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PUBLIC HEALTH SERVICE
CENTER FOR DISEASE CONTROL
NATIONAL INSTITUTE FOR OCCUPATIONAL SAFETY AND HEALTH
CINCINNATI, OHIO 45226

HEALTH HAZARD EVALUATION DETERMINATION REPORT
HE 79-37-684

STERLING FAUCET COMPANY
SABRATON, WEST VIRGINIA

APRIL, 1980

I. SUMMARY

On March 7 and 8, 1979, and again on June 27, 1979, the National Institute for Occupational Safety and Health (NIOSH) conducted a health hazard evaluaton at the Sterling Faucet Company in Sabraton, West Virginia, to evaluate possible hazards of a graphite lubricant used in the Hollow Forge Department. A comprehensive walk-through survey and environmental sampling was conducted, ventilation measurements were taken, and non-directed medical questionnaire interviews were performed to determine possible employee exposures to graphite, formaldehyde, petrolium spirits and poly-nuclear aromatic compounds.

Personal and area samples for total and respirable synthetic graphite dust, refined petroleum solvents (naphtha portion) and poly-nuclear aromatics were taken of the drop-forge operators.

Analyses of these samples revealed levels of graphite dusts and refined petrolium solvents which were below current environmental criteria for these substances. Analyses of air and bulk samples for several poly-nuclear aromatic compounds were negative. However, interviews with the exposed employees revealed a high prevalence of skin and upper respiratory irritation.

On the basis of data obtained in the investigation, NIOSH determined that although air concentrations of the substances measured were within acceptable limits, skin and vapor respiratory irritation were associated with this industrial exposure. Recommendations to help control these effects are presented on page 6.

II. INTRODUCTION

Under the Occupational Safety and Health Act of 1970*, NIOSH investigates the toxic effects of substances found in the workplace. The United Steelworkers Local 6214 request such an investigation from NIOSH on December 22, 1978, to evaluate the possible health effects of a graphite lubricant upon the drop-forge operatiors in the Hollow Forge Department.

*Section 20(a)(6) of the Occupational Safety and Health Act of 1970, 29 U.S.C. 669(a)(6), authorizes the Secretary of Health, Education, and Welfare, following a written request by any employer or authorized representative of employees, to determine whether any substrance normally found in the place of employment has potentially toxic effects in such concentrations as used or found.

NIOSH met with management and union representatives for the opening and closing conferences, performed a walk-through survey and environmental sampling, and took ventilation measurements on March 7 and 8, 1979. Interim Report #1, April, 1979, was sent out to the company and union representatives.

On May 23, 1979, NIOSH Region III received an additional request from the United Steelworkers International Union for measuring the poly-nuclear aromatic hydrocarbon levels in the air near the forges and testing the mutagenic activitiy either by the Ames test or by other short-term tests of material captured in the air filters. This request was prompted by reports of increased lung cancer and leukemia incidence rates in drop-forge workers in Massachusetts and documentation of poly-nuclear aromatics around drop-forge operations. On June 27, 1979, NIOSH conducted additional environmental sampling and testing for these components. Interim Report #2, July, 1979, was sent out to the company and union representatives.

III. BACKGROUND

The Hollow Forge Department produces brass fittings and valve bodies from cut brass bar stock that is run through 100 ton drop-forge presses. This department contains seven drop-forge presses (Taylor-Challen 171.4 - 4 MIC II and 3 MIC II) and twelve machine/trimmer operators over two shifts.

Each press contains a punch and die which are automatically coated with the liquid graphite emulsion (graphite/polymer emulsion + water) before each drop of the press. The graphite lubricant facilitates the release of the forged parts from the press.

The graphite lubricant or parting agent consists of fine particles of graphite suspended in 25% refined petroleum spirits, < 0.1% formaldehyde, and water (further diluted 5:1, water to graphite) in a centralized mixing/holding tank which is pumped, by air, to the various presses. An air pressure control valve regulates the amount of spray to the punch and die surfaces. Surrounding the punch and die may be up to a half dozen copper tubes through which the graphite is sprayed. These tubes are prearranged based on the configuration of the punch and die.

