U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES ■ Public Health Service
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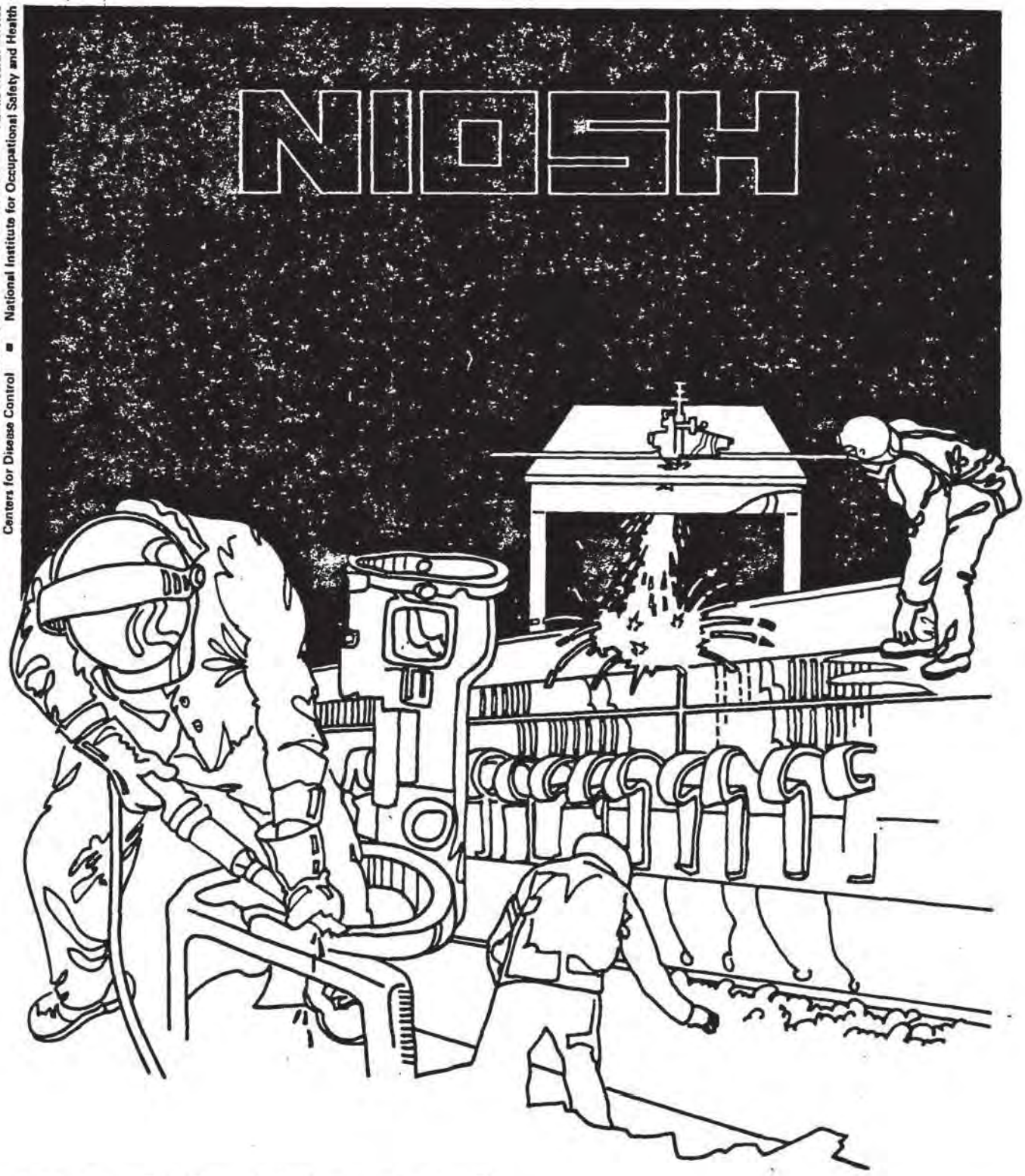

Health Hazard Evaluation Report

HETA 82-226-1433
ROPER EASTERN PRODUCTS
BALTIMORE, MARYLAND

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 82-226-1433
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ROPER EASTERN PRODUCTS
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I. SUMMARY

In April 1982, the National Institute for Occupational Safety and Health (NIOSH) received a request to evaluate reported cases of dizziness, nausea, skin rash and hair loss in workers at Roper Eastern Products, Baltimore, Maryland.

