HEALTH HAZARD EVALUATION REPORT 72-99-55
HAZARD EVALUATION SERVICES BRANCH
DIVISION OF TECHNICAL SERVICES

Establishment : Peerless Wire Goods Company
Lafayette, Indiana

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JULY 1973

U.S. DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE
NATIONAL INSTITUTE FOR OCCUPATIONAL SAFETY AND HEALTH
CINCINNATI, OHIO 45202

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PEERLESS WIRE GOODS COMPANY
LAFAYETTE, INDIANA

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I. SUMMARY DETERMINATION

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 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 National Institute for Occupational Safety and Health (NIOSH) received such a request from an authorized representative of employees regarding exposures to fumes from chemicals, specifically cyanide, in the electroplating processes at the Peerless Wire Goods Company, Lafayette, Indiana.

A NIOSH investigator conducted an observational survey of the associated operations on December 14, 1972, and an environmental survey was performed on February 13-14, 1973. Samples were collected and analyzed for cyanide, as well as hydrogen chloride as hydrochloric acid (HCl), nitric acid as nitrate (NO_3), zinc oxide, and chromium.

Interviews were conducted with the employees in the electroplating area to determine if they experienced any symptomatic effects from the chemicals used in the electroplating process.

The Occupational Safety and Health Standards as promulgated by the U. S. Department of Labor (Federal Register, Part II, § 1910.93, Table G-1) applicable to substances sampled and the range of environmental concentrations measured from thirty samples are:

Substance	Standard* mg/M^3	Range Environmental Concentration mg/M^3	Mean mg/M^3
Cyanide (as CN) - Skin	5	0.0016-0.0062	0.0049
C Hydrogen Chloride**	7	0.0073-0.0180	0.0099
Nitric Acid	5	0.4 - 2.3	1.2
Zinc Oxide Fume	5	0.0012-0.0061	0.0024
Chromium, Soluble Chromic, Chromous Salts as Cr	0.5	0.0012-0.0054	0.0032

* mg/M^3 - Approximate milligrams of particulate per cubic meter of air.

** Materials with names preceded by "C"--Ceiling Values. An employee's exposure to any material in table G-1, the name of which is preceded by a "C" shall at no time exceed the ceiling value given for that material in the table.

Other materials--8-hour time weighted averages. An employee's exposure to any material in table G-1, the name of which is not preceded by "C", in any 8-hour work shift of a 40-hour work week, shall not exceed the 8-hour time weighted average given for that material in the table.

The maximum concentration value obtained, that for nitric acid, is less than 50% of the established standard, and all other substances appear at concentrations of 1% or less of the standards. The equivalent exposure for the mixture of contaminants, which should not exceed unity (Federal Register, Part II, § 1910.93, Subpart (d)(2)(i))is o.25 for the mean concentration and o.48 for the maximum concentrations measured.

Employees did not express undue concern or symptomatic effects from working with the electroplating process, although one employee reported sporadic headaches and nasal irritation when working over the plating tanks to adjust or add solutions.

Based on the results of the employee interviews and environmental samples presented above, it has been judged that the subject substances; cyanide, hydrogen chloride, nitric acid, zinc oxide fume, and chromium, are <u>not potentially toxic</u> at the concentrations normally used or found in the zinc electroplating process. This does not preclude the fact

that there may be occasional periods when air concentrations in the electroplating area may be sufficient to produce irritation.

Copies of this Summary Determination evaluation are available upon request from the Hazard Evaluation Services Branch, NIOSH, U. S. Post Office Building, Room 508, Fifth and Walnut Streets, Cincinnati, Ohio. Copies have been sent to:

a) Peerless Wire Goods Company, Lafayette, Indiana

b) Authorized Representative of Employees

c) U. S. Department of Labor - Region V

For purposes of informing the approximately 30 "affected employees" who work in the electroplating area, the employer will promptly "post" the Summary Determination in a prominent place(s) near where affected employees work for a period of 30 calendar days.