Spray tubes oriented towards the operator and the outward draft created during the downstroke of the press may cause the operator to be exposed to the "liquid graphite."

The machine operators wear cotton gloves, safety glasses (no side-shields) and earplugs. The graphite spray material was observed on their faces, hands, and clothing (front) by the NIOSH Regional Industrial Hygienist.

Wooden platforms are used by the shorter employees in order to get their faces above the spray release zone. An air spray (20 psi - normally used) is directed toward the graphite spray in order to "push back" any graphite mist entering the operator's breathing zone, but turbulence is noted which "kicks back" spray to the operator anyway.

IV. EVALUATION DESIGN AND METHODS

Discussions with management and union representatives involved the process description, engineering controls, personal protective equipment and clothing, work and hygiene practices, training programs, recordkeeping, medical surveillance, and air monitoring. Non-directed medical questionnaires were given to six employees; all were machine operators.

Breathing zone and area air samples were taken of the drop-forge operators for exposure to total and respirable graphite dust, petroleum solvent (naphtha) and poly-nuclear aromatics. Air sampling pumps with preweighed AA (0.8μ) filters were used for total dust; with preweighed AA (0.8M) filters with cyclone assembly for respirable dust; with silver membrane/glass fiber filters for poly-nuclear aromatics. Low flow pumps with charcoal tubes were used to sample for petroleum solvents. Air velocity measurements were taken in and around the operators' work area using a velometer in conjunction with a smoke tube assembly kit.

Wipe-samples were taken on the die/punch area, conveyor belt, and back-side of the drop-forge assembly to be used for potential testing carcinogenicity and mutagenicity of released air contaminants.

V. EVALUATION CRITERIA[2,3,4,5,6,7]

Graphite

Local - None.

Systemic - Exposure to natural graphite may produce a progressive and disabling pneumoconiosis similar to anthracosilicosis. Symptoms include headache, coughing, depression, decreased appetite, dyspnea, and the production of black sputum. Some individuals may be asymptomatic for many years then suddenly become disabled. It has not yet been determined whether the free crystalline silica in graphite is solely responsible for development of the disease. There is evidence that artifical graphite may be capable of producing a pneumoconiosis.

The environmental criteria for graphite is an 8hr. time-weighted average of 5 mg/M^3 (respirable) and 15 mg/M^3 (total) = OSHA* and 10 mg/M^3 (total dust) = ACGIH**.

Poly-Nuclear Aromatics

Exposure to poly-nuclear aromatics may produce phototoxic effects, such as erythema (reddening of the skin) and burning and itching of skin, photophobia, conjunctivitis, and skin and lung cancer, in humans.

Benzo(a)pyrene, benzathracene, chrysene, and phenathrene are by themselves carcinogenic substances. Anthracene, carbazole, fluoranthene, and pyrene may also cause cancer, but this has not been well documented.

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*8hr. time-weighed average and 15 minute ceiling to be legally enforceable - OSHA - Occupational Safety and Health Administration.

**8hr. TLV - Threshold Limit Value on TWA and STEL - short-term excursion limit - ACGIH - American Conference of Governmental Industrial Hygienists.

The environmental criteria established for poly-nuclear aromatics is designed to reduce the risk of lung and skin cancer. NIOSH has recommended that the permissible exposure limit be set at the lowest concentration that can be reliably detected by the recommended analytical method; however, NIOSH states that while this may reduce the incidence of cancer, no threshold of carcinogenic response can be established at this time.

The environmental criteria for poly-nuclear aromatics is 0.2 mg/M^3 - 8hr.TWA (benzene solubles) - OSHA 0.1 mg/M^3 -8hr.TWA (cyclohexane solubles) - NIOSH***, and 0.2 mg/M^3 -8hr.TLV (benzene solubles) - ACGIH.

