PRELIMINARY INDUSTRIAL HYGIENE SURVEY OF

Ohio Valley Graphic Arts
Cincinnati, Ohio

SURVEY DATE:

November 20, 1973

SURVEY CONDUCTED AND REPORT WRITTEN BY:

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16. Abstract (Limit: 200 words)

Worker exposures to chromic-acid ( ) (CrO3) were surveyed at Ohio Valley Graphic Arts (SIC-3471) in Cincinnati, Ohio, on November 20, 1973. No preemployment or periodic physical examinations were required. Serious injuries were treated at the local hospital. Production employees were given safety glasses and gloves. Air samples to measure chromic-acid exposures, chemical wipe samples to detect hexavalent chromium (7440473) (CrVI) and ventilation measurements were taken. The OSHA 8-hour time weighted standard for CrO3 is 0.1 milligram per cubic meter (mg/cu m). Concentrations of CrVI ranged from 0.0091 to 0.4825mg/cu m and CrO3 concentrations ranged from 0.0174 to 0.9264mg/cu m. Ventilation rates ranged from 500 to 1000 feet per minute. The author recommends implementation of appropriate safety, hygiene and medical programs.

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PLACE VISITED:	Ohio Valley Graphic Arts Cincinnati, Ohio
DATE OF VISIT:	November 20, 1973
PERSON CONTACTED:	Mr. Fredrick Zinnbauer
PURPOSE OF VISIT:	To become familiar with chrome plating operations and to perform preliminary sampling for airborne chromic acid (chromium trioxide)

INTRODUCTION

The Division of Field Studies and Clinical Investigations of the National Institute for Occupational Safety and Health (NIOSH) has underway an environmental and medical study of worker exposure to chromic acid (chromium trioxide - CrO_3). Exposures to chromic acid have been documented in the past as a cause of damage to the mucus epithelium in man; however, recent data have not been compiled that adequately substantiate the actual levels of exposure that cause the noted biological effects.

This survey was initiated for the purposes of becoming familiar with chrome plating operations and for obtaining preliminary environmental air measurements so that work environments with CrO_3 exposure levels less than 0.05 mg/m^3* and 0.10 mg/m^3** could be identified for more detailed industrial hygiene and medical surveys.

During the survey a total of ten air samples, both personal and general area were taken for evaluation of CrO_3. In addition, wipe samples were collected from various surfaces in the work environment and tested for hexavalent chromium (Cr VI). Ventilation measurements also were made in appropriate areas.

DESCRIPTION OF PLANT

General

The major operation at this plant is what is known in the trade as hard chrome plating. This differs from decorative chrome plating in that

* 8-hour time weighted average as recommended in "Criteria for a Recommended Standard--Occupational Exposure to Chromic Acid", USDHEW, Public Health Service, National Institute for Occupational Safety and Health,1973.

** 8-hour time weighted average as promulgated by the Occupational Safety and Health Administration (CFR Part 1910, October 18, 1972).

the plated pieces receive a greater deposit of chrome. This usually is achieved by increasing plating time from the 5-10 minutes utilized in decorative chrome plating to 8-16 hours.

The major production operation at this plant is electroplating of printing rollers for the lithographic industry. The production area consists of one large room housing four chrome plating tanks and a assembly table. (Figure 1) All plating tanks are equipped with a local slot exhaust ventilation. Located beneath the two larger plating tanks is a holding tank which captures all run off of chrome from the plating tanks and plated pieces. The holding tanks are periodically neutralized with soda ash before being flushed into the sewage system.

Description of Operation

The chrome plating tanks are made of steel and lined with a non-corrosive material called Korseal. The plating operation requires a technical grade chromium trioxide acid in concentrations of 33 to 35 ounces per gallon of solution. Operation temperatures range from 110 to 130°F. The electrical current needed for each tank ranges from 4-7 volts and 100 to 1500 amps, depending on the amount of roller surface area being plated. The greater the surface area, the higher the amperage and voltage. Periodic tests of the solutions are made to determine the chromic acid concentration. Concentration determinations are made by either titration or specific gravity.

The non-plated rollers, as received at the plant, are taken to the assembly table where they are unpacked and prepared for plating. The rollers are wiped clean and those portions of the rollers which will not be plated are either masked with tape or coated with lacquer. A suitable

hook is fixed to one end of the roller for attachment to the cathode of one of the tanks. The size of the rollers dictates into which tank they are placed. The larger rollers (2 ft. x 8 ft.) are conveyed to the tanks by an overhead hoist while the smaller rollers are individually carried by hand to the tanks. The rollers are vertically submerged into the tanks and attached to a cathode rod which spans across the top of the tank. An employee usually positions himself next to the side of the tank and guides the piece into the solution. This procedure of submerging the roller takes approximately five to ten minutes. After the roller has been submerged, a sufficient quantity of a mist inhibitor is added to the chromic acid solution until a uniform blanket of foam is formed across the surface.

