) prior to inspection and packing.

The primary operations, yarn preparation and fixing the dimensions of the parts are the primary sources of fiber generation. The finishing and packing operations contribute some airborne metal particulate, much less than the primary source. During the preliminary survey, when the majority of electrostatic brushes were produced with stainless steel, there was little local ventilation to control airborne particulate. Also, no respiratory protection and little protective clothing were available.

During the follow-up survey, NIOSH-certified disposable respirators were available for certain high exposure operations. Protective gloves and aprons were available for all workers in the brush department. In addition, more local exhaust ventilation was in place to control airborne particulate at the source of generation.

Schlegel has a plant medical department staffed by a full-time registered nurse. All employees receive a physical examination and audiogram at the time of employment. Workers in the electrostatic brush department do not receive any type of periodic physical examination.

IV. EVALUATION DESIGN AND METHODS

A. Environmental

Environmental sampling was conducted at the Schlegel Corporation on October 27-28, 1982 and November 29-30, 1983. For both surveys, personal breathing zone and area air samples for total particulate exposures were collected on pre-weighed polyvinyl chloride (PVC) filters at a flowrate of 1.5 liters per minute (lpm). Area air samples for fiber characterization (size and count) were collected on mixed cellulose ester membrane (AA) filters at a flowrate of 1.5 lpm. During the first survey, two area air samples for airborne fiber diameter size-distribution were collected using 4-stage Sierra® cascade impactors at a flowrate of 2 lpm. Also during the first survey, pre- and post-shift wipe samples were collected from workers' exposed skin using AA filters and analyzed for fiber size and count.

B. Medical

During both the 1982 and 1983 surveys, NIOSH medical investigators conducted confidential interviews with all employees working in the electrostatic brush department. A medical questionnaire, designed to obtain information regarding the prevalence of skin disorders; eye, nose, and throat irritation; and respiratory symptoms associated with the use of stainless steel and graphite fibers, was administered to all participants. Demographic data, work and smoking histories, and information regarding the use of personal protective equipment was also obtained. In addition, we interviewed the plant nurse and reviewed employees' medical records.

V. EVALUATION CRITERIA

A. Environmental Criteria

As a guide to the evaluation of the hazards posed by workplace exposures, NIOSH field staff employ environmental evaluation criteria for assessment of a number of chemical and physical agents. These criteria are intended to suggest levels of exposure

to which most workers may be exposed up to 10 hours per day, 40 hours per week for a working lifetime without experiencing adverse health effects. It is, however, important to note that not all workers will be protected from adverse health effects if their exposures are maintained below these levels. A small percentage may experience adverse health effects because of individual susceptibility, a pre-existing medical condition, and/or a hypersensitivity (allergy).

The primary sources of environmental evaluation criteria for the workplace are: 1) NIOSH Criteria Documents and recommendations, 2) the American Conference of Governmental Industrial Hygienists' (ACGIH) Threshold Limit Values (TLV's), and 3) the U.S. Department of Labor (OSHA) occupational health standards. Often, the NIOSH recommendations and ACGIH TLV's are lower than the corresponding OSHA standards. Both NIOSH recommendations and ACGIH TLV's usually are based on more recent information than are the OSHA standards. The OSHA standards also may be required to take into account the feasibility of controlling exposures in various industries where the agents are used; the NIOSH-recommended standards, by contrast, are based primarily on concerns relating to the prevention of occupational disease. In evaluating the exposure levels and the recommendations for reducing these levels found in this report, it should be noted that industry is legally required to meet only those levels specified by an OSHA standard.

A time-weighted average (TWA) exposure refers to the average airborne concentration of a substance during a normal 8- to 10-hour workday. Some substances have recommended short-term exposure limits or ceiling values which are intended to supplement the TWA where there are recognized toxic effects from high short-term exposures.

NIOSH does not have an environmental standard for carbon graphite or stainless steel fibers. However, because of similar irritant properties, NIOSH fiber experts from the Division of Standards Development and Technology Transfer have suggested that the NIOSH recommended standard for fibrous glass (3 fibers/cc) is the most analogous environmental evaluation criterion.

	8-Hour TWA Exposure Limit	
	Nuisance Dust	Fibrous Glass
NIOSH	--	3 fibers/cc
ACGIH	10 mg/m^3	10 mg/m^3
OSHA	15 mg/m^3	--

B. Toxicologic Studies of Graphite Fiber

Human morbidity and mortality studies of persons exposed to carbon graphite fibers have not been conducted. However, two animal studies, one long-term (18-24 mon.) and one short-term (104 hrs.) have been conducted. In the first study one malignant tumor was found in relation to a fiber implant. The second study, involving the inhalation of respirable-size fibers, found no tumors.[1,2]

VI. RESULTS AND DISCUSSION

A. Environmental

1. Initial Survey

During the initial survey, stainless steel brushes were primarily being produced. For the stainless steel operation, total particulate concentrations (Table I) for 8 personal samples ranged from 0.04 to 0.56 milligrams per cubic meter (mg/m^3) and for 6 area samples from 0.02 to 0.05 mg/m^3. Although there is no specified environmental standard for the total particulate cconcentration of stainless steel, OSHA has a 15 mg/m^3 standard for nuisance dusts.