NIOSH investigators conducted a preliminary walk-through survey during the week of July 19, 1982, and a follow-up environmental/medical survey during the week of October 26. The final industrial hygiene survey was conducted on November 26 and 27, 1982. Environmental samples were collected to determine both personal exposures and general area concentrations of process-related substances. Thirty-one production workers were interviewed regarding symptoms possibly related to workplace exposures.

Area and personal air monitoring for ammonia, benzene, butyl cellosolve, chromium VI, hydrochloric acid, methyl ethyl ketone, methyl isobutyl ketone, mineral spirits, sodium hydroxide, sulfuric acid, toluene, total aromatic hydrocarbons, and xylene was conducted in various areas throughout the plant. The results of these samples were within the recommended criteria/standards used in this report: ammonia (none detected), butyl cellosolve (none detected) chromic acid (none detected), hydrochloric acid (none detected), methyl ethyl ketone (2 and 8 ppm), methyl isobutyl ketone (6 ppm), mineral spirits (5 ppm), sodium hydroxide (none detected), sulfuric acid (0.09 to 0.18 mg/m^3), toluene (0.03 to 3 ppm), xylene (0.5 and 0.7 ppm), benzene (none detected). Carbon monoxide detector tube readings (in the packing area) ranged from 25 to 50 ppm throughout the day (NIOSH recommended standard: 35ppm) and chlorine detector tubes (chemical waste treatment area) showed < 1 ppm.

Of the thirty-one workers interviewed seventeen reported at least four of seven possible respiratory symptoms (54%). Three of six neurologic symptoms were reported by 11 workers (35%). The respiratory symptoms reported by the Roper Eastern workers were found to be statistically significantly associated with duration of dust exposure ($p= 0.03$) and duration of fume exposure ($p= 0.006$). Each worker reporting irritative symptoms attributed the symptoms to exposure to dusts/fumes at work.

Based on air sampling results it is possible that workers in the packing/cardboard box assembly line area are overexposed to carbon monoxide. On the basis of the interview data obtained in this investigation, NIOSH determined that although the levels of exposure on the day of the environmental evaluation were below the evaluation criteria, the employees reported symptoms consistent with the known effects of process substances used in the plant. Considering that benzene and chromium compounds are carcinogens, exposures should be maintained at the lowest level feasible. Recommendations to help alleviate the reported problems are found in Section VIII of this report.

KEYWORDS: SIC 3317, metal processing, metal pickling/plating carbon monoxide, benzene, irritative effects.

II. INTRODUCTION

On April 19, 1982 NIOSH recieved a request from the United Furniture Workers of America (AFL-CIO) Local 75-A for a health hazard evaluation at the Roper Eastern plant in Baltimore, Maryland. The request cited employee exposures to a variety of chemicals and paints such as solvents, acid and base solutions, chromium compounds and paint mixtures. The request expressed concern over possible relationships of these exposures to skin rash, hair loss, dizziness and nausea.

In response to this request, NIOSH conducted an opening conference and preliminary survey during the week of July 19, 1982. This meeting was summarized and initial recommendations were made in a letter, sent to both labor and management in September, 1982. A follow-up medical/-environmental survey was conducted the week of October 26, 1982. A final industrial hygiene survey was conducted November 26-27, 1982

III. BACKGROUND

Roper Eastern Products of Baltimore, Maryland is a subdivision of Roper Companies. Roper Companies have a variety of production facilities throughout the United States and Canada. This corporation engages in the manufacture of lawn products, appliances, outdoor products and luggage. The Roper Eastern plant in Baltimore is engaged in the manufacture of small metal and plastic parts to be used on window curtains and blinds. The primary production processes deal with the finishing of sheet steel, which is then used in the production of a variety of products (venetian blinds, outdoor storage sheds, etc.).

The production areas, where most of the health complaints originated, were associated with the metal finishing process. Large spools of steel are fed into the 48-inch line for plating and processing. The steel sheet moves first through a series of alkaline tanks. The sheet steel then enters the acid (pickling) tanks, moving next to the plating tanks, on to bond coat tanks, and then through drying ovens. The processed steel is then paint coated and moves on through the final drying oven. Sodium hydroxide was the primary substance used in the alkaline tank. The acid tank contained sulfuric acid and a pickling inhibitor. The plating tanks, where workers had direct contact with solutions, contained a mixture of sodium cyanide, zinc oxide and sodium hydroxide. The bond coat tanks contained sodium sulfates.

