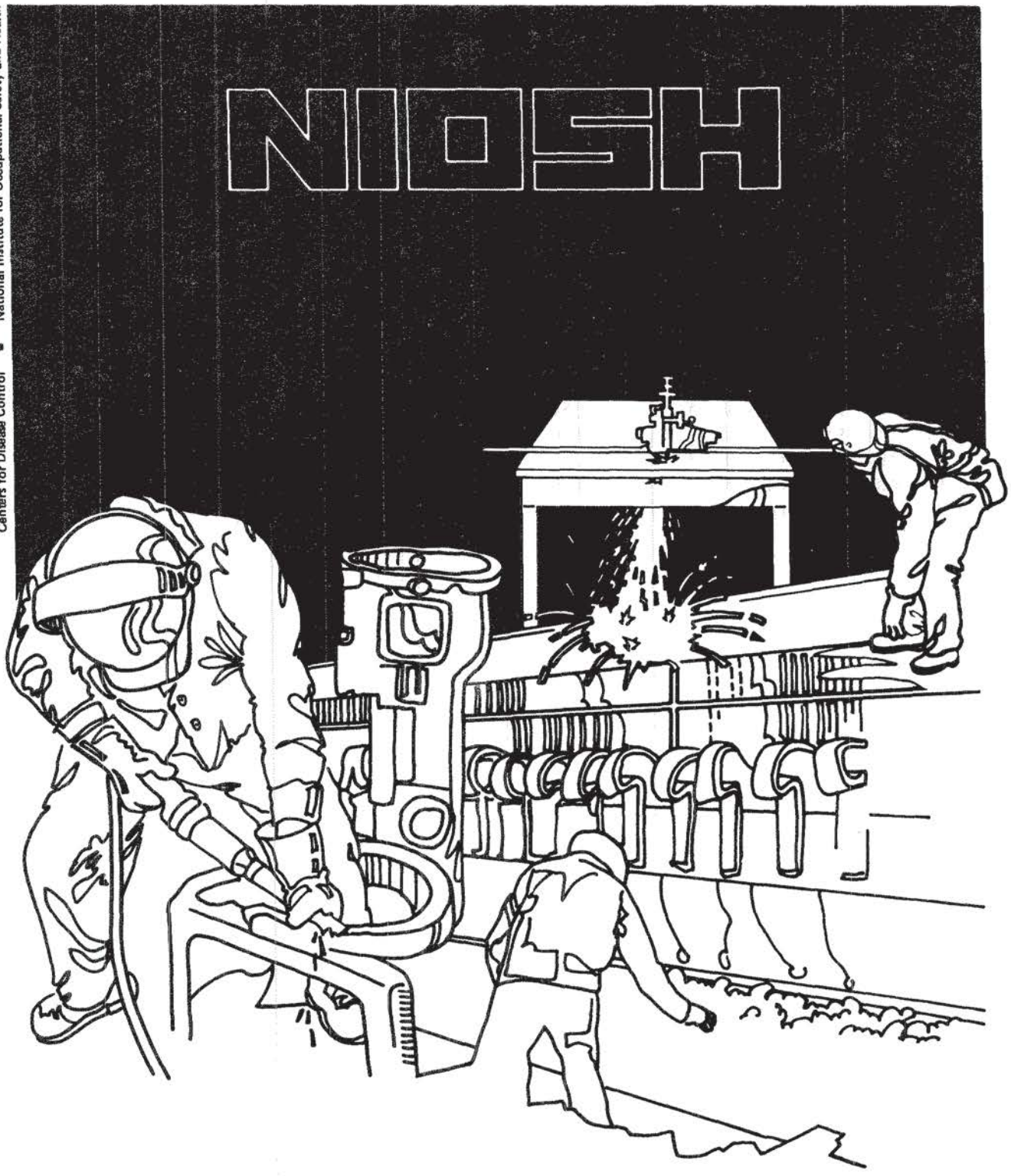
U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES ■ Public Health Service
Centers for Disease Control ■ National Institute for Occupational Safety and Health

NIOSH



Health Hazard Evaluation Report

HHE 80-143-1001
JEFFERSON ELECTRIC COMPANY
WILLIAMSTOWN, KENTUCKY

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.

HE 80-143-1001
NOVEMBER 1981
JEFFERSON ELECTRIC CO.
WILLIAMSTOWN, KENTUCKY

NIOSH INVESTIGATORS:
BRIGITTE FRONEBERG, M.D.
JOHN R. LOVE, I.H.

