

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. 78-102-677

CONTINENTAL COLUMBUS CORPORATION
COLUMBUS, WISCONSIN

April 1980

I. SUMMARY

On June 16, 1978, the Business Representative, Sheet Metal Workers International Association Local 565, requested a health hazard evaluation at Continental Columbus Corporation, Columbus, Wisconsin. The request stated that employees were exposed to contaminants generated during spray painting and curing operations.

To evaluate the complaint, NIOSH conducted an initial and environmental survey of general workroom and touch-up spray painting employees, and a follow-up environmental survey of the spray painting operation.

Personal and area air samples were obtained for determination of the following contaminants: xylene, toluene, benzene, coal tar pitch volatiles (CTPV's), 2-ethoxyethylacetate, heptane, hexamethylene diisocyanate (HMDI), and chromium VI.

Concentrations of benzene, chromium VI, CTPV's, and HMDI in touch-up painter personal samples exceeded the NIOSH recommended standards. Concentrations of xylene, toluene, 2-ethoxyethylacetate, and heptane in touch-up painter personal samples were within the NIOSH recommended standard or OSHA standard. Concentrations of CTPV's, xylene, and toluene in personal samples collected from the general workroom environment were within the NIOSH recommended standard.

On the basis of the data obtained in this investigation, NIOSH determined that a serious hazard for exposure to benzene, chromium VI, CTPV's, and HMDI existed for touch-up painters at Continental Columbus Corporation at the time of this survey. General workroom employees were not exposed to hazardous levels of xylene, benzene, and CTPV's. Recommendations on engineering controls, work practices, environmental monitoring, and medical surveillance procedures have been developed by NIOSH and are incorporated in detail on page 7.

II. INTRODUCTION.

On June 16, 1978, the Business Representative, Sheet Metal Workers International Association Local 565, requested a health hazard evaluation at Continental Columbus Corporation, Columbus, Wisconsin. The purpose of the study was to evaluate employee exposure to contaminants generated during spray painting and curing operations. Employee complaints included eye, nose, and throat irritation, contact dermatitis, headache, and nausea.

III. BACKGROUND.

Continental Columbus Corporation fabricates metal outdoor enclosures for housing junction boxes and transformers. They also manufacture metal toilet partitions. Metal sheet stock is trimmed and bent, and various fixtures are welded to the metal. The metal is cleaned, zinc coated, and placed on a slow moving hook conveyer. The metal is primed in a ventilated spray booth, and the paint is automatically applied from an electrostatic painting system. Minor touch-up paint is applied in a second ventilated spray booth. The metal is then sent through a baking oven and off-loaded from the conveyer where it is boxed for shipment as a disassembled enclosure.

Before NIOSH was contacted, a Compliance Safety and Health Officer (CSHO) from the Madison, Wisconsin, OSHA area office conducted atmospheric sampling at this plant in December, 1977. The CSHO sampled for isopropanol, methyl ethyl ketone, butanol, methyl isobutyl ketone, toluene, butyl acetate, ethylbenzene, petroleum distillates (naphtha), xylene, and total particulates. None of the sample concentrations were in excess of OSHA standards.

On March 1, 1978, an Occupational Health Evaluation was conducted by a consultant from the Division of Health, District 3, Wisconsin Department of Health and Social Services. The consultant was unable to determine the cause of the employee complaints but reported that the complaints probably resulted from the emissions of the paint baking oven.

A complaint to OSHA on February 10, 1978 resulted in another industrial hygiene inspection on March 7, 1978. Air samples for toluene, xylene, petroleum distillates (naphtha), lead, chromium, and zinc were within OSHA limits, and no citations were issued.

IV. EVALUATION DESIGN,

An initial survey of the plant was conducted by a NIOSH Industrial Hygienist on August 16-17, 1978. General observation and statements taken from employees revealed that the complaints resulted from emissions from the paint baking oven. An environmental survey was conducted by NIOSH on February 23, 1979 to assess general workroom and spray painter employee exposure to bake-off products from the baking oven.

NIOSH Interim Report #1 was submitted to the requestor and plant management in May, 1979. This report provided the preliminary results from the initial and environmental surveys, provided recommendations designed to alleviate exposure problems, and indicated that a follow-up environmental survey would be required in order to assess the touch-up spray painters' exposure to toxicants contained in the polyurethane and coal tar paints.

The follow-up environmental survey was conducted by NIOSH on August 15, 1979. Due to the infrequent use of the coal tar paint, NIOSH investigators were limited to assessing the spray painters' exposure to the polyurethane paint. The results of this survey were submitted to the requestor and plant management in December, 1979.