II. 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 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 National Institute for Occupational Safety and Health (NIOSH) received such a request from an authorized representative of employees regarding exposures to fumes from chemicals, specifically cyanide, from electroplating processes at the Peerless Wire Goods Company in Lafayette, Indiana.

III. BACKGROUND HAZARD INFORMATION

A. Standards

The occupational health standards promulgated by the U. S. Department of Labor (Federal Register, Part II, 1910.93, Table G-1) applicable to substances of this evaluation are as follows:

Substance	mg/M^3*
Cyanide (as CN) - Skin	5
C Hydrogen Chloride**	7
Nitric Acid	5
Zinc Oxide Fume	5
Chromium, Sol. Chromic, Chromous Salts as Cr	0.5

* mg/M^3 - milligrams of substance per cubic meter of air.

** Materials with names preceded by "C"--Ceiling Values. An Employee's exposure to any material in table G-1, the name of which is preceded by a "C" shall at no time exceed the ceiling value given for that material in the table.

Other materials--8-hour time weighted averages. An employee's exposure to any material in table G-1, the name of which is not preceded by "C", in any 8-hour work shift of a 40-hour work week, shall not exceed the 8-hour time weighted average given for that material in the table.

B. Toxic Effects

1. Cyanide

Cyanides are widely used in electroplating processes. The established standard of 5 mg/M^3 (milligram per cubic meter) for cyanides is based on the ability of this ion to cause skin irritation, and epistaxis (nosebleed), and nasal ulceration. The air concentration of cyanide from the alkali cyanides producing this effect do not greatly exceed 5 ppm.[1]

2. Hydrogen Chloride

The adueous solution of hydrogen chloride gas is called hydrochloric or muriatic acid.

Harmful Effects: Hydrochloric acid and high concentrations of hydrogen chloride gas are highly irritating to eyes, skin, and mucous membranes. Discoloration of teeth and tooth decay have been noted from exposure to low concentrations of gas.

With inhalation of gas or mist, pulmonary edema is possible, but usually the cough and choking sensation from intense irritation of the upper respiratory tract compel worker to leave the area.[2]

3. Nitric Acid

Harmful Effects: Nitric acid is capable of producing severe burns, ulcers and necrosis of skin, mucous membrances and eyes. Prolonged exposure to vapor may cause yellowing of skin and erosion of teeth.

Inhalation may cause irritation of entire respiratory tract. Pulmonary edema may result. Pulmonary fibrosis has been reported to follow inhalation.[3]

4. Zinc and Compounds

Harmful Effects: Zinc chloride is extremely irritating to skin and may produce extensive ulceration; in addition it is very irritating to the eyes, nose, and throat. Perforation of the nasal septum may be produced. Zinc chromate, zinc cyanide and zinc sulfate may cause dermatitis.

Inhalation of zinc chloride fumes may produce severe pneumonitis. Certain smoke-screening compounds produce upon ignition primarily zinc

chloride and aluminum oxide. When inhaled, the zinc chloride fume in extremely high concentrations will produce a chemical irritation of the upper respiratory tract; in the concentrations usually met with among military personnel, an insidious chemical pneumonitis has been reported to occur.[4]

5. Chromium

The literature on chromium toxicology is devoted primarily to hexavalent chromium. Early studies indicated trivalent (and presumably bivalent) chromium compounds to be essentially nontoxic. Dermatitis from certain chromic salts has been reported, however, and trivalent chromium compounds have been found to react with protein.

Although hexavalent chromium has usually been present in plants where lung cancer incidence was high, experimental evidence has been reported indicating that trivalent chromium possibly possess carcinogenic properties.

The above reports indicate that chromic compounds, although less toxic than hexavalent chromic acid, cannot be considered harmless. The Federal Standard of 0.5 mg/M^3 for soluble chromium and 1 mg/M^3 of insoluble chromium (with the exception of hexavalent chromium compounds) are recommended to prevent possible pulmonary disease or other toxic effects.[5]

IV. OBSERVATIONAL SURVEY

A. Observational Survey

The observational survey of the Peerless Wire Goods Company was made on December 14, 1972, by the National Institute for Occupational Safety and Health (NIOSH) representative Mr. Richard S. Kramkowski.