IV. EVALUATION DESIGN AND METHODS

A. Environmental

A total of eight 8-hour TWA samples, and 15 direct reading grab samples were collected at Roper-Eastern. One ammonia area sample was collected

in the barrel-plating area on a sulfuric acid-treated silica gel tube using an air sampling pump at 200 cc/min. The sample was analyzed on an ion chromatograph. The samples were desorbed in 5-6 ml of aqueous solution of 0.0025 NHCl.

A series of ammonium standards covering the range of 0.4 to 20 micrograms per milliliter NH_4+ were prepared and used to calibrate the samples. The detection limit of 4 micrograms NH_3 per sample is estimated.

Personal air samples were collected for benzene (#48 coater room, silk-screening), methyl ethyl ketone (paint storage and mixing, lab personnel), methyl isobutyl ketone and butyl cellosolve (paint storage and mixing), toluene (#48 coater room, silk screening), and mineral spirits (silk screening) on activated charcoal tubes and ambersorb tubes (for MEK and MIBK) with air sampling pumps at a rate of 200 cc/min. These personal air samples were analyzed using gas chromatography. The detection limits for the components in mg/sample are benzene - 0.002, toluene - 0.01, total aromatic hydrocarbons - 0.01, methy ethyl ketone - 0.01, methyl isobutyl ketone 0.01, total aromatic hydrocarbons - 0.1 and butyl cellosolve - 1.01.

One chromic acid area sample was collected in the barrel plating area on a pre-weighted filter using an air sampling pump at a flow rate of 1.5 liters per minute. The sample was analyzed for chromium according to NIOSH Method No. P&CAM 319. The limit of detection was 0.2 ug of chromium per sample.

Two personal samples (chemical mixer and lab personnel) as well as two area samples (barrel plating and entry end of dip line hutch) for hydrochloric acid and sulfuric acid were collected at a rate of 200 cc per minute. The samples were analyzed on an ion chromatograph using NIOSH Method P&CAM 339. A detection limit of 4 micrograms per sample is estimated for each analyte.

Two personal (chemical mixer and lab personnel) and one area (barrel plating) sample for sodium hydroxide were collected on a teflon filter using portable air sampling pumps at a rate of 1.5 liters per minute. The samples were leached from the filters in 35 ml deionized distilled water as described in NIOSH Method No. 5-381. Atomic emission spectroscopy was used to determine the sodium, and the results were calculated as sodium hydroxide. The limit of detection was 5 micrograms of sodium hydroxide per sample.

An Alnor senior/junior portable velometer was used for all air-velocity measurements taken during the survey.

B. Medical

The medical component of this evaluation was designed to evaluate the employees' health, as related to workplace exposure to a wide variety of physical and chemical agents, via the administration of a questionnaire that addressed basic demographic information, medical history, possible workplace exposures, reported symptoms/health problems and occupational history. The workers who completed the questionnaire were all available employees from the process areas of concern as well as several workers who asked to be interviewed.

V. EVALUATION CRITERIA

A. Environmental Criteria

As a guide to the evaluation of the hazard 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).

In addition, some hazardous substances may act in combination with other workplace exposures, the general environment, or with medications or personal habits of the worker to produce health effects even if the occupational exposures are controlled at the level set by the evaluation criterion. These combined effects are often not considered in the evaluation criteria. Also, some substances are absorbed by direct contact with the skin and mucous membranes, and thus potentially increase the overall exposure. Finally, evaluation criteria may change over the years as new information on the toxic effects of an agent become available.

The primary sources of environmental evaluation criteria for the workplace are: (1) NIOSH Criteria Documents ad 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 may also be required to take into account the feasibility of controlling

exposures in various industries where the agents are used; the NIOSH-recommended standards 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 required to meet 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 8-10-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.

Presented below are the various criteria/standards applicable to the substances evaluated at the Roper plant.