V. METHODS AND MATERIALS

A. Initial Environmental Survey

Coal tar pitch volatiles were collected on glass fiber filters followed by silver membrane filters and back-up pads which were mounted in 37 mm., 3 piece plastic cassettes. The sampling train consisted of filters connected to battery powered air sampling pumps operating at 1.5 liters per minute. The samples were analysed for benzene solubles by benzene extraction and gravimetric determination utilizing NIOSH method P&CAM #217.¹

Employee exposures to benzene, xylene, and toluene were monitored using personal plus area air sampling equipment. Solvent vapors were collected in air sampling tubes containing activated charcoal and were analysed by gas chromatography according to NIOSH method #127 (modified)².

B. Follow-up Environmental Survey

Breathing zone and general area atmospheric samples for xylene, benzene, toluene, 2-ethoxyethylacetate, and heptane were monitored using personal and general area sampling equipment. Solvent vapors were collected in air sampling tubes containing activated charcoal and were analysed by gas chromatography (NIOSH method #127)².

Breathing zone and general area atmospheric samples for hexavalent chromium were collected on 37 mm. diameter polyvinyl chloride copolymer filters attached to battery operated air sampling pumps and analysed by atomic absorption spectrophotometry (NIOSH P&CAM #169)³.

Breathing zone and general area atmospheric samples for hexamethylene diisocyanate were collected by midget impinger and analysed by high pressure liquid chromatography (NIOSH P&CAM #240).⁴.

V. EVALUATION CRITERIA

A number of sources recommend airborne levels of substances under which it is believed that nearly all workers may be repeatedly exposed day after day without adverse effect. Such airborne levels are referred to as standards or threshold limit values (TLV's). It is believed that concentrations below these limits represent conditions under which nearly all workers may be repeatedly exposed 8-10 hours per day, 40 hours per week, without suffering adverse health effects. Due to variations in individual susceptability, a small percentage of workers may experience effects at levels at or below the threshold limit; a smaller percentage may be more seriously affected by aggravation of a pre-existing condition or by a hypersensitivity reaction.

The environmental evaluation criteria used for this study are presented in Table 1. Listed in this table, for each substance, are the recommended environmental limit, the source of the recommended environmental limit and the current OSHA standard. For the substances in Table 1, only HMDI does not have a legal (OSHA) standard.

VI. RESULTS AND DISCUSSION

A. Initial Survey (Aug. 16-17, 1980)

The confidential employee interviews performed during the initial survey revealed a high prevalence of eye, nose, and throat irritation, headache, and nausea among spray painters, welders, press operators, and general laborers. The workers were concerned with emissions from the paint oven which they believed had caused their symptoms, especially during the colder weather when the plant doors and windows were closed.

B. Environmental Survey (February 23, 1979)

On February 23, 1979, a ventilation system consisting of a 10,000 cubic foot per minute capacity vane axial fan and ductwork was activated to prevent emission of bake-off product from the paint baking oven. The NIOSH Industrial Hygienist observed that the newly installed ventilation system effectively prevented bake-off product from escaping into the general workroom environment.

This observation was supported by the results of full-shift personal air sampling conducted on February 23, 1979. The only employee to receive significant exposure to a toxicant was the touch-up spray painter who was exposed to hazardous levels of coal tar pitch volatiles. The touch-up painter received a time-weighted-average exposure of 0.48 mg/M³ CTPV's (benzene extractable) which is in excess of the 0.20 mg/M³ OSHA standard.

Repeated exposure to coal tar pitch has been associated with an increased risk for developing lung and skin cancer. These materials may also produce phototoxic effects, whereby the skin and eyes become sensitive to sunlight resulting in skin erythema, burning and itching of the skin; eye irritation and lacrimation, conjunctivitis and interferences with vision.

The results of the personal air sampling indicated that workers located in the general workroom (the sheer press operators) were not exposed to CTPV's. The level of CTPV's ranged from none detected to 0.08 mg/M³, while the average was 0.037 mg/M³ which is below the OSHA standard.

Other results of personal air sampling indicated that the touch-up spray painter and the three sheer operators were not exposed to hazardous concentrations of xylene (range: 0.2-14.2 ppm; average 4.4 ppm; NIOSH criteria: 100 ppm) toluene (range: 0.8 - 42 ppm; average 16 ppm; NIOSH criteria: 100 ppm) or benzene (range: none detected for the three sheer operators, 0.5 ppm for the spray painter, NIOSH criteria: 1 ppm).

