U.S. DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE
CENTER FOR DISEASE CONTROL
NATIONAL INSTITUTE FOR OCCUPATIONAL SAFETY AND HEALTH
CINCINNATI, OHIO 45226

HEALTH HAZARD EVALUATION DETERMINATION
REPORT NO. 76-106-384

FILE COPY

AJAX MAGNETHERMIC CORPORATION
WARREN, OHIO

APRIL 1977

I. TOXICITY DETERMINATION

The following determinations have been made based upon environmental air samples collected on December 6-7, 1976, confidential employee interviews, evaluation of ventilation system, evaluation of work procedures, and available toxicity information.

1. Employee exposures at the Burning Table in the Weld Shop to total dust, iron oxide, and manganese did not constitute a health hazard at the time of the survey. When cutting 2-inch yokes with four jets for any extended period of time, adequate ventilation should be provided.

2. Employee exposure to total dust and BGE (n-Butyl Glycidyl Ether) from an epoxy resin in the Bluecoat Spray Booth did not constitute a health hazard during the survey. Employees should always wear hand protection to guard against dermatitis. For safety reasons, a recommendation is made to modify the spray painting process.

3. Employee exposures to an epoxy resin in the Scotchcast Room of the Coil Department were not monitored during the survey due to work inactivity. However, during the initial survey of September 14, 1976, the general ventilation was judged to be sufficient and employees wore proper skin protection, and a health hazard is not judged to exist there.

II. DISTRIBUTION AND AVAILABILITY OF DETERMINATION REPORT

Copies of this Determination Report are currently available upon request from NIOSH, Division of Technical Services, Information 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. 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:

a) Ajax Magnethermic Corporation, Warren, Ohio
b) Authorized Representative of Employees - United Steelworkers of America - Local 5939, Warren, Ohio
c) U.S. Department of Labor - Region V
d) NIOSH - Region V

For the purpose of informing the "approximately fifty (50) affected employees", the employer will promptly "post" the Determination Report for a period of thirty (30) calendar days in a prominent place(s) near where the affected employees work.

III. INTRODUCTION

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 an 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 National Institute for Occupational Safety and Health (NIOSH) received such a request from an authorized representative of employees - United Steelworkers of America Local 5939. The request stated that employees were complaining of headaches in certain areas of the facility. Employees also did not feel ventilation was sufficient in these areas.

IV. HEALTH HAZARD EVALUATION

A. Description of Process - Conditions of Use

The Ajax Magnethermic Corporation builds induction heating and melting systems, such as for use in foundries. The request for a health hazard survey centered on three areas:

(1) Coil Department - "Scotchcast Room"
(2) Weld Shop - Burning Table
(3) Bluecoat Spray Booth

1. In the Scotch Cast Room, wound copper coils are hand painted with an epoxy resin, used as an insulator. Parts "A" and "B" of the epoxy system are first scooped out using a hand tool from separated containers onto a piece of cardboard. After the required waiting time, painting begins. This process occurs periodically using two or three employees. General ventilation is provided in the room by fans which push air across the room and through wall exhaust fans to the exterior of the building. The contaminants that could be released into the air include volatile components of the epoxy resin system.

2. In the Weld Shop, one process involves the cutting of hot rolled plate steel into desired dimensions. A Linde Flame Cutting Machine cuts through various thicknesses of the steel - usually 1/4, 1/2, 3/4, 1, 1 1/4, 1 1/2, and 2 inch sizes - at a temperature of 3000^{o}F using up to four separate oxy-acetylene torches. One employee per shift operates the controls for the automatic cutting process while another acts as a helper, assisting in removing steel pieces from the horizontal cutting surface with a magnetic hoist. Air contaminants which could be released here include nuisance dust, iron oxide, and manganese.

The specifications of the steel give the following composition of trace materials:

0.22% Carbon
1.06% Manganese
0.007% Phosphorous
0.21% Sulfur
0.023% Silicon

Iron makes up the remaining approximately 98% of the composition.

The cutting occurs in an area with a high ceiling - about 40-60 feet. Only general ventilation exists in this area. Employees claim that cutting of 2-inch pieces generally creates a dense dust cloud in the area, generating complaints from nearby workers. This may occur for one to two full days per week; however, the heaviest buildup reportedly occurs during cutting of 2-inch yokes using four flame jets on the cutting machine. This particular process generally occurs once or twice per month.

