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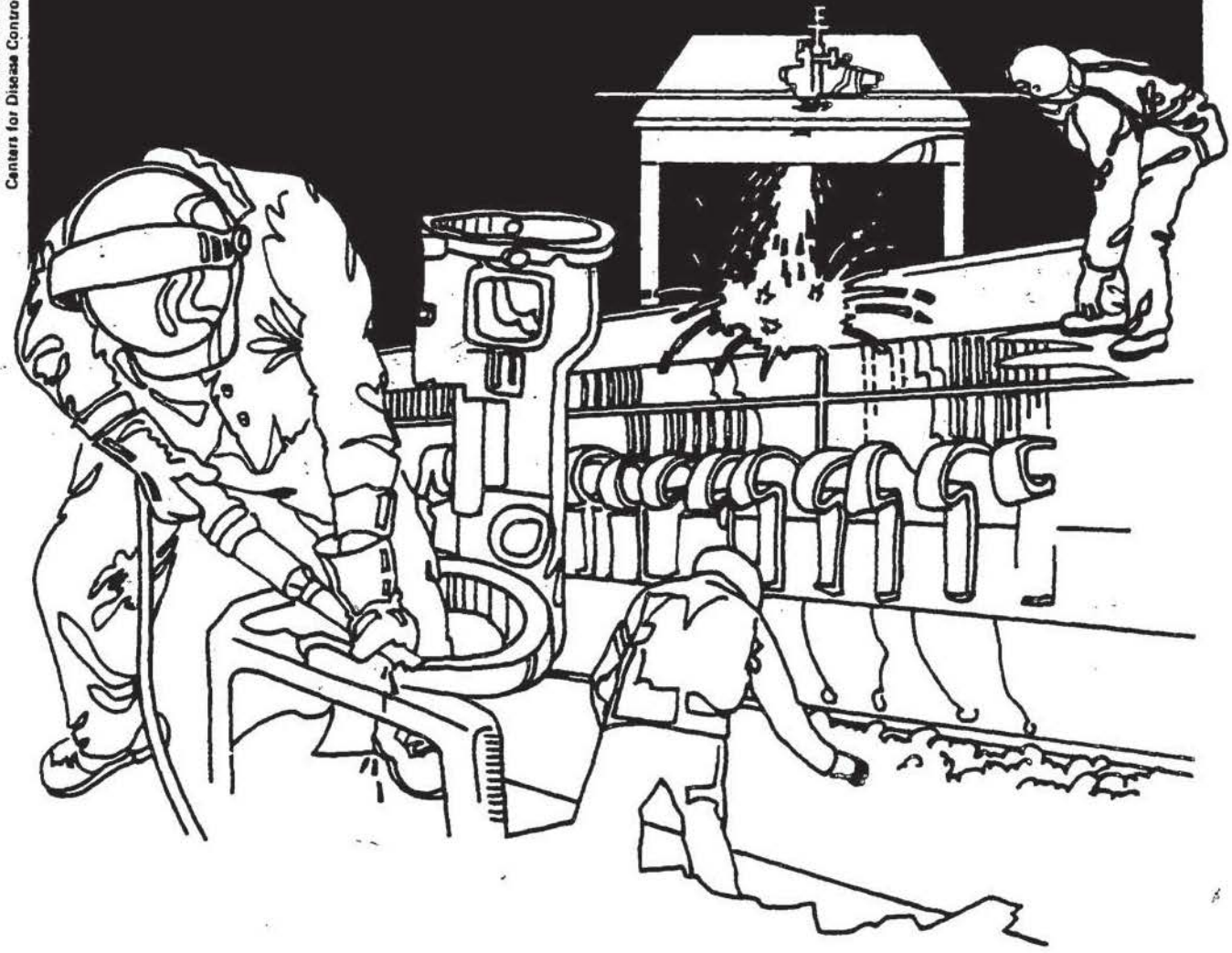

Health Hazard Evaluation Report

HETA 85-441-1765
NEW BOSTON COKE CORPORATION
NEW BOSTON, OHIO

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.

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I. SUMMARY

In June 1985, the National Institute for Occupational Safety and Health (NIOSH) received a request from the Industrial Commission of Ohio to assist in evaluating worker complaints of skin disease at the New Boston Coke Corporation's plant in New Boston, Ohio. The specific complaints which gave rise to the request involved dermatitis believed to be associated with exposure to steam in the coke quenching operation.

Site visits were made to the plant in July 1985 and February 1986. Several cases of common non-occupational skin disorders were found during examinations of workers complaining of dermatitis. The possibility that these skin problems were being exacerbated by exposure to the quenching steam was investigated by means of a laboratory experiment which evaluated the irritant capacity of the quenching water in a closed patch test in rabbits. This test showed that the quench water was roughly equivalent in its irritant capacity to distilled water.

Based on these experiments, we concluded that the chemical constituents of the quenching steam were not likely to cause exacerbation of non-occupational skin conditions and do not represent a health hazard. Recommendations for an improved skin care program to included elimination of abrasive soaps, increased availability of skin moisturizers, and an improved system for medical referral of workers with skin conditions thought possibly to be of occupational origin are contained in Section IX of this report.