Petroleum Distillates (naphtha portion)

Local - The naphthas are irritating to the skin, conjunctiva, and the mucous membranes of the upper respiratory tract. Skin "chapping" and photosensitivity may develop after repeated contact with the liquid. If confined against skin by clothing, the naphthas may cause skin burns.

Systemic - Petroleum naphtha has a lower order of toxicity than that derived from coal tar, where the major hazard is brought about by the aromatic hydrocarbon content. Sufficient quantities of both naphthas cause central nervous system depression. Symptoms include inebriation, followed by headache, and nausea. In severe cases, dizziness, convulsions, and unconsciousness occasionally result. Anorexia and nervousness have been reported to persist for several months following an acute overexposure, but this appears to be rare.

The environmental criteria for refined petroleum solvent is 2950 mg/M^3 - OSHA 350 mg/M^3 - 8hr.TLV, 1800 mg/M^3 (15 minute) ceiling and 575 mg/M^3 - 8hr.TLV, 720 mg/M^3 - STEL."

Formaldehyde

Local - Formaldehyde gas may cause severe irritation to the mucous membranes of the respiratory tract and eyes. The aqueous solution splashed in the eyes may cause eye burns. Urticaria has been reported following inhalation of gas. Repeated exposure to formaldehyde may cause dermatitis either from irritation or allergy.

Systemic - Systemic intoxication is unlikely to occur since intense irritation of upper respiratory passages compels workers to leave areas of exposure. If workers do inhale high concentrations of formaldehyde, coughing, difficulty in breathing, and pulmonary edema may occur. Ingestion, though usually not occurring in industrial experience, may cause severe irritation of the mouth, throat, and stomach.

The environmental criteria for formaldehyde is an 8hr.TWA of 3 PPM, acceptable ceiling of 5 PPM, and maxium ceiling (30 minutes) of 10 PPM - OSHA; 1 PPM ceiling (30 minutes) - NIOSH; and 2 PPM 8hr.TLV - ACGIH.

Recent findings of nasal cancer in rats, reported by the Chemical Industry Institute of Toxicology, has generated additional concern for the potential adverse health effects that can be caused by exposure to formaldehyde.

***8hr.TWA and 15 minute ceiling - NIOSH - National Institute for Occupational Safety and Health.

VI. RESULTS AND DISCUSSION

Eight-hour TWA (time-weighed average) samples were taken in the breathing zones of two machine operators working at presses #1 and #5 to determine exposures to synthetic graphite dust (total) and refined petroleum spirits (naphtha portion). Area samples for respirable synthetic graphite dust were obtained at each press next to the operator.

The results of the air sampling (March 8, 1979) for graphite dust (total and respirable are as follows:

Hollow Forge area - machine operator at press No. 5 - personal sample (total dust) = 0.14 mg/M^3; area sample (respirable dust) = 0.21 mg/M^3.

Hollow Forge area - machine operator at press No. 1 - personal sample (total dust) = 1.8 mg/M^3; area sample (respirable dust) = 0.29 mg/M^3.

These results are well below the environmental criteria for synthetic graphite/ "nuisance" or "inert" dusts of 5 mg/M^3 (respirable) and 15 mg/M^3 (total) = OSHA and 10 mg/M^3 (total dust) = ACGIH.

The analyses of the air sampling (March 8, 1979) for refined petroleum spirits did not detect the presence of any identifiable components in the breathing zone of the operators. As with formaldehyde, the dilution of the graphite mixture with water evidently results in a very low (and undetectable) concentration of petroleum spirits in the air.

Additional environmental sampling was conducted on June 27, 1979, to identify and quantify any poly-nuclear aromatics in the breathing zone of the operators and around the drop-forge machines.

Eight-hour TWA samples were taken in the breathing zones of three machine operators working at presses #2, 3, 4, 5, and 7. Three area samples were also taken at the back-end of presses #2, 3, 4, 5, and 7.

PNA air and bulk samples showed no benzo(a)pyrene, chrysene, pyrene, benzo(a)anthracene or fluorathene; therefore, testing of carcinogenicity and mutagencity of the released air contaminants was not deemed necessary. Benzene solubles other than poly-nuclear aromatics were found but were not identified.