Ambient air detector tube measurements taken from the general workroom environment for carbon monoxide (CO) showed levels of less than 5 parts per million (ppm). NIOSH recommends a time weighted average exposure of 35 ppm with a ceiling value of 200 ppm.

B. Follow-up Environmental Survey (August 15, 1979)

Based on the results of short-term personal air sampling conducted on August 15, 1979, it has been determined that the touch-up spray painter was exposed to hazardous levels of hexamethylene diisocyanate (HMDI), benzene, and chromium VI, ingredients of the diisocyanate (polyurethane) paint. This conclusion is based on the following observations:

1. Touch-up painter exposure is essentially constant throughout the course of a workday.
2. The results of the short term sampling are representative of the employees 8-hour time-weighted-average exposure.
3. The painting operation normally encompasses the 8-hour workday.

Results of area and personal air sampling for hexamethylene diisocyanate (HMDI) are shown in Table 2. The average personal exposure to HMDI was 45 micrograms per cubic meter of air ($\mu\text{g}/\text{M}^3$) which is in excess of the 35 $\mu\text{g}/\text{M}^3$ NIOSH recommended criteria. An area sample located in the booth indicated a concentration of HMDI of 192 $\mu\text{g}/\text{M}^3$.

HMDI is a type of diisocyanate. Diisocyanates irritate the respiratory tract and can act as respiratory sensitizers, producing asthma-like symptoms in sensitized individuals at very low concentrations. Exposure to diisocyanates may also result in chronic impairment of pulmonary function.¹⁰

Results of area and personal air sampling for chromium VI are shown in Table 3. The average personal exposure to chromium VI was 22 $\mu\text{g}/\text{M}^3$ which is in excess of the 1 $\mu\text{g}/\text{M}^3$ NIOSH recommended criteria. An area sample located in the booth indicated a concentration of 57 $\mu\text{g}/\text{M}^3$.

Occupational exposures to chromium and its compounds has been found to cause skin and mucous membrane irritation and corrosion, dermatitis, and chrome ulceration, and has been related to an increase in the incidence of lung cancer.⁸

Results of area and personal air sampling for benzene are shown in Table 4. The average personal exposure to benzene was 1.6 part per million parts of air (ppm) which is in excess of the 1 ppm NIOSH ceiling criteria.

Exposure to benzene liquid or vapor may produce primary irritation to the skin, eyes, and upper respiratory tract. Acute exposure to benzene results in central nervous system depression. Chronic exposure to benzene is well documented to cause blood changes. Recent epidemiologic studies along with case reports of benzene related blood dyscrasias and chromosomal aberrations have led NIOSH to conclude that benzene causes leukemia.⁶

Results of area and personal sampling for xylene, toluene 2-ethoxyethylacetate, and heptane are shown in Table 4 and 5. All exposures to these substances were within evaluation criteria.

The results of the follow-up environmental survey were submitted to the requestor and plant management on December 1979. Once the plant manager was aware that the touch-up painter was receiving hazardous exposure to toxicants, a call was made to the NIOSH regional office for the purpose of discussing feasible engineering controls. The plant manager indicated that the following two control measures were immediately available to the spray painter and would be implemented:

1. Conversion of the conventional touch-up spray paint operation into an electrostatic operation.
2. Utilization of a type "C" supplied-air respirator.

VII. CONCLUSIONS

1. Personal and area air atmospheric sampling and general observation revealed that the local exhaust ventilation addition effectively prevented toxic emissions from the paint baking oven into the general workroom environment (at the time of the survey).
2. Personal and area air sampling revealed that the touch-up spray painter was exposed to hazardous levels of benzene, HMDI, CTPV's, and chromium VI. The plant managers indicated that engineering and respiratory protection control measures would be implemented to reduce the exposure.

VIII. RECOMMENDATIONS

1. Touch-up painter exposure to toxicants contained within the polyurethane and coal tar paint should be immediately reduced to the lowest level possible through effective engineering and administrative controls and through improved work practices.
2. Respirators as a means of control should be used in the interim period when effective engineering controls are being implemented. The company should design a respiratory protection program and ensure that it is in compliance with the requirements described and

outlined as 11 criteria for a minimal acceptable program in the Occupational Safety and Health Administration Standards, Title 29 of the Code of Federal Regulations, Part 1910, Section 134.

3. A medical surveillance program for all touch-up spray paint employees should be implemented as soon as possible. The program should be designed to detect adverse health effects which result from occupational exposure to benzene, CTPV's, chromium VI, and HMDI. These employees should be given pre-employment and periodic physical examinations with particular attention given to the oral cavity, skin, blood, and respiratory system. The specific hazard examinations are listed in detail in the corresponding NIOSH criteria documents.