The purpose of the visit was explained to [redacted], [redacted] Vice-President, Mr. William Shelby, Personnel, Mr. Albert W. [redacted]y, Requestor, and Mr. Abeny Quinn, Bargaining Committee. [redacted] and Mr. Newberry accompanied me to the electroplating area, where we were met by [redacted], in charge of the electroplating process.

The Peerless Wire Goods Company manufactures wire shelves for appliances such as refrigerators and freezers. The plant works three shifts per day and employs approximately 375 people in the work areas. Approximately 8 to 10 people work in the electroplating area per shift.

Plant Process-Conditions of Use: There are three automated electroplating processes in the area of the alleged hazard. Two processes involve zinc plating and one process is for nickel plating. Chemicals used in the processes include sodium cyanide, nitric acid, muriatic acid, phosphoric acid, boric acid, nickel sulfate, nickel chloride, sulfuric acid, chromates, soda ash, caustic soda, and selected activator, brighteners and metals. There are two or three workers at each of the three plating processes normally located at material work stations at one end of the U-shaped plating process. The workers rotate assignments, including one man being located above the tanks to monitor the processes and make minor adjustments, if necessary. One man is employed as a plater-doper to adjust the plating process solutions as required.

Plating tanks, where required, are individually ventilated across the top, with push-pull ventilation. The exhaust ventilation is downward and out.

The request was for cyanide evaluation, but a label from phosphoric acid was also included. Both chemicals are used only in the zinc plating process and in very small quantities.

Interviews were conducted with four of the workers. None expressed concern or problems relating to the process. One employee did indicate that fumes in the area can be more prominent on certain days.

Although some smoke and fumes were visible over the tanks, there was no apparent detectable odor or high concentration in the work areas. The buildings do not have additional ventilation besides that on the tanks, except for fresh air makeup.

B. Environmental Evaluation

Environmental samples were collected on February 13-14, 1973. Samples were collected for cyanide, hydrochloric acid, nitric acid (nitrate), zinc oxide and chromium. Both personal and area samples were collected using MSA Model G pumps. Samples for zinc oxide and chromium were collected on membrane filters for time periods 5-7 hours. Samples for nitric acid and cyanide were collected in 10 ml of 0.1 N NaOH in an impinger for time periods ranging from 70 to 120 minutes. Samples for hydrochloric acid were collected in 10 ml of 0.5 M NaAc in an impinger with sampling times similar to those for nitric acid and cyanide.

Samples for zinc and chromium were analyzed by atomic absorption. Samples for cyanide, nitrate and chloride were analyzed by ion specific electrode. Thirty samples were collected with fifty-two determinations performed.

The results for personal and area samples are summarized in Table I. Concentrations per sample for zinc ranged from a high of 0.0061 mg/M^3 to a low of 0.0012 mg/M^3, with an average for ten samples of 0.0024 mg/M^3. For chromium, the results ranged from a high of 0.0054 mg/M^3 to less than detectable, with an average detectable concentration of 0.0032 mg/M^3 for four samples. Samples for cyanide ranged from 0.0062 mg/M^3 to less than detectable, with an average concentration for seven samples of 0.0049 mg/M^3. Hydrochloric acid concentration ranged from 0.018 to 0.0073 mg/M^3, with an average of 0.0099 mg/M^3 for five samples. Samples collected and analyzed for nitrate (NO_3) ranged from 2.3 to 0.4 mg/M^3, with an average of 1.2 mg/M^3 for ten samples.

No employees expressed any symptomatic effects from the presence of air contaminants during the two days during which samples were collected.

The nickel plating line was not operating during the environmental survey. The company has plans to discontinue its use and convert it to zinc.