On March 8, 1979, ventilation measurements (velometer and smoke tube assembly kit), in and around the operator's area, showed 0-50 ft./min. of turbulent air movement at press #5 and 0-25 ft./min. of turbulent air movement at press #1; air currents, for the most part, are up and away from the breathing zone - but with some backlash into the worker, particularly on down strokes of the press. Heat convection currents and the use of the air spray account for these air movement characteristics.

On June 27, 1979, it was observed that ventilation improvements had been made since NIOSH's last visit on March 8, 1979; three 4-ft. wall fans had been equidistantly placed on the wall behind the presses and a large (4' x 8') open louver system located on this wall to the left of these presses.

Ventilation measurements (velometer and smoke tubes) showed increased air movement in front of and behind the presses; 50 FPM at the front and 75 FPM at the rear compared to 25 FPM and 50 FPM, prior to ventilation improvements.

Non-directed interviews of six employees in the Hollow Forge area revealed: throat irritation, two cases; nose irritation, one; eye irritation, one; sinus irritation, one; chest tightness, one. Two of the six reported no symptoms.

II. RECOMMENDATIONS[4,5,6]

The following recommendations were given to management in order to minimize contact with the dust, mists, and vapors coming from the graphite spray operation:

1. Cotton gloves are not satisfactory to protect hands from the skin contact and absorption of refined petroleum spirits and formaldehyde. In fact, constant contact of skin with "saturated" gloves may provide a worse condition than if no gloves were worn. A glove should be used that is impervious to the solvents as well as protective against hot and sharp objects.

2. A splash shield should be placed between the spray area and machine operator in order to block the travel of the liquid graphite spray and prevent any skin or respiratory tract irritation.

3. Safety glasses with side shields are preferred, or even chemical goggles, to minimize splashing/contact to the eyes. Of course, a chemical face shield would be best since it would protect the whole face.

4. Local exhaust ventilation should be utilized where machine oil, "liquid graphite" vapors and decomposition products are coming off of the forged parts on the conveyor belts and in the collecting bins.

5. Food storage, eating, drinking, and smoking should be prohibited in the press area.

III. AUTHORSHIP AND ACKNOWLEDGEMENTS

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IX. DISTRIBUTION AND AVAILABILITY

Copies of this report are currently available, upon request, from NIOSH, Division of Technical Services, Publications Dissemination, 4676 Columbia Parkway, Cincinnati, Ohio 45226. After 90 days, the report will be available through the National Technical Information Service (NTIS), Springfield, Virginia 22161.

Copies of this report have been sent to:

1. Sterling Faucet Company
2. United Steelworkers, Local 6214
3. NIOSH, Region III
4. OSHA, Region III

For the purpose of informing the approximately twenty "affected employees," the employer shall promptly "post" the determination report for a period of 30 days in a prominent place near where exposed employees work.

X. REFERENCES

1. NIOSH Manual of Sampling Data Sheets, 1977 Edition, U.S. DHEW, PHS, CDC, NIOSH, Cincinnati, Ohio, March 1977.

2. General Industry, OSHA Standard and Health Standards, 29 CFR OSHA 2206, Revised, November 7, 1978.

3. Threshold Limit Values for Chemical Substances and Physical Agents in the Workroom Environment with Intended Changes for 1979, American Conference of Governmental Industrial Hygienists, Cincinnati, Ohio.

4. Criteria for a Recommended Standard....Occupational Exposure to Coal Tar Products, NIOSH, Publication No. 78-107.

5. Criteria for a Recommended Standard....Occupational Exposure to Refined Petroleum Solvents, NIOSH, Publication No. 77-192.

6. Criteria for a Recommended Standard....Occupational Exposure to Formaldehyde, NIOSH, Publication No. 77-126.

7. Carcinogenic Potential of Formaldehyde, Memorandum from Acting Chief, Technical Evaluation and Review Branch, Office of Extramural Coordination and Special Projects, February 1, 1980.