4. An environmental monitoring program should be developed to accurately assess each employee's occupational exposure to benzene, CTPV's, chromium VI, HMDI, and other toxicants contained within the paints.

5. Touch-up painters should be informed of the health hazards associated benzene, CTPV's, chromium VI, HMDI and other toxicants contained within the paints. They should receive training by a qualified person to ensure that each employee has a current understanding of the job hazards, proper maintenance and clean-up procedures, the correct use of respirators, and the need for employee cooperation, support, and participation in a medical and environmental surveillance program.

6. Employees responsible for handling and applying the coal tar paint should be required to wear disposable protective coveralls, gloves, and head cover. In areas lacking adequate engineering controls use of respirators should also be required as an interim measure.

7. Good personal hygiene is of prime importance. Spray painter employees should shower and wash thoroughly with soap and water at the end of a shift. Attention should be given to flushing of the eyes with water at this time. A complete change of clothing should be made after showering. Freshly laundered work clothes should be worn daily.

8. Skin contaminated with the coal tar paint should be washed promptly with soap or a waterless hand cleaner. To prevent skin absorption of coal tar pitch, employees should not use solvent to clean their hands.

VI. REFERENCES

1. P&CA Method No. 217: NIOSH Manual of Analytic Methods, Volume 1, DHEW(NIOSH) Publication No. 77-157-A, (April 1977).
2. Ibid, P&CAM #127.
3. Ibid, P&CAM #169.
4. Vogt CRH, Ko CY, Ryan TR: Modification of An Analytical Procedure for Isocyanates to High Speed Liquid Chromatography, NIOSH, 1976, 87pp.
5. General Industry Standards: Occupational Safety and Health Administration Safety and Health Standards (29 CFR 1910) revised January 1976.
6. Criteria for a Recommended Standard.. Occupational Exposure to Benzene: NIOSH Publication No. 74-137 (1974).
7. Criteria for a Recommended Standard.. Occupational Exposure to Coal Tar Products: NIOSH Publication No. 78-107, (1977)
8. Criteria for a Recommended Standard.. Occupational Exposure to Hexavalent Chromium: NIOSH Publication No. 76-129 (1975).
9. Criteria for a Recommended Standard.. Occupational Exposure to Alkanes: NIOSH Publication No. 77-151, (1977)
10. Criteria for a Recommended Standard.. Occupational Exposure to Diisocyanates: NIOSH Publication No. 78-215, (1978)
11. Criteria for a Recommended Standard.. Occupational Exposure to Toluene: NIOSH Publication No. 73-11023 (1973).
12. Criteria for a Recommended Standard.. Occupational Exposure to Xylene: NIOSH Publication No. 75-168, (1975)

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VIII. DISTRIBUTION AND AVAILABILITY

Copies of this Determination Report are currently available upon request from NIOSH, Division of Technical Services, Information Resources and Dissemination Section, 4676 Columbia Parkway, Cincinnati, Ohio 45226. After ninety (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 the NIOSH Publications Office at the Cincinnati, Ohio address.

Copies of this report have been sent to:

- a. Sheet Metal Workers International Assn., Local 565
- b. Manufacturing Manager, Continental Columbus Corp,
Wisconsin
- c. U. S. Department of Labor, OSHA, Region V
- d. Wisconsin Division of Health

For the purpose of informing the affected employees, copies of the report should be posted in a prominent place accessible to the employees, for a period of 30 calendar days.

Table 1

Continental Columbus Corp.
Columbus, Wisconsin

<u>Substance</u>	<u>Recommended Environmental Limit*</u>	<u>Source</u>	<u>Primary Health Effects</u>	<u>OSHA Standard (Ref. 5)</u>
Benzene	1 ppm (ceiling)	NIOSH (Ref. 6)	Blood changes including leukemia	1 ppm
CTPV's	0.1 mg/M ³ (cyclohexane- extractable fraction)	NIOSH (Ref. 7)	Lung and skin cancer	0.2 mg/M ³ (benzene-soluble fraction)
Chromium VI	1 ug/M ³ for carcinogenic 25 ug/M ³ for other Cr VI	NIOSH (Ref. 8)	Lung cancer, skin ulcers, lung irritation	10 ug/M ³ (ceiling)
Heptane	85 ppm 440 ppm (ceiling)	NIOSH (Ref. 9)	Dermatitis, mucous membrane irritation, periferal nervous system effects	500 ppm
HMDI	35 ug/M ³ 140 ug/M ³ (ceiling)	NIOSH (Ref. 10)	Respiratory effects and sensit- ization, irritation	None
2-ethoxyethyl acetate	100 ppm	OSHA (Ref. 5)	Central nervous system (CNS) depressant, irritant	
toluene	100 ppm 200 ppm (ceiling)	NIOSH (Ref. 11)	CNS depressant	200 ppm
xylene	100 ppm 200 ppm (ceiling)	NIOSH (Ref. 12)	CNS depressant, airway irritant	100 ppm