I. SUMMARY

On May 16, 1980, NIOSH received a request from the employees of the Jefferson Electric Company, Williamstown, Kentucky, to evaluate an exposure that occurred on April 23, 1980. The request stated that approximately 20 employees of the subassembly and adjacent repair departments had been exposed to "toxic fumes" which resulted when a mixture of wax, #7 rosin flux, and levulinic acid overheated. The exposure incident lasted for more than an hour, and as a result twelve workers sought medical treatment; three were hospitalized. Symptoms included effects on mucous membranes, upper and lower respiratory tract, skin, central nervous system, gastrointestinal and urinary tracts.

On May 27, 1980, a NIOSH industrial hygienist and physician visited the plant. A walk-through survey of the area was performed, and medical questionnaires were distributed to the employees of both departments. Fourteen of the approximately 20 employees responded. Further information was collected from medical records of eleven of these fourteen workers. Medical records revealed upper or lower respiratory inflammation in several cases.

No air sampling was performed because the process had been discontinued by the company immediately after the incident. Bulk samples of the rosin and levulinic acid (the wax was not available) were obtained by NIOSH from company suppliers to attempt to simulate exposures that had occured on April 23rd. These bulk samples were mixed in an approximate ratio of 5 parts of rosin to 1 part levulinic acid and heated to between approximately 480°F and 660°F. Air samples obtained during this laboratory simulation indicated that n-butanol and levulinic acid were evolving from the mixture, and that no decomposition products were formed. Analysis of the rosin flux bulk indicated that its major component was n-butanol.

Since n-Butanol was the major component of the rosin flux and the known toxic effects of n-Butanol are similar to the health effects in the exposed workers, exposure to n-Butanol might have been the cause of the symptoms reported. However, the conditions and/or components that were present on the day of the incident could have been different from those tested and there is, at this time, insufficient data and information to prove or refute this hypothesis. The process was discontinued shortly after the incident.

Keywords: SIC 3612 (Electric Transmission and Distribution Equipment): Fuses, Rosin flux, n-Butanol, Levulinic Acid, Wax.

II. INTRODUCTION

On May 16, 1980, the National Institute for Occupational Safety and Health (NIOSH) received a request from workers at the Jefferson Electric Company, Williamstown, Kentucky, to evaluate an incident involving exposure to levulinic acid fumes from the manufacture of fuses.

III. BACKGROUND

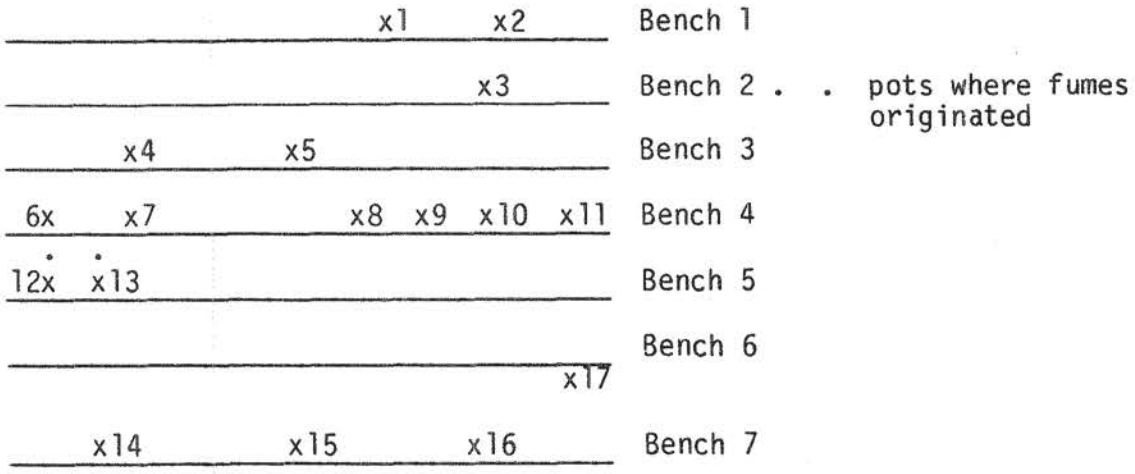
On May 27, 1980, a walk through survey of the area was performed by NIOSH. No air sampling was performed because the process had been discontinued and replaced by another operation immediately after the incident. Bulk samples could not be obtained since the company stated that all the remaining raw material (wax, rosin flux, and levulinic acid) used in the operation had either been destroyed or shipped back to the manufacturers.

The episode on April 23, 1980 was described consistently by both employees and management personnel. During the morning hours two employees were mixing the wax, rosin and levulinic acid in two big pots under heat, fuses were put into a special holder; the mixture was poured over them, and the fuses were removed upon drying. This operation had usually generated some irritant fumes that would cause mild eye and throat irritation, along with nausea and headache in some of the exposed employees. (There is no local exhaust system). On April 23rd, however, the fumes appeared to be more pungent than usual; no cause was ever determined. Between 10:00 and 11:30 a.m. people started to feel sick. At about noon the plant manager shut the operation down.