3. In the Bluecoat Spray booth, the process of interest is a part of a complete coil preparation. The complete process will be described first:

(1) Coils are wound and necessary hardware attached.
(2) Coils are cleaned by shot or sand blasting.
(3) Almost all coils are bluecoated with an epoxy resin which serves as insulation.
(4) Coils are manually taped by one of two methods.
(5) Stripping of shrink tape from "vacuum-use" coils occurs last.

The contaminants which could be released during the process include nuisance dust and n-butyl glycidyl ether.

In "bluecoating", one employee manually sprays a coil using an electrostatic-type spray gun. The blue epoxy powder is applied without a vehicle, and is a basic Bis-Phenol A resin. Unlike some epoxy systems, it is a one part system that rapidly heat cures at temperatures of 300°F-450°F.

The interior of the coil is first preheated with hot oil. An employee, in overalls, hood, and respirator, then sprays and coats a coil in approximately 25 minutes. Excess powder, sprayed at a low velocity, is captured by wall exhaust grilles. After the employee leaves the booth, the temperature of the coil is raised and curing of the epoxy resin begins.

Employee exposure to chemicals that might be released into the air during taping and stripping of the tape (xylene during taping and ethyl acetate and ethanol during stripping) could not be monitored, because the process did not occur during the survey. However, hazardous exposures are not expected because of the long intervals (possibly two to three times per week or one to two times per year) between jobs and the well ventilated work areas.

B. Study Progress and Design

1. Preliminary Survey

On September 14, 1976, an initial walk-through survey was conducted at Ajax Magnethermic Corporation by a NIOSH industrial hygienist. Following a tour of the work areas, several employees were interviewed using a non-directed questionnaire.

2. Follow-up Environmental Survey

On December 6-7, 1976, environmental sampling was conducted in the work areas of concern.

C. Environmental Evaluation Methods

Atmospheric samples for iron oxide and manganese were collected on Millipore* Type AA filters with 0.8 micron pore size. Atmospheric samples for total particulate (dust) matter were collected on 5 micron pore size polyvinyl chloride (PVC) filters.

The filters, 37 millimeters in diameter, were encased in plastic three piece field monitor cassettes with face caps on and small plugs removed. Personal samples were taken in the employee's breathing zone using battery powered Mine Safety Appliance* (MSA) gravimetric pumps, Type G, operating at a flow rate of 1.5 liters per minute (lpm). The pumps and samples were worn by the employees for approximately an 8-hour period.

An atmospheric sample for n-butyl glycidyl ether (BGE) was collected by drawing air through a charcoal tube using a Sipin* pump operating at a flow rate of approximately 200 milliliters per minute (ml/min.). The pump and sample collection device were worn by the employee in a similar manner to that described above.

Ventilation measurements were recorded using a Sierra* thermoanemometer.

D. Evaluation Criteria

1. Environmental Evaluation Criteria

Airborne exposure limits for the protection of the health of workers have been recommended or promulgated by several sources. These limits are established at levels designed to protect workers occupationally exposed to a substance on an 8-hour per day, 40 hours per week basis over a normal working lifetime. For this investigation, the criteria used to assess the degree of health hazard to workers were selected from two sources:

*Mention of commercial names does not constitute endorsement by the National Institute for Occupational Safety and Health.

a) Threshold Limit Values (TLV) - guidelines for airborne exposures recommended by the American Conference of Governmental Industrial Hygienists (ACGIH) for 1976.

b) OSHA (Occupational Safety and Health Administration) standards - The air contaminant standards for various substances enforced by the U.S. Department of Labor, and found in the Federal Register 29 CFR 1910.1000 (Table Z-1).

The criteria are listed below:

Substance	Sources	
	OSHA	ACGIH (TLV)
	Concentration(a)	
Total Dust	15 mg/M^3(b)	10 mg/M^3
Iron Oxide	10 mg/M^3	5 mg/M^3
Manganese	5 mg/M^3(c)	5 mg/M^3(c)
Butyl Glycidyl Ether	50 ppm(d)	50 ppm

(a) 8-hour time weighted average concentration
(b) mg/M^3 = milligrams per cubic meter
(c) These values should never be exceeded in an 8-hour period
(d) ppm = parts of substance per million parts of contaminated air at 25°C and 760 mm Hg.