*All air concentrations are time weighted average (TWA) exposures for a normal work day unles designated "ceiling". A "ceiling" limit is one which should not be exceeded.

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TABLE 2
RESULTS OF ENVIRONMENTAL SAMPLING
ON 8-15-79 for HEXAMETHYLENEDIISOCYANATES (HDI)

<u>JOB/LOCATION</u>	<u>TIME OF SAMPLE</u>	<u>TOTAL VOLUME SAMPLED(M³)</u>	<u>HDI (ug/M³)</u>	<u>TYPE OF SAMPLE</u>
Painter/Painting Booth	1305-1420	0.060	57	Personal
Painter/Painting Booth	1504-1614	0.056	34	Personal
Painting booth	1305-1420	0.052	192	Area

NIOSH EVALUATION CRITERIA: 35 (TWA)
NIOSH UNIT OF DETECTION: 1.6

ABBREVIATIONS: M³ = cubic meter
ug/M³ = micrograms per cubic meter
TWA= time-weighted-average

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TABLE 3
 RESULTS OF ENVIRONMENTAL SAMPLING
 ON 8-15-79 FOR CHROMIUM VI

<u>JOB/LOCATION</u>	<u>SAMPLE NUMBER</u>	<u>TIME OF SAMPLE</u>	<u>TOTAL VOLUME SAMPLED(M³)</u>	<u>CHROMIUM VI (ug/M³)</u>	<u>TYPE OF SAMPLE</u>
Painter/Painting Booth	1	1305-1420	.105	27	Personal
Painter/Painting Booth	2	1504-1614	.098	17	Personal
Painting Booth	3	1305-1420	.083	57	Area

NIOSH Evaluation criteria: 1 (TWA)
 NIOSH Limit of Detection (ug/sample) 0.2

ABBREVIATIONS: M³ = cubic meter
 ug/M³ = micrograms of substance per cubic meter of air.
 TWA = time-weighted-average

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TABLE 4
 RESULTS OF ENVIRONMENTAL SAMPLING
 ON 8-15-79 FOR SOLVENTS

<u>JOB/LOCATION</u>	<u>TIME OF SAMPLE</u>	<u>TOTAL VOLUME SAMPLED</u>	<u>XYLENE (ppm)</u>	<u>BENZENE (ppm)</u>	<u>TOLUENE (ppm)</u>	<u>TYPE OF SAMPLE</u>
Painter/Painting Booth	1305-1420	0.004	1.8	0.17	18	Personal
Painter/Painting Booth	1504-1614	0.004	ND	3.14	5	Personal
Painting Booth	1305-1420	0.004	4.8	0.41	67	Area
NIOSH EVALUATION CRITERIA:			100	1*	100	
OSHA EVALUATION CRITERIA:			100	1	200	
NIOSH LIMIT OF DETECTION(mg/sample):			.01	.001	.01	

ABBREVIATIONS: M³ = cubic meter
 mg = milligrams
 ppm = parts of contaminate per million parts of air.
 * = ceiling level

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TABLE 5
RESULTS OF ENVIRONMENTAL SAMPLING
ON 8-15-79 FOR SOLVENTS

<u>JOB/LOCATION</u>	<u>TIME OF SAMPLE</u>	<u>TOTAL VOLUME SAMPLED(M³)</u>	<u>2-Ethoxyethylacetate (mg/M³)</u>	<u>Heptane (ppm)</u>	<u>TYPE OF SAMPLE</u>
Painter/Painting Booth	1305-1420	0.004	24	ND	Personal
Painter/Painting Booth	1504-1614	0.004	47	ND	Personal
Painting Booth	1305-1420	0.004	126	ND	Area
NIOSH EVALUATION CRITERIA:			540	85	
NIOSH LIMIT OF DETECTION(mg/sample):			0.03	0.01	

ABBREVIATIONS: M³ = cubic meter.
mg/M³ = milligrams per cubic meter
ppm = parts of contaminant per million parts of air.
ND = none detected.