Keywords: SIC 3312 (Blast furnaces (including Coke Ovens), Steel Works, and Rolling Mills), Occupational skin disease, coke ovens, patch testing

II. INTRODUCTION

In June 1985, NIOSH received a request from the Industrial Commission of Ohio to assist in evaluating worker complaints of skin disease at the New Boston Coke Corporation's plant in New Boston, Ohio. The plant is located at the site of a steel works which closed in 1980; the only operation currently active is the coke manufacturing process. The plant employs about 175 workers on three shifts. The specific complaints which gave rise to the request involved dermatitis thought to arise from exposure to steam in the coke quenching operation.

The first case of dermatitis thought to be connected to the steam exposure was reported to the plant medical department in November of 1983, and six additional cases of dermatitis possibly related to exposure to quenching steam were reported prior to the time of our initial visit in July 1985. The Ohio Industrial Commission began an investigation at the plant in September 1984. Air sampling was done to measure the breathing zone exposures of four workers to the quenching steam, evaluating specifically exposures to ammonia and phenol. All four workers had exposures to ammonia which were less than 3 percent of the OSHA recommended permissible exposure limit (PEL), and exposures to phenol were less than the limit of detection. A bulk sample of the quench water was also taken, and an area sample was taken in the vicinity of the quenching operation for hydrogen cyanide. The results of these studies were not helpful in identifying the cause of the rashes reported by the workers in the coke oven and coke handling departments.

A report on the results of the initial site visit was made to the New Boston Coke Corporation and representatives of the United Steelworkers Local 2116 on October 2, 1985. A preliminary verbal report on the results of medical examinations performed at the second site visit was given to the New Boston Coke Corporation and Local 2116.

III. BACKGROUND

Coal is the basic raw material for the coke-making process. It is brought into the plant on railroad cars and moved on conveyors into the milling (coal handling) department. The milling operation reduces the coal to a dust which is subjected to destructive distillation in a coke oven for 18 hours at 2000 degrees Fahrenheit. Gases derived from the distillation are collected from the head space in the oven (above the coke pile) and recovered in a coke by-products plant, which produces light oil and natural gas. Water from overflow tanks in the by-products plant is also used as the primary source of the water for the coke quenching operation. About 20 percent of the quench water is derived directly from the Scioto River.

At the end of the coking cycle, the door of the "coke side" of the oven is opened using a type of modified railroad car called the "door machine." A "pusher car" on the opposite side of the oven rams the mass of hot coke through a slot in the "door machine" and into a second railroad car, known as the "quenching car." The quenching car is moved from the coke oven down a short stretch of track to a tower where the entire load is drenched with water; the car is then moved back up the same set of tracks and the load of coke is dumped onto a wharf directly opposite the coke oven battery.

A large volume of steam is given off during the process of moving the quench car from the cooling tower to the wharf, and workers exposed to the steam include the quench car operator, "wharf" man, and all workers who are employed in jobs on the "coke" side of the oven - i.e., the side of the oven where the finished coke is pushed out of the oven and into the quench car. Since there are 70 ovens in the battery at the New Boston plant, a load of coke is quenched approximately every 10 to 15 minutes. Workers with jobs on the "coke" side of the ovens may have some exposure to mists of steam during the first 3 to 5 minutes of each quenching cycle.

IV. ENVIRONMENTAL EVALUATION METHODS

Because it was not possible to quantitatively evaluate the degree of dermal exposure to process materials in the coke oven operation, skin exposures were evaluated qualitatively by considering both the physical form of the process material and the duration of skin contact with the material during the process cycle. In addition to process materials (such as the quenching steam), soaps and skin cleansers used in the plant were evaluated as potential hazards since these materials are frequent sources of occupational skin disease and are capable of aggravating common non-work-related skin conditions such as atopic dermatitis.[1]

To evaluate the potential of the quench water to cause skin irritation, a sample was taken from the quench water pit during the second site visit. The sample was analyzed for the pH and the concentration of phenol, ammonia, total particulates, and calcium oxide. A 24-hour occluded patch test was conducted on rabbits comparing the irritant potential of the quench water to skin reactions caused by distilled water.

V. MEDICAL EVALUATION METHODS

An initial site-visit was conducted on July 17, 1985. In addition to a tour of the plant facilities, a review of medical records was conducted and physical examinations performed on six individuals employed in jobs involving exposure to steam from the quenching operation on the "coke-side" of the process, and one primarily employed as a "coal handler." A second visit to the plant was made on February 19, 1986, to examine several workers who had reported rashes to the plant nurse in the two preceding weeks.