For a short-term carbon graphite operation the total particulate concentration for the personal breathing zone sample was 0.42 mg/m^3 (no available environmental limit) and the mean particulate concentration for the 2 area air samples was 0.21 mg/m^3.

Four area air samples (2 each for stainless steel and carbon graphite) were analyzed by electron microscopy analysis (EM) for fiber size and count according to the Zumwalde-Dement procedure outlined in NIOSH Publication 77-204. For the stainless steel samples, the respirable fiber counts were 0.01 and 0.04 fibers per cubic centimeter of air (fibers/cc) and the arithmetic mean size of the fibers for the two samples was 0.6×10^{-6} meters (0.6 um) diameter and 3.6 um length. For the carbon graphite samples the fiber counts were 0.3 and 0.10 fibers/cc and the arithmetric mean size of the fibers for the 2 samples was 0.6 um diameter and 4.5 um length.

The pre- and post-shift skin wipe samples were analyzed by EM and did not reveal the presence of stainless steel or carbon graphite fibers.

2. Follow-up Survey

During the follow-up survey, only carbon graphite brushes were being produced. For the carbon graphite operation, total particulate concentrations (Table II) for 7 personal samples ranged from 0.14 to 0.31 mg/m^3 (no available environmental limit) and for 4 area samples from 0.06 to 0.31 mg/m^3.

During the carbon graphite operation, six area air samples and 11 personal breathing-zone air samples were collected for carbon graphite fiber size and count. The majority (>90% by mass) of material present on these filters were small, round, non-fibrous, tin and iron-containing metallic particles. For these air samples, the respirable fiber portion is less than 1% of the total mass. Generally, carbon graphite fiber size was large (6 to 7 um in diameter and 80 to several hundred um length) and non-respirable, while the respirable fiber count was low (less than 0.02 fibers/cc as determined by polarized light microscopy using NIOSH Method 7400). One area sample collected next to the conditioner machine yielded the highest fiber count (as measured by scanning electron microscopy) observed in our study, 0.04 fibers/cc.

B. Medical

Twenty-two employees were interviewed during the 1982 survey and 20 during the 1983 survey. Eleven of these employees participated in both the 1982 and 1983 interviews. The 1983 investigation included only hourly workers, whereas the 1982 survey included four salaried personnel.

Forty-five percent of the 1982 participants and 25% of the 1983 participants were males. The mean ages of the two populations were 36 years and 37 years, respectively. Production workers in the 1982 survey had worked in the department an average of 8 months; in 1983 the average was approximately 15 months.

Thirteen (59%) of the 22 workers interviewed in 1982 reported experiencing skin problems during the preceding six months. The most commonly described skin problem was itching and redness, with small bumps where fibers became embedded in the skin. This irritation was most often on the hands and forearms, although one employee reported a rash on his chest and base of his neck.

Workers reported that rashes lasted anywhere from several days to five months (in the case of small white bumps). All 20 workers interviewed in 1983 reported skin problems (including itching) within the preceding six months, with 11 (55%) reporting rashes, primarily on the hands, but also on the face and/or forearms, and in several cases on the neck, upper chest, and legs. Workers described the rashes as macular (red spots), papular (solid bumps), and/or small pustules. No worker had an active rash at the time of the survey, however four workers pointed out small darkened areas on their hands where fibers had previously been imbedded.

Nose and throat irritation were each more frequently reported in 1983 than in 1982, whereas eye irritation was reported at a similar rate both years (Table III). Nosebleeds and cough were infrequent both years.

In 1982, seven workers (32%) and in 1983, 10 workers (50%), reported seeing the plant nurse regarding skin problems. According to the plant nurse, three employees were transferred out of the department in 1982 because of skin problems and approximately six were transferred during 1983. The transfer of workers both in and out of the department, either on a temporary or permanent basis, is accomplished without much difficulty according to the plant nurse. Therefore, requests from workers or medical recommendations for transfer out of the department related to a skin rash are usually met. During both surveys, we interviewed one worker transferred out of the department for medical reasons. Both of these workers experienced more severe skin rashes shortly after coming to the department.