The following morning all 12 subassembly workers and one of four workers in the adjacent repair department, along with two maintenance men, two supervisors, one material handler, one industrial engineer, and the plant manager were seen by a company physician. Three of these workers were admitted to a hospital.

There are three components used in the mixture; wax, rosin flux, and levulinic acid, which are mixed in a ratio of 50:5:1. The wax which is heated separately to about 350°F is drained into the levulinic acid/rosin mixture, heated to about 250°F. After positioning the fuses in a special holder, the mixture is poured, coating the fuses. After sufficient drying, the coated fuses are removed and used in another subassembly process. Since the same fuses can be purchased from another supplier at a cost less than that which Jefferson Electric could make them, this process will probably not be used again.

The following schematic diagram contains the seven benches comprising the work area where the incident occured. Each employee's general work station is represented by an "x" with a corresponding worker identification number. This area is divided into two sections: a subassembly area consisting of the first five benches, and a repair department. Employee's numbers 4 and 5 work practices involve moving the length of benches two and three, while workers 14-17, in the repair department, move about between benches six and seven. There are no barriers around either the individual benches or the whole area.



Fourteen of the 23 "exposed" workers completed the questionaire: all 12 subassembly workers, the material handler, and the "affected" repair department worker.

IV. METHODS

Bulk samples of the rosin flux and levulinic acid were obtained from the suppliers of Jefferson Electric for analysis (a sample of the wax was unavailable from the supplier). These two bulks were mixed in an approximate ratio of one part levulinic acid to five parts rosin and heated. A tube furnace was used to heat the sample mixture contained in ceramic boats. Air was continuously passed through the oven and this effulent was then sampled with charcoal tubes. Two charcoal tubes samples were collected using this procedure; one collected at an oven temparature of approximately 480°F and the other at an oven temperature of 660°F. Both charcoal tubes were desorbed with carbon disulfide and then analyzed by gas chromatography (GC) with flame ionization detector, then by GC/mass spectrophotometry. A twenty-five meter methyl silicone fused silica capillary column was used for these analyses. Portions of the levulinic acid and rosin flux were analyzed directly (no heat) by direct GC.

Seventeen of the 23 "exposed" workers were asked to complete a self-administered questionaire. Additional medical information on 13 employees was obtained from a physician hired by the company after the incident, and from several hospitals where three of the workers had been admitted.

V. EVALUATION CRITERIA

n-Butanol is a colorless volatile liquid with a pungent odor. The liquid is a primary skin irritant with the vapor an irritant to the eyes and mucous membranes of the ear, nose, and throat. Inhalation can cause transitory and persistent dizziness. In addition, headaches and drowsiness may occur.[1,2]

After conducting a literature search through all availible data no toxicological information could be obtained on levulinic acid.

VI. RESULTS

A. Medical

Symptoms reported included effects on mucous membranes, upper and lower respiratory tract, central nervous system (CNS), gastrointestinal tract, urinary tract and skin (table I); the duration of these symptoms lasted from 1 day to several weeks. The most commonly reported symptoms were headache (11 people), sore throat (9), chest tightness (6), cough (5), dizziness (5), and weakness (5).

Of the 11 employees who responded to the questions about their perceptions of conditions on the day of the incident and causes of the incident, four noted that the odor (or "fumes") seemed stronger, but only two of the 11 identified any possibly relevent differences on that particular day: placement of fans. Three others also mentioned inadquate ventilation as a possible cause but did not mention any differences that day. Interestingly, two employees said that the symptoms occured every time the process was run.

NIOSH obtained the medical records of 11 affected employees, including all three admitted to a hospital. Half of the eight outpatients first sought medical care one day after the incident; three others first sought medical care five days later. Headache (6 cases) and sore throat (3 cases) were the most common symptoms reported. In no case was there mention of any relvent physical examination finding. One person had a chest x-ray, which was normal.

The three persons admitted to a hospital all had an initial diagnosis of chlorine intoxication, persumably based on information- apparently erroneous- that they were exposed to chlorine. Symptoms reported by at least two of the three people included headache, sore throat, chest disscomfort, nausea, and numbness and tingling of the hands and feet. One of the three had physical exam findings (not specified) of upper and lower respiratory tract irritation. The others had "occasional rhonchi" (lung sounds suggestive of inflammation of the large airways). All three had chest x-rays which showed no acute abnormalities.