2. Physiological Criteria

Manganese - Manganese itself is not of hygienic significance but certain of its compounds, such as manganese dioxide are. Neurological symptoms will indicate chronic exposure from skin absorption and inhalation of dust or fume. Commonly, "crow step" may develop as a difficulty in forward or backward walking without falling. Other chronic symptoms may be eye disturbance, weakness, excitibility, and stuttering.[1]

Iron Oxide - The fumes of iron oxide may cause X-ray changes in chest films. The collection of particles in the lungs has been termed "siderosis", a benign condition not leading to a disabling fibrosis. However, the X-ray changes make diagnoses of other disease conditions difficult. Excessive concentrations may reduce visibility or cause chemical or physical irritation to the skin and mucous membranes.[2]

Total Dust (Titanium Dioxide in Epoxy Resin) - "Nuisance" dusts have a long history of little harm on the respiratory system. The relationship between these dusts and effect on the lungs have been given the following characteristics:

(1) The architecture of the air spaces remains intact.
(2) Scar tissue is not formed to any degree.
(3) Any tissue reaction is potentially reversible. Excessive concentrations of nuisance dusts may reduce visibility also and cause unpleasant deposits in the eyes, ears, and nasal passages.[3]

Epoxy Resins - Epoxy resins are a group of cyclic ethers or alkene oxides, usually viscous liquids or solids with widely variable molecular weights and boiling points. The toxicity of the resin is very dependent on the nature of its components.[4] Resin curing agents, such as amines or acid anhydrides, have been known to cause contact dermatitis and irritation to the respiratory tract. Uncured epoxy resin systems may cause allergic sensitization of the skin. Less hazardous substitutes now exist in some epoxy systems. Cured epoxy resins are generally inert unless further fabrication allows resin decomposition products to be formed.[5]

The "Scotchcast" one part-epoxy resin used in the Bluecoat spray booth is a basic bisphenol A type (2,2-Bis-(4-hydroxyphenyl) propane) with dicyandiamide as the curing agent. Few experiments on the toxicity of bisphenol A had been made by 1964, and the industrial hazard was defined as insignificant.[6] The active thinner in this system is butyl glycidyl ether (BGE), classified as a mild skin and eye irritant.[1] The curing agent dicyandiamide (cyanoguanidine) was found to be relatively non-toxic by the oral route given to mice.[7] Recent literature on possible toxicity is lacking.

E. Evaluation Results and Discussion

1. Weld Shop-Burning Table

The flame cutting operator and helper were exposed to atmospheric concentrations of nuisance particulates, and iron oxide and manganese metal below legal and recommended evaluation criteria. The personal breathing zone concentrations illustrated in Table 1, show a range of 1.4-5.6 milligrams per cubic meter (mg/M^3) for nuisance dust, 0.95-4.3 mg/M^3 for iron oxide, and 0.01-0.02 mg/M^3 for manganese.* Atmospheric levels of contaminants were kept within allowable ranges partly due to the presence of a high (40-60 foot) ceiling in the work area. General ventilation measurements in the vicinity of the Burning Table indicated an air velocity of approximately 10-30 feet per minute.

However, some employees related that the most dusty operation occurred with flame cutting of 2-inch yokes using four torches. It was reported that this process occasionally occurs for an entire workday. However, a complete workday of this process did not occur during the survey. It is therefore recommended that adequate ventilation be provided during complete workdays of this particular process to minimize employee exposure to fumes and dusts.

2. Blue Coat Spray Booth

The Bluecoat sprayer was exposed to a concentration of nuisance dust (actually) titanium dioxide in the epoxy resin) of 15 mg/M^3, exceeding the recommended value of 10 mg/M^3 set by the American Conference of Governmental Industrial Hygienists (ACGIH) for an 8-hour workday. Since the Bluecoating of a coil

*Most of the steel cut during the survey was in the range of 1/2-1 1/2 inch thickness with 2-inch yokes cut for approximately one hour.

usually takes 1/2-1 hour or less and usually only one coil is sprayed during a work shift, the recommended time weighted average (TWA) concentration for an entire work shift would not be exceeded. Atmospheric sampling for n-butyl glycidyl ether was conducted, also. None of the substance could be detected in the sample.