During the 1983 survey we attempted to characterize the irritant nature of the graphite fibers in relation to the stainless steel fibers and fibrous glass (a substance not used in the department but one which workers may have been exposed to outside of work at Schlegel). Most of the workers interviewed in 1982 worked primarily with stainless steel fibers. By 1983, workers had used both types and were able to make a comparison between the two fibers. Thirteen of those interviewed in 1983 stated that carbon fibers were more irritating than the stainless steel fibers, two stated the stainless steel fibers were worse, and three stated they were similar. Eight workers had previously worked with fibrous glass. Three reported that graphite was just as irritating as fibrous glass, three stated that graphite was more irritating, and two stated that it was less irritating than fibrous glass.

The irritant effects of fibrous glass are well documented.[3] It was noteworthy that workers described graphite fibers, in most cases, as equally or more irritating than fibrous glass. Carbon fibers were reported to be more problematic than stainless steel fibers, in part because they become more easily airborne and, therefore, more irritating to the nose, throat, and skin.

Results of the interviews indicate that exposure to both stainless steel and graphite fibers is irritating to the skin. Workers reported that protective clothing currently used does not prevent all fibers from becoming embedded in the skin. However, the protective clothing does lessen skin irritation and is generally worn on the job when conditions are not too warm and the clothing does not interfere with performance. One-forth of employees complained of eye irritation. Fibrous glass is a known eye irritant, and cases of eye injury resulting from fibers becoming embedded in the eye have been reported.[4]

Only one worker during each survey complained of an occassional cough related to fiber inhalation. Exposure to current levels of airborne stainless steel and graphite fibers does not appear to cause acute respiratory irritation. The question of the chronic respiratory effect of exposure to either stainless steel or graphite fibers could not be addressed during this survey, since both fibers had been used less than two years. Although there is little scientific information available regarding chronic respiratory effects of inhalation of either fiber, research has been completed on other types of fibers. These studies indicate that the physical characteristics of the fiber, such as length and diameter, rather than the chemical composition of the fiber, play the greatest role in determining its potential toxic effect on the lung. In general, long and thin fibers, those < 3.5um in diameter and > 10um in length are thought to have the greatest potential for deposition and retention in the lower airways of the lungs, resulting in fibrosis and/or lung cancer.[5] Microscopic analyses of the stainless steel fibers indicate that these fibers have a smaller diameter and shorter length than fibers such as asbestos, which are known to cause lung problems. Microscopic analyses of the graphite fibers indicate that these fibers have a larger diameter and much greater length than the fibers known to cause lung disease.

In general, more workers reported the use of personal protective equipment in 1983 than in 1982 (Table IV). During both surveys, however, they reported wearing protective clothing intermittently or only during certain operations. Workers reported less frequent use of protective clothing in the summer because of warmer weather.

VII. CONCLUSIONS AND RECOMMENDATIONS

The environmental portion of both the 1982 and 1983 surveys indicate that, because of the large fiber sizes and the low fiber counts, we conclude a health hazard due to inhalation of carbon graphite or stainless steel fibers is unlikely. However, the medical surveys indicate a high prevalence of skin irritation and an increase in both skin and eye irritation from the 1982 to the 1983 survey.

Although a number of improvements had been made in the local exhaust ventilation since the 1982 survey, the high prevalence of skin and eye irritation among workers support the need for continued improvement not only in ventilation but also improvements in protective equipment and work practices. The following recommendations should help reduce this irritation.

1. Enclosure of contaminants at the source of generation and local exhaust ventilation should be utilized in the finishing areas wherever possible. Maintenance of these and all ventilation systems (i.e. changing filter, cleaning ductwork) are essential for the proper functioning of these systems. One person should be responsible for overseeing this maintenance.

2. The use of personal protective equipment will help to minimize skin and eye irritation by limiting exposure. The company has supplies of coats, aprons, gloves, arm covers, and glasses or goggles for all workers. Eye protection should be worn by all personnel working with stainless steel and graphite fibers.

   Clothing, such as coats and aprons should be made from material (e.g., Tyvek® 1422A or 1443 CS) which is relatively impermeable to fibers.[6] To minimize the penetration of fibers, NIOSH clothing experts from the Division of Safety Research have recommended that gloves be made from nitrile butadiene rubber (NBR). The Edmont Company manufactures a thin (11 mils) brand of glove (Sol-Vex®) made from NBR which protects against fibers.

3. In addition to limiting skin exposure, protective clothing is also valuable because it minimizes contamination of the worker's personal clothing. If workers do not wear protective clothing, they should wash their personal work clothes separately from other wash to prevent contamination of non-work and other family members' clothing.

4. Although respiratory protection is not required, the company has supplies of NIOSH-certified disposable respirators which will help reduce exposure to airborne fibers.