VI. EVALUATION CRITERIA

Environmental Criteria

Evaluation of skin exposures depends on assessment of the degree of worker exposure to process materials, although it is not usually possible to quantify the exposure to specific chemical contaminants.[2] The hazard which a particular process material represents depends on its chemical makeup and the capacity of its chemical constituents for causing skin disease, either due to skin irritation or sensitization, in the concentrations present in the material. In many instances no relevant published information is available to gauge the threshold concentrations of particular chemicals. Even less information is available regarding the skin effects of chemical mixtures. However, it is possible, given suitable resources, to test specific process materials in order to evaluate their capacity to cause cutaneous irritation.[3]

Medical Criteria

Diagnosis of skin disease depends primarily on the recognition of the type and distribution of skin lesions present at the time of clinical examination. Non-occupational illnesses that may be difficult to distinguish from occupational skin disease include atopic dermatitis, dyshidrosis, nummular eczema, and psoriasis.[4] If one or more of these conditions is present, further evaluation of the process exposures is still appropriate, since individuals with these conditions may react to relatively low level exposures to irritant materials with flare-up or exacerbation of their skin conditions.[5]

VII. ENVIRONMENTAL RESULTS AND DISCUSSION

Many work surfaces in the plant were contaminated with dust from the coking process. The degree to which skin and work clothing are contaminated depends on individual work and hygiene practices. There

was little "wet-work" (i.e. work involving the handling of liquids or direct exposure to liquids). Cleaning agents available in the plant included abrasive and detergent soaps. Moisturizing and barrier creams were also available.

Approximately 48 workers from the coke oven and coke handling departments have potential exposure to the quenching process steam. The actual number frequently exposed may be somewhat less since approximately half of the 35 employees in the coke oven department work on the side of the coke battery where the coal is loaded into the ovens and are not routinely exposed to quenching steam. The exposures occur intermittently during the first 3-5 minutes of each 10-15 minute quenching cycle, with the largest volume given off in the first minute and diminishing amounts thereafter. The results presented below describe the chemical makeup of the water used in the quenching process and give the results of experimental patch testing done on laboratory animals to evaluate the degree to which the chemical constituents of the quench water were capable of provoking skin irritation.

Laboratory Results

The sample taken at the time of our visit in February, 1986 had a pH of 8.85, a phenol concentration of 0.44 milligrams per milliliter (mg/ml), and a concentration of ammonia of 2.78 mg/ml. The concentration of calcium oxide (quick-lime), calculated from the analysis of elemental calcium in solution, was 288 micrograms per milliliter and the concentration of total suspended particulate in the sample was 1.4 mg/ml. A heating test indicated that the dust consisted of approximately 82 percent organic and 18 percent inorganic compounds. Qualitative analysis of the dust using X-ray diffraction analysis indicated the presence of amorphous materials, calcium hydroxide, and quartz, but calcium oxide was not conclusively identified in the sample.

Since no relevant information could be located which would indicate an irritant threshold concentration for the quench water contaminants, it was necessary to perform cutaneous patch testing in order to evaluate the irritant capacity of the quench water. Occlusive patch testing on rabbit skin showed that the quench water had a minimal capacity for causing cutaneous irritation. No significant difference was noted in the skin patches tested with quench water and those tested with distilled water.

VIII. MEDICAL RESULTS AND DISCUSSION

The medical records showed that a number of employees had been seen by the plant physician during the year prior to the initial visit, chiefly during the winter months, for a rash occurring underneath the work clothing. No individual was reported to be experiencing such a rash at the time of our visit, although one case of chronic stasis dermatitis was identified. On the basis of the information available during our initial visit, we were unable to determine whether the rashes reported to the plant medical department were occupational in origin.

At the time of the second site visit in February, 1986 seven workers were examined; four had at least minimally active cases of dermatitis. The pattern of skin lesions noted on these workers, all of whom had potential exposure to steam from the quenching operation, was consistent with nummular eczema or atopic dermatitis. These illnesses are primarily non-occupational in origin and are frequently associated with a history of childhood eczema, asthma, or seasonal rhinitis and an increased sensitivity to skin irritation.[2] All of the four affected workers had a history of having previously experienced one or more of the above conditions.

The results of our investigations do not indicate that there is a health hazard due to dermal exposures to steam from the quenching process at the New Boston Coke plant. The levels of contaminants measured did not suggest that the quench water was likely to be a skin irritant, and this was confirmed by animal tests which showed that the quench water had a low capacity for causing skin irritation even when occluded directly against the skin. The cases of atopic dermatitis and nummular eczema we were able to document in workers exposed to steam from the quenching operation may be aggravated by work activities which result in chafing and rubbing of work clothing against the skin, or occlusion of moisture and particles of dirt against the skin.

IX. RECOMMENDATIONS

Although the skin conditions identified to date in workers from the New Boston Coke Corporation appear to be largely non-occupational in origin, it may be prudent to institute improvements in the skin care program within the facility. Specific recommendations include:

1. Elimination where possible of abrasive soaps and skin cleansers.

2. Liberal use of skin moisturizers after soaps and skin cleansers have been used.

3. Prompt medical referral of workers with complaints of skin illnesses for appropriate evaluation.

X. REFERENCES

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XII. 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. New Boston Coke Corporation
2. United Steelworkers Local 2116
3. Industrial Commission of Ohio, Division of Safety and Hygiene
4. OSHA, Region V

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.