Substance	NIOSH (4) recommended std.	ACGIH(3) 8-hr.-TWA	OSHA(2) 8-hr.-TWA
Ammonia	50 ppm (5-min C)*	25 ppm	50 ppm
Benzene	1 ppm (60-min.)	10 ppm*	10 ppm
Butyl Cellosolve	--	25 ppm	50 ppm
Carbon Monoxide	35 ppm	50 ppm	50 ppm
Chlorine	0.5 ppm (15-min.C)	1 ppm	1 ppm
Chromic Acid	0.05 mg/m^3	0.05 mg/m^3	0.1 mg/m^3
Hydrochloric Acid	--	5 ppm C	5 ppm
Methyl Ethyl Ketone	--	200 ppm	200 ppm
Methyl Isobutyl Ketone	--	50 ppm	100 ppm
Mineral Spirits	--	--	2000 mg/m^3
Sodium Hydroxide 2 mg/m^3	2/mg/m^3 (15-min.C)		2 mg/m^3 C
Sulfuric Acid	1 mg/m^3	1 mg/m^3	1 mg/m^3
Toluene	100 ppm	100 ppm (5 min.)	200 ppm
Xylene	100 ppm	100 ppm	100 ppm

*C = Ceiling Value

B. Medical Criteria

In analyzing the questionnaire data, symptoms were grouped as being either respiratory, neurologic or systemic in nature. Only symptoms reported to last for more than one hour, and occur for more than one day per month were counted. A t-test was used to make statistical observations concerning the workers reported symptoms, and duration of exposure to dust and fumes.

C. Toxicology

1. Ammonia

Effects - Contact with anhydrous liquid ammonia or with aqueous solutions is intensely irritating to the mucous membranes, eyes and skin. Eye symptoms range from tearing, spasmodic winking, and palpebral edema to a rise of intraocular pressure, and other signs resembling acute-angle closure glaucoma, corneal ulceraton, and blindness. There may be corrosive burns of skin or blister formation. Ammonia gas is also irritating to the eyes and to moist skin.

Mild to moderate exposure to the gas can produce headache, salivation, burning of throat, anosmia, perspiration, nausea, vomiting, and substernal pain. Irritation by ammonia gas in the eyes and nose may be sufficently intense to compel workers to leave the area. If escape is not possible, there may be severe irritation of the respiratory tract with the production of cough, glottal edema, bronchospasm, pulmonary edema, or respiratory arrest. Bronchitis or pneumonia may follow a severe exposure if the person survives. Hives is a rare allergic manifestation from inhalation of the gas.

2. Benzene

Exposure to benezene liquid and vapor may produce primary irritation to skin, eyes and upper respiratory tract. If the liquid is aspirated into the lung, it may cause pulmonary edema and hemorrhage. Erythema vesiculation, and dry, scaly dermatitis may also develop from defatting of the skin.

Acute exposure to benzene results in central nervous system depression. Headache, dizziness, nausea, convulsions, and coma may result. Death has occurred following highly concentrated, acute exposure as a result of ventricular fibrillation (racing heartbeat), probably caused by myocardial sensitization to endogenous epinephrine. Early reported autopsies revealed hemorrahages (non-pathognomonic) in the brain, pericardium, urinary tract, mucous membranes, and skin.

Chronic exposure to benzene is well documented to cause blood changes. Benzene is basically a myelotoxic agent. Erythrocyte, leukocyte, and thrombocyte counts may first increase, and then aplastic anemia may delvelop with anemia, leukopenia, and thrombocytopenia. The bone marrow may become hypo- or hyper-active and may not always correlate with peripheral blood.

Recent epidemiologic studies along with case reports of benzene related blood dyscrasias and chromosal aberrations have led NIOSH to conclude that benzene is leukemogenic (causes leukemia). The evidence is most convincing for acute myelogenous leukemia and for acute erythroleukemia, but a connection with chronic leukemia has been noted by a few investigators.

3. Butyl Cellosolve (Ethylene glycol monobutyl ether)

Ethylene glycol ethers are only mildly irritating to the skin. Vapor may cause conjunctivitis and upper respiratory tract irritation. Temporary corneal clouding may also result and may last several hours. Acetate derivatives cause greater eye irritation than the parent compounds. The butyl and methyl ethers may penetrate skin readily.

Acute exposure to these compounds results in narcosis, pulmonary edema, and severe kidney and liver damage. Symptoms from repeated overexposure to vapors are fatigue and lethargy, headache, nausea, anorexia, and tremor. Anemia and encephalopathy have been reported with ethylene glycol monomethyl ether. Rats show increased hemolysis of erythrocytes from inhalation of ethylene glycol monobutyl ether. This has not yet been shown in man. Acute poisoning by ingestion resembles ethylene glycol toxicity, with death from renal failure.