The epoxy powder was analyzed for the presence of asbestos and epichlorohydrin, the latter compound being an intermediate in the production of an epoxy resin. The results were below the analytical limits of detection (Table 2). Therefore, no health hazard is presently judged to exist during this operation. Epoxy powder residue cleared the booth within 2-3 minutes of the spraying completion. Ventilation measurements indicated an air velocity of approximately 40-100 fpm in the booth where spraying occurs.

It was observed during the process that the employee was not wearing protective gloves. It is recommended that gloves always be worn to guard against the potential formation of dermatitis from the epoxy resin. Since sensitization to the epoxy powder can occur through skin contact, soap and water should be used to remove the powder promptly. Soiled clothing should be handled with care also.

One recommendation concerning the spraying technique is presented for consideration. The sprayer paints part of the heating coil from inside the coil. If a fire or explosion would occur in the booth vicinity the employee might be injured before having time to climb over the coil which is resting on the booth floor. It is recommended that the coil rest on blocks or other suitable fixture to allow exit from below the coil.

A second recommendation involves the use of respirators in the Bluecoat Spray Booth for epoxy resin spraying, and also for manual removal of shrink tape, which may allow the release of organic vapors. During epoxy powder spraying, employees should wear a chemical cartridge type respirator affording protection against organic vapors and dusts and mists. During shrink tape removal, employees should wear a chemical cartridge respirator for protection against organic vapors. A dust and mist respirator was observed on hand for this latter process, but it will not protect against organic vapors. Only NIOSH-certified equipment should be used. Single copies of the NIOSH-certified equipment list can be obtained from: NIOSH, Division of Technical Services, Robert A. Taft Laboratories, 4676 Columbia Parkway, Cincinnati, Ohio 45226 (include self-addressed mailing label).

3. Scotchcast Room

No production in the Scotchcast Room of the Coil Department occurred during the follow-up survey. However, during the initial survey, observation of the hand painting of heating coils with a two-part epoxy resin was observed. General ventilation in the work area appeared sufficient to control the release of vapors. It is recommended that proper protective clothing and gloves always be worn during painting to avoid possible dermatitis.

D. Medical

Nine employees in the work areas of concern were privately interviewed in regard to their work history and medical history. The interviews were conducted in a non-directed manner. One employee in the weld shop said that on certain days, he experienced eye and chest irritation from the fumes and dust of the flame-cutting. Other employees had no health complaints that were judged to be job related.

V. REFERENCES

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6. Malten, K. and Zielhuis, R.: Industrial Toxicology and Dermatology in the Production and Processing of Plastics. Elsevier Publishing Company, London, pp. 108-109, 1964.

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Acknowledgments

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TABLE I

Results of Air Sampling

Ajax Magnethermic Corporation
Warren, Ohio

December 6-7, 1976

Employee	Date	Sampling Period (hr./min.)	Concentrations (mg/M^3)[1] Total Dust	Iron Oxide (Fe_2O_3)	Manganese (Mn)	N-Butyl Glycidyl Ether (BGE)
Flame Cutting Operator	12/6/76	7/20	5.6	4.3	-	-
Flame Cutting Helper	12/6/76	7/30	2.9	2.3	0.02	-
Flame Cutting Operator	12/7/76	7/20	1.9	1.3	0.02	-
Flame Cutting Helper	12/7/76	7/20	1.4	0.95	0.01	-
Bluecoat Sprayer	12/6/76	0/25	15	0.4	-	N.D.

[1] mg/M^3 = milligrams of substance per cubic meter of air
N.D. = Non-detectable

HYGIENIC STANDARDS: (8-hour TWA concentrations except where noted)

	Sources OSHA (Legal)	ACGIH (TLV-recommended)
Total Dust	15/mg/M^3	10 mg/M^3
Iron Oxide	10 mg/M^3	5 mg/M^3
Manganese	5*	5*
N-Butyl Glycidyl Ether (BGE)	50 ppm	50 ppm[2]

*Value not to be exceeded at any time
2 - Parts of substance per million parts of air

TABLE 2

Results of Bulk Sample Analyses

Ajax Magnethermic Corporation
Warren, Ohio

December 6-7, 1976

Sample	-Substance- Epichlorohydrin	Asbestos
Bluecoat Spray Powder	Non-detectable	Non-detectable