B. Environmental

The major peaks found on both of the charcoal tube samples generated by heating the mixed bulks were identified by GC/MS as n-Butanol and levulinic acid. n-Butanol was the major component of the rosin flux sample analyzed. Minor constituents included a few unsaturated hydrocarbons including $C_{10}H_{16}$ terpenes (such as pinene isomers) and a $C_{15}H_{24}$ compound such as longifolene.

VI. DISCUSSION

Information from the NIOSH questionaires and medical records indicates that several individuals had headache, sore throat, and other respiratory and systemic symptoms following the incident on April 23, 1980. Since these symptoms are common and non-specific, and since the questionnaire survey revealed no apparent explanation of the outbreak, the cause cannot be determined without environmental data.

Laboratory simulation of the heating of the rosin flux/levulinic acid mixture, even to almost twice normal temparatures, produced only the basic components of these substances, n-Butanol and levulinic acid. Since no decomposition products were formed in the laboratory while heating and with the inability, due to process discontinuation, to sample actual work conditions, there is currently insufficient data and information to pinpoint an actual caustive agent(s) of the illnesses. However, the effects of n-Butanol are consistant with some of the symptoms reported by the workers, while data on the toxicological effects of levulinic acid are not availible.

VII. RECOMMENDATIONS:

At this time, since the process has been discontinued, no recommendations can be made.

VIII. REFERENCE

1. National Institute for Occupational Safety and Health. Occupational Diseases-A Guide to Their Recognition, 1977. Cincinnati, Ohio: National Institute for Occupational Safety and Health, 1977. (DHEW Publication No. (NIOSH) 77-181).

2. Proctor NG, Hughes JP. Chemical Hazards of the Workplace. Philadelphia: Lippincott, 1978.

IX. ACKNOWLEDGMENTS

Report Prepared By:

Brigitte Froneberg, M.D.
Medical Officer
Medical Section

John R. Love, B.S., Ch.E.
Industrial Hygienist
Industrial Section, HETAB

Originating Office:

Hazard Evaluations & Technical Assistance Branch, NIOSH
Division of Surveillance, Hazard Evaluations & Field Studies
NIOSH - Cincinnati, Ohio

Report Typed By:

Terry R. O'Neal
Clerk-Typist
Medical Section

IX. DISTRIBUTION AND AVAILABILITY

Copies of this report are currently available upon request from NIOSH, Division of Standards Development and Technology Transfer, 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 22216.

Copies of this report have been sent to:

1. Jefferson Electric Company
2. U.S. Department of Labor/OSHA - Region IV.
3. NIOSH Region IV.
4. Requestor Confidential

For the purpose of informing the approximately 20 employees, a copy of this report shall be posted in a prominent place accessible to the employees for a period of 30 calendar days.

TABLE I

SYMPTOM, NUMBER, AND DURATION OF EXPRESSED EXPOSURES
JEFFERSON ELECTRIC COMPANY
WILLIAMSTOWN, KENTUCKY

MAY 27, 1980

Symptom	Number affected	Duration (range)
watery, burning eyes	3	2 days - 2 weeks
burning nose	3	2 days - 1 week
sore throat	9	5 days - 5 weeks
cough	5	3 days - 1 week
difficulty breathing	4	4 days - 1 week
feeling of suffocation	4	2 days - 6 days
chest tightness	6	1 week - 5 weeks
skin effects (face, neck, arms)	2*	2 days - 3 weeks
burning sensation	1	2 weeks
redness	2	2 days - 3 days
itching	2	3 days - 3 weeks
blistering	1	2 days - 3 weeks
peeling/scaling	2	3 days - 3 weeks
swelling	1	1
headache	11	1 days - 4 weeks
lightheadedness	3	2 days - 1 week
dizziness	5	2 days - 5 days
numbness	4	1 day - 1 week
weakness	5	4 days - 2 weeks
ringing ears	3	3 days - 1 week
fainting	1	1
mental confusion	1	3 weeks
insomnia	4	4 weeks
nausea	3	2 days (in one until removal of gallbladder on 5/4/80)
vomiting	3	1 day
diarrhea	2	2 days
urinary incontinence	1	1

*(These 2 persons reported never to have suffered from dermatitis or allergies).

1 Duration of symptom unknown.

DEPARTMENT OF HEALTH AND HUMAN SERVICES
PUBLIC HEALTH SERVICE
CENTERS FOR DISEASE CONTROL
NATIONAL INSTITUTE FOR OCCUPATIONAL SAFETY AND HEALTH
ROBERT A. TAFT LABORATORIES
4676 COLUMBIA PARKWAY, CINCINNATI, OHIO 45226

OFFICIAL BUSINESS
PENALTY FOR PRIVATE USE, $300

Third Class Mail

POSTAGE AND FEES PAID
U.S. DEPARTMENT OF HHS
HHS 396