4. Carbon Monoxide

Carbon monoxide combines with hemoglobin to form carboxyhemoglobin which interferes with the oxygen carrying capacity of blood, resulting in a state of tissue hypoxia (lack of oxygen). The typical signs and symptoms of acute CO poisoning range from headache, dizziness, drowsiness, nausea, vomiting, and collapse, to coma, and death. Initially the victim is pale; later the skin and mucous membranes may be cherry-red in color. Loss of consciousness occurs at about the 50% carboxyhemoglobin level. The amount of carboxyhemoglobin formed is dependent on concentration and duration of CO exposure, ambient temperature, health status, and metabolism of the individual. The formation of carboxyhemoglobin is a reversible process. Recovery from acute poisoning usually occurs without sequalae unless tissue hypoxia was sever enough to result in brain cell degeneration.

Carbon monoxide at low levels may initiate or enhance deleterious myocardial alterations (heart disease) in individuals with restricted coronary artery blood flow and decreased myocardial lactate production.

5. Chlorine

Chlorine reacts with body moisture to form acids. It is itself extremely irritating to skin, eyes, and mucous membranes, and it may cause corrosion of teeth. Prolonged exposure to low concentrations may produce chloracne.

Chlorine in high concentrations acts as an asphyxiant by causing cramps in the muscles of the larynx (choking), swelling of the mucous membranes, nausea, vomiting, anxiety and fainting. Acute respiratory distress including cough, cough with blood, chest pain, shortness of breath, and cyanosis development and later trachcobronchitis, pulmonary edema, and pneumonia.

6. Chromic Acid

In some workers, chromium compounds act as allergens which cause dermatitis to exposed skin. They may also produce pulmonary sensitization. Chromic acid has a direct corrosive effect on the skin and the mucous membranes of the upper respiratory tract; and although rare, the possibility of skin and pulmonary sensitization should be considered.

Chromium compounds in the +3 state are of a low order of toxicity. In the +6 state, chromium compounds are irritants and corrosive, which can enter the body by ingestion, inhalation, and through the skin. Acute exposure to dust or mist may cause coughing and wheezing, headache, dyspnea, pain on deep inspiration, fever, and loss of weight.

Tracheobronchial irritation and edema persist after other symptoms subside. In electroplating operations, workers may experience a variety of symptoms including lacrimation, inflammation of the conjunctiva, nasal itch and soreness, epistaxis, ulceration and perforation of the nasal septum, congested nasal mucosa and turbinates, chronic asthmatic bronchitis, dermatitis and ulceration of the skin, inflammation of laryngeal nucosa, cutaneous discoloration, and dental erosion.

Liver injury has been reported from exposure to chromic acid used in plating baths, but appears to be rare.

Working in the a chromate-related industry increases the risk of lung cancer.

7. Hydrochloric Acid

Hydrochloric acid and high concentrations of hydrogen chloride are highly corrosive to eyes, skin, and mucous membranes. The acid may

produce burns, ulceration, and scarring on skin and mucous membranes and it may produce dermatitis on repeated exposure. Eye contact may result in reduced vision or blindness. Dental discoloration and erosion of exposed incisors occur on prolonged exposure to low concentrations. Ingestion may produce fatal effects from esophageal or gastric tissue destruction.

The irritant effect of vapors on the respiratory tract may produce laryngitis, glottal edema, bronchitis, pulmonary edema, and death.

8. & 9. Methyl Ethyl Ketone (MEK) and Methyl Isobutyl Ketone (MIBK)

These solvents may produce a dry, scaly, and fissured dermatitis after repeated exposure. High vapor concentrations may irritate the conjunctiva and mucous membranes of the nose and throat, producing eye and throat symptoms.

In high concentrations, narcosis is produced, with symptoms of headache, nausea, light headedness, vomiting, dizziness, incoordination, and unconsciousness.

10. Mineral Spirits

Mineral spirits are irritating to the skin, conjunctiva and mucous membranes of the upper respiratory tract. Skin "chapping" may develop after repeated contact with the liquid. The vapor is a central nervous system depressant.

11. Sodium Hydroxide

Sodium hydroxide is extremely alkaline in nature and is very corrosive to body tissues. Dermatitis may result from repeated exposure to dilute solutions in the form of liquids, dusts, or mists.

Systmeic effects are due entirely to local tissue injury. Extreme pulmonary irritation may result from inhalationof dust or mist.