C. Summary and Conclusions

The maximum concentration value obtained, that for nitrate (NO_3), is less than 50% of the established standard for nitric acid, and all other substances appear at concentrations of 1% or less of the Federal standards. The equivalent exposure for the mixture of contaminants, which should not exceed unity (Federal Register, Part II, § 1910.93, Subpart (d)(2)(i)) is 0.25 for the mean concentrations and 0.48 for the maximum concentrations of each contaminant measured.

Employees did not express undue concern or symptomatic effects from working with the electroplating process, although one employee reported sporadic headaches and nasal irritation when working over the plating tanks to adjust or add solutions.

Based on the results of the employees interviews and environmental samples, it has been judged that the subject substances; cyanide, hydrogen chloride, nitric acid, zinc oxide fume, and chromium, are <u>not potentially toxic</u> at the concentrations found or used in the zinc electroplating process.

This does not preclude the fact that there may be occasional periods when air concentrations in the electroplating area may be sufficient

to produce irritation.

V. RECOMMENDATIONS

1. The addition of overhead exhaust ventilation should be considered to eliminate concentrations of contaminants from accumulating in the air above the electroplating tanks and from being carried over into adjacent work areas.

2. Efforts should be made to avoid cross draft ventilation over the electroplating tanks from such things as open windows or fans that can greatly reduce the efficiency of the existing push-pull tank ventilation system.

3. The use of a respirator approved for use in an atmosphere containing the contaminants used in the electroplating process should be considered for employees such as the plater-doper when they are working directly over the plating solutions.

IV. REFERENCES

1. Documentation of the Threshold Limit Lavues for Substances in Workroom Air. American Conference of Governmental Industrial Hygienists, 3rd. ed., 1971, page 64.

2. Occupational Diseases - A Guide to Their Recognition, U. S. Department of Health, Education, and Welfare, Public Health Service Publication No. 1097, 1964, page 159.

3. Ibid - Occupational Diseases, page 188.

4. Ibid - Occupational Diseases, page 239

5. TLV Document, Reference 1 above, page 56.

TABLE I

SUMMARY OF RESULTS OF ENVIRONMENTAL SAMPLES COLLECTED AT THE PEERLESS WIRE GOODS COMPANY

Sample #	Location	Type of Sample	Sampling Time (minutes)	Atmospheric Concentrations-mg/M^3* of Sampled Air				
				Zinc	Chromium	Cyanide	Nitric Acid	Hydrochloric Acid
3	No.1 Zinc Line	General Area	410	0.0015	N.D.**			
10	"	"	310	0.0015	N.D.			
D	"	"	120			0.0052	1.6	
1	"	Personal	412	0.0036	0.0036			
2	"	"	409	0.0061	0.0024			
7	"	"	310	0.0026	N.D.			
8	"	"	315	0.0024	N.D.			
A	"	"	120			0.0062		
E	"	"	120			0.0044	1.2	
G	"	"	120					0.0073
J	"	"	120			0.0050	0.4	
L	"	"	120					0.0088
Q	"	"	70			N.D.	0.9	
R	"	"	70					0.0180
4	No.2 Zinc Line	General Area	400	0.0012	0.0012			
11	"	"	310	0.0016	N.D.			
C	"	"	120			0.0038		
5	"	Personal	407	0.0015	N.D.			
B	"	"	120			0.0016		
H	"	"	120					0.0073
I	"	"	120			0.0057	1.4	
K	"	"	120					0.0080
O	"	"	80		N.D.	1.3		
P	"	"	75			N.D.	0.9	
6	Plater-Doper	Personal	386	0.0026	0.0054			
F	"	"	120			0.0040	0.7	
M	"	"	71			N.D.	2.3	
N	"	"	92			N.D.	1.2	

* mg/M^3 - Milligrams of substance per cubic meter of sampled air

** N.D. - not detected in the sample: Sensitivity of Analytical Methods for those substances
Cyanide - 0.0039 mg/sample
Chromium - 0.0010 mg/sample