5. Good hand washing is essential, even when protective gloves are worn, because fibers may contact the skin during removal of gloves. Good hand washing before meals and before using the bathroom should limit skin exposure to these fibers.

6. Workers, newly assigned to the department where stainless steel and carbon graphite are used, should be informed of the irritant nature of the fibers and educated regarding means of avoiding skin contact with the fibers through the use of local exhaust ventilation, personal protective equipment, good hygiene, and good work practices.

7. A preplacement examination should be made available to all employees and should include as a minimum; a medical and work history, and a physical examination, both giving particular attention to the skin and respiratory system.

8. Periodic examinations should be made available to employees and should include an interim medical and work history, and physical examination as described above.

VIII. REFERENCES

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X. DISTRIBUTION AND AVAILABILITY OF REPORT

Copies of this report are currently available upon request from NIOSH, Division of Standards Development and Technology Transfer, Publications Dissemination Section, 4676 Columbia Parkway, Cincinnati, Ohio 45226. After 90 days, the report will be available through the National Technical Information Service (NTIS), 5285 Port Royal, Springfield, Virginia 22161. 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. Local 3T, Amalgamated Clothing and Textile Workers Union
2. The Schlegel Corporation
3. NIOSH, Region II
4. OSHA, Region II

For the purpose of informing affected employees, copies of this report shall be posted by the employer in a prominent place accessible to the employees for a period of 30 calendar days.

Table I

Total Particulate Concentration for
Personal and Area Samples

Schlegel Corporation
Rochester, New York
HETA 82-289
October 27-28, 1982

Material	Worker/Area	Job Description/location Machine Tag Number	Sample Duration	Particulate Concentration (mg/m^3)
Stainless Steel	Personal		Day 1 (October 27)	
	#1	0135	8:22-15:37	0.12
	#2	0111	8:14-15:35	0.18
	#3	Assembler	8:12-15:31	0.12
	#4	Assembler	8:05-15:30	0.24
	#5	1305	8:00-15:32	0.56
	#6	Supervisor	8:37-15:47	0.08
	#7	Assembler	17:33-23:25	0.04
	#8	Assembler	17:35-23:25	0.06
	Area			
	Area #1	9455	9:32-15:54	0.04
	Area #2	Finishing	9:37-15:57	0.05
	Area #3	5058	9:43-16:00	0.04
	Area #4	50105	9:46-15:54	0.05
	Area #5	1305	17:33-23:25	0.02
	Area #2	Finishing	17:35-23:25	0.02
Carbon Graphite	Personal		Day 2 (October 28)	
	#1	9548	9:54:-10:42	0.42
	Area			
	Area #6	Light Fixture above 9548	9:53-10:42	0.27
	Area #7	"	9:53-10:47	0.14

Table II

Total Particulate Concentration for
Personal and Area Samples

Schlegel Corporation
Rochester, New York
HETA 82-289
November 29-30, 1983

Material	Worker/Area	Machine Tag Number	Sample Duration	Particulate Concentration (mg/m^3)
Carbon Graphite	Personal		Day 1 (November 29)	
	#1	0135	9:14-15:55	0.18
	#2	9548	9:42-15:55	0.17
	#3	0082	14:04-15:55	0.26
	Area			
	Area #1	9548	9:27-15:50	0.11
	" #2	0135	9:19-16:22	0.31
	Personal		Day 2 (November 30)	
	#1	0259	7:53-15:42	0.14
	#2	9548	7:44-15:47	0.17
	#4	0135	8:00-15:50	0.31
	#5	0082	12:37-15:45	0.22
	Area			
	Area #1	9548	7:47-15:55	0.11
	Area #3	0082	12:24-15:55	0.06

Table III

Frequency of Symptoms Reported by Workers
During 1982 and 1983 Surveys

Schlegel Corporation
Rochester, New York
HETA 82-289

Symptom	1982 22 Workers #	1982 22 Workers %	1983 20 Workers #	1983 20 Workers %
Skin irritation	12	59	20	100
Skin rash	4	18	11	55
Eye irritation	5	24	6	30
Throat irritation	2	9	8	40
Nose irritation	0	0	11	55
Nosebleed	1	5	0	0
Cough	1	5	1	5

Table IV

Reported Use of Personal Protective Equipment
During 1982 and 1983 Surveys

Schlegel Corporation
Rochester, New York
HETA 82-289

Type of Equipment	1982 22 Workers #	1982 22 Workers %	1983 20 Workers #	1983 20 Workers %
Gloves	20	90	12	60
Sleeves	3	14	15	75
Apron	9	41	14	70
Eye protection	2	9	10	50
Coat	1	5	7	35
Respirator	0	0	4	20

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