12. Sulfuric Acid

Concentrated sulfuric acid will effectively remove the elements of water from many organic materials with which it comes in contact. It is even more rapidly injurious to mucous membranes and exceedingly dangerous to the eyes. Ingestion causes serious burns of the mouth or perforation of the esophagus or stomach. Dilute sulfuric acid does not posses this property, but is an irritant to skin and mucous membranes due to its acidity and may cause irreparable corneal damage and blindness as well as scarring of the eyelids and face.

Sulfuric acid mist exposure causes irritation of the mucous membranes, including the eye, but principally the respiratory tract epithelium. The mist also causes ecthing of the dental enamel followed by erosion of the enamel and dentine with loss of tooth substance. Central and lateral incisors are mainly affected. Breathing high concentrations of sulfuric acid causes tickling in the nose and throat, sneezing, and coughing. At lower levels sulfuric acid causes a relfex increase in respiratory rate and diminution of depth, with reflex bronchoconstriction resulting in increased pulmonary air flow resistance. A single overexposure may lead to laryngeal, tracheobronchial, and pulmonary edema. Repeated excessive exposures, over long periods have resulted in bronchitic symptoms, and rhinorrhea, tearing, and bloody nose. Long exposures are claimed to result in conjunctivitis, frequent respiratory infections, emphysema and digestive disturbances.

13. Toluene

Toluene may cause irritation of the eyes, respiratory tract, and skin. Repeated or prolonged contact with liquid may cause removal of natural lipids from the skin, resulting in dry, fissured dermatitis. The liquid splashed in the eyes may cause irritation and reversible damage.

Acute exposure to toluene predominantly results in central nervous system depression. Symptoms and signs include headache, dizziness, fatigue, muscular weakness, drowsiness, incoordination with staggering gait, skin paresthesias, collapse, and coma. A common contaminant of toluene is benzene.

14. Xylene

Xylene vapor may cause irritation of the eyes, nose and throat. Repeated or prolonged skin contact with xylene may cause drying and defatting of the skin which may lead to dermatitis. Liquid xylene is irritating to the eyes and mucous membranes, and aspiration of few milliliters may cause chemical pneumonitis, pulmonary edema, and hemorrhage. Repeated exposure of the eyes to high concentrations of xylene vapor may cause reversible eye damage.

Acute exposure to xylene vapor may cause central nervous system depression and minor reversible effects upon liver and kidneys. At high concentrations xylene vapor may cause dizziness, staggering, drowsiness, and unconsciousness. Also at very high concentrations, breathing xylene vapors may cause pulmonary edema, anorexia, nausea, vomiting, and abdominal pain.

VI. RESULTS AND DISCUSSION

A. Environmental*

1. Air sampling

The No. 48 coater room operator had no detected benzene exposure, toluene was found in a concentration of 3.1 ppm, and xylene was measured at 0.7 ppm. Aromatic hydrocarbons were not detected and a toluene concentration of 2.0 ppm was measured on a "Dippity-Doo" operator. Samples taken on a chemical mixer operator were non-detectable for both hydrochloric acid and sodium hydroxide. The sulphuric acid sample for the same mixer was 0.09 mg/m^3. A concentration of 21 mg/m^3 of mineral spirits, and non-detectable levels of benzene, toluene and xylene were the results of samples taken on a silk screen operator. A paint storage and mixing operator had concentrations of 8 ppm for methyl ethyl ketone, 6 ppm for methyl isobutyl ketone, and non-detectable for butyl cellosolve. A lab technican was sampled for hydrochloric acid and none was detected.

* All concentrations are 8-Hr.-TWA

Concentrations of 0.15 mg/m^3 for sulphuric acid and 2 mg/m^3 for methyl ethyl ketone were found for the same lab technican. None of these exposures exceeded their respective NIOSH recommended standards.

Area samples taken in the barrel-plating area were non-detectable for ammonia, chromic acid, hydrochloric acid or sodium hydroxide. The sulphuric acid concentration in the barrel plating area was 0.11 mg/m^3. In the dip line hutch area, hydrochloric acid was non-detectable and sulphuric acid concentration was 0.18 mg/m^3.

Detector tube samples for carbon monoxide and chlorine were taken using a manual air sampling pump. Ten carbon monoxide readings taken in Packing Area No. 2 showed the following results: at either end of the line, the CO concentration was 25 ppm (four readings - two on each end) and the middle of the line it was 50 ppm CO (six readings - three on each side). The CO concentrations at the middle of the packing line approach the numerical criteria for the NIOSH recommended standard for CO of 35 ppm.

Five chlorine detector tube readings were taken throughout the waste treatment area (particularly in a chlorine tank storage); no chlorine was detected (limit of detection: 1ppm).

2. Ventilation Evaluation

During the July visit, NIOSH investigators observed workers in the painting area of the 48-inch line wet mopping the floor with toulene which was drawn, by use of a petcock valve, from a 55-gallon drum used expressly for paint clean up. In the paint area of the 109 department we also found an inoperable local exhaust ventilation unit. The most common ventilation method used in the plant was dilution ventilation accomplished through the use of upright rotary fans. Since the NIOSH evaluation last visit the Dippity-Doo Line has reportedly been fully automated.

The ventilation measurements in the Packing/Cardboard Box Assembly Line showed 25 to 50 cubic feet per minute on either end of the line and less than 25 feet per minute at the middle of the line (the area of highest carbon monoxide concentrations). Both wall fan(s) near the Packing Area , and an open overhead door near the bottom end of the Cardboard Box Assembly Line account for the lower CO concentrations at either end of the line.

B. Medical

Thirty-one Roper Eastern employees answered the questionnaire. Their average age was 48 years (range 26 to 63 years). Seventy percent were black, and 30 percent white. Their average length of employment was 15.5 years (range three to 31 years). Fifty-eight percent were smokers, and 42 percent non-smokers.

As noted in Table II, 54.8 percent of respondents (17/31) reported at least four of seven possible respiratory symptoms. Thirty-five percent (11/13) reported at least three of six possible neurologic symptoms. Nineteen percent (6/31) reported at least three of six systemic symptoms. Reporting of respiratory symptoms was significantly and positively associated with the duration of workplace exposure to dust and fumes. Mean duration of dust exposure for those reporting at least four of seven respiratory symptoms was 13.6 years, compared to 7.4 years for those not reporting at least four of seven possible respiratory symptoms. Mean duration of fume exposure were 12.5 and six years for those respectively reporting and not reporting at least four of seven respiratory symptoms.

Twenty-seven of 31 workers complained of excessive noise, and seasonably related extremes of heat and cold. Workers in the "Dippity-Doo" lacquer line in the 109 process area evidenced dry, cracking skin on their hands and forearms, and reported transient respiratory irritations, both of which they related to their lacquer exposure.

The entire group of 31 workers reported exposure most commonly to plating tank process caustics, acids and solvents. Thirty workers reported exposure to irritant fumes with the average length of workplace exposure occuring over a nine year period (range 0.4-25 years). Twenty-five of the 31 workers reported dust exposure over an average 10.5 year period (range 1-31 years). The only individual reporting no exposure and no symptoms was an inspector whose primary work area was removed from the process plating areas. Three reports of excessive hair lose occurred exclusively in workers on the "Ransburg line" in the 109 department. No definitive statement concerning an occupational etiology for these reports of hair loss can be made.

VII. RECOMMENDATIONS

1. The practice of dilution ventilation by upright rotary fans should be discontinued. A fresh air, recirculating general ventilation system should be instituted in order to alleviate the health complaints of the workers. We recommend that this higher level of ventilation be maintained to ensure that levels of contaminants do not build up to concentrations that could cause upper respiratory tract irritation problems. Both the Dip-Line Coater Room and the Adhesive Area ventilation should be increased. Until this is accomplished (as an interim solution) operators should wear appropriate chemical cartridge respirators (full-face) to prevent eye irritation and any respiratory irritations.

2. Carbon monoxide levels in the cardboard box assembly/packing line approach or exceed the environmental criteria. The use of internal combustion engines in the area should be curtailed. Air movement could be increased by introducing more fresh air via a recirculating general ventilation system.

3. The employees should remain at a reasonable distance from the acid tanks during the placement of the charge into the acid bath. Chemical mixers/operators and lab personnel should use impervious gloves, aprons, chemical goggles/splash shield and the appropriate (acid, alkai, organic vapor) chemical cartridge respirator when transferring, mixing, handling or sampling corrosive/toxic materials.

4. Appropriate respiratory protection should be provided to all workers and used until engineering controls have been implimented. A respiratory protection program should be established and maintained in accordance with 29 CFR 1910.134.

5. Establish a environmental monitoring program for the toxic substances used in the manufacturing process. Sampling should document both short and long term exposures. The assistance of Roper Eastern's insurance carrier could be sought in formulating such a program.

6. A housekeeping program should be established whereby equipment, work areas, and floors would be cleaned on a weekly basis. Contaminated clothing and toweling should be changed or disposed of in a proper enclosure to prevent skin contact or inhalation of organic solvents, acids and alkali compounds.

7. Good work practices and good personal hygiene should be stressed, with the goal of preventing or minimizing inhalation, ingestion, and skin and eye contact with the process substances. Included in this program should be: 1) hand washing before eating, drinking, and smoking, 2) continued abstinence from eating, drinking, and smoking in the production area; 3) elimination of the practice of wet-mopping paint spills with toulene, and 4) use of long sleeved, company provided protective clothing.

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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, 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. Roper Eastern of Baltimore, Maryland
2. President, UFWA Local 75-A
3. United Furniture Workers of America
4. NIOSH, Region III
5. OSHA, Region III

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

Results of personal and area air sampling conducted on November 27 and 27, 1982

1. Paint Storage and Mixing Operator

Substance	Sampling Time (mins.)	Concentration (ppm)
Butyl Cellosolve	480	N.D.*
Methyl Ethyl Ketone	480	8
Methyl Isobutyl Ketone	480	6

2. Chemical Mixer Operator

Substance	Sampling Time (mins.)	Concentration (mg/m^3)
Hydrochloric Acid	455	N.D.
Sodium Hydroxide	455	N.D.
Sulphuric Acid	455	0.09

3. Lab Personnel Technician

Substance	Sampling Time (mins.)	Concentration (mg/m^3)
Hydrochloric Acid	465	N.D.
Sulphuric Acid	465	0.15
Methyl Ethyl Ketone	470	2

4. Barrel Plating Area

Substance	Sampling Time (mins.)	Concentration (mg/m^3)
Ammonia	415	N.D.
Chromic Acid	415	N.D.
Hydrochloric Acid	415	N.D.
Sodium Hydroxide	415	N.D.
Sulfuric Acid	415	0.11

Table I (continued)

Results of personal and area air sampling conducted
on November 27 and 27, 1982

5. Dippity-Doo Operator

Substance	Sampling Time (mins.)	Concentration (ppm)
Aromatic Hydrocarbons	425	N.D.
Toluene	425	2.0

6. No. 48 Coater Room Operator

Substance	Sampling Time (mins.)	Concentration (ppm)
Benzene	410	N.D.
Toluene	410	3.1
Xylene	410	0.7

7. Silk Screening Operator

Substance	Sampling Time (mins.)	Concentration (mg/m^3)
Benzene	485	N.D.
Mineral Spirits	485	21 mg/m^3
Toluene	485	N.D.
Xylene	485	N.D.

8. Dip Line Hutch Area

Substance	Sampling Time (mins.)	Concentration (mg/m^3)
Hydrochloric Acid	415	N.D.
Sulfuric Acid	415	0.18

*N.D. = None detected

Table II

	Workers from 48-inch-line	Workers from 109 Department	Workers from production areas
Number of workers:	N = 9	N = 12	N = 9
Respiratory Symptoms			
eye irritation	8 (88%)	9 (75%)	6 (66%)
nose irritation	5 (55%)	7 (58%)	6 (66%)
dry mouth	9 (100%)	8 (66%)	5 (55%)
throat irritation	6 (66%)	7 (58%)	4 (44%)
hoarseness	6 (66%)	3 (25%)	1 (11%)
cough	7 (77%)	8 (66%)	6 (66%)
chest tightness	2 (22%)	4 (33%)	2 (22%)
Neurologic Symptoms			
headache	4 (44%)	10 (83%)	3 (33%)
dizziness	2 (22%)	4 (33%)	3 (33%)
lightheadedness	4 (44%)	4 (33%)	2 (22%)
weakness	2 (22%)	2 (16%)	1 (11%)
numbness	5 (55%)	4 (33%)	1 (11%)
sleepiness	5 (55%)	6 (50%)	2 (22%)
Systemic Symptoms			
nausea	4 (44%)	5 (41%)	1 (11%)
vomiting	2 (22%)	3 (25%)	2 (22%)
abdominal pain	1 (11%)	3 (25%)	0
diarrhea	3 (33%)	2 (16%)	0
hair loss	3 (33%)	3 (25%)	1 (11%)