The desired thickness of chrome is usually dictated by the length of time in the tank. Once the roller has obtained this thickness, an employee will remove the roller and let it hang over the tank so the run off will spill back into the tank. While the roller is suspended over the tank, it is rinsed lightly with water. The roller is then removed from over the plating tank and suspended over the holding tank. Here it is rinsed thoroughly with water and the run off is captured in the holding tank below. This procedure of removing and rinsing the roller usually takes ten to fifteen minutes. The roller is suspended over the holding tank until dry. Once dried, the roller is taken back over to the assembly table and the tape or lacquer is removed. In the removal of lacquer, methyl ethyl ketone is used.

At the plant, small quantities of Flash Chroming also are performed. The procedure of masking, dipping, and rinsing is like that of the hard chrome operation. The only difference being the plating time, which is usually less than 15 minutes.

Ventilation

All four plating tanks are equipped with an individual exhaust system, including local slot ventilation. The local exhaust is attached to the periphery of the tank on two opposite sides. The slot opening is three inches in height and the length is the same as the side dimension of the tank. The exhausted air from each ventilation system is expelled directly out the building's roof. The slot ventilators are illustrated in Figure 1.

Medical, Safety and Housekeeping Programs

Pre-employment and periodic physicals are not required for employment. If a serious injury occurs, a local hospital is notified; otherwise, all other minor first aid is performed at the facility. All of the production employees are furnished safety glasses and gloves; however, gloves are used only during the dipping and rinsing portion of the process. It was noted that those employees wearing gloves did not remove or store gloves properly. Personal clothing is worn on the job and it did appear that a change of clothing was made before departure from the facility. Eating, drinking and smoking was a common practice in all work areas. Lunch breaks were usually confined to the offices in the facility. The floors were generally kept clean of debris and all chromic acid spills were rinsed into the holding tank.

SURVEY PROCEDURES

Ten air samples were collected for determining exposures to chromic acid. Of these ten samples, three were personal samples collected in the breathing zone of two workers. The remaining seven were stationary (general area) samples collected at various areas of the work environment. All samples were collected on 5.0 micron polyvinyl chloride (PVC) filters using a vacuum pump which was operated at a flow rate of 2.0 liters of air per minute.

During this same period of time, a chemical wipe sample was obtained to detect the presence of Cr VI on various surfaces within the plant. This test was adopted from the method of Feigl[1]. Prior to the field survey, a one percent solution of diphenylcarbazide (DPC) in ethyl alcohol was prepared and stored in a semi-opaque brown bottle to prevent photo-decomposition. The test was performed by emmersing a cotton swab in a solution of 1.0 N sulfuric acid and then rubbing the cotton swab vigorously on the surface to be tested. One or two drops of the one percent DPC solution was then placed on the cotton. In the presence of Cr VI, a violet to red color is formed. The cotton swabs were discarded after each test. Work tables, racks, parts, gloves (inside and out) and workers' finger tips were tested for the presence of Cr VI in both areas of known exposure and areas considered to be without chromic acid (e.g., eating areas, offices, rest rooms, etc.).

Ventilation measurements were taken at the plating tank slot hoods with a Alnor velometer. A pitot probe was used with the velometer for measurements of face velocities.

RESULTS OF SURVEY

All ten air samples (both personal and general area) were analyzed for Cr VI using the colorimetric method of Abell and Carlberg[2]. This method involves the washing of the sampled PVC filter to remove the Cr VI and adding s diphenylcarbazide to the wash for the colorimetric determination by a spectrophotometer. Using this method, the samples are reported as µg Cr VI per filter. For comparison to the NIOSH recommended health standard, the results, in µg Cr VI per filter, were multiplied by 1.92 (the gravimetric factor relating CrO_3 to Cr) to obtain µg CrO_3.

Of the ten samples, only two appeared to be above the OSHA 8-hour time weighted standard of 0.1 mg/m^3. There is some question regarding how representative these two samples are of 8-hour time weighted employee exposures. These two particular samples were collected between tanks No. 1 and No. 2 and fairly close to the floor. The remaining eight personal and general samples revealed levels below that of 0.1 mg/m^3. The personal samples should represent 8-hour time weighted average exposures. Sample results and corresponding sample locations are presented in Table 1.

The DCP spot test results obtained on the assembly work table showed positive indications of Cr VI. The rubber gloves (inside and out), the hang racks, and the finger tips of the workers also showed the presence of Cr VI. Other areas of the plant (e.g., offices and restrooms) also were tested. It was found that the surface of the tables in the offices were all positive. In the restroom, the counter surfaces and faucet handles on the sinks showed a weakly positive reaction. The results of the ventilation measurements on the slot hoods of the plating tanks are presented in Table 2.

DISCUSSION

As a result of these current studies being made in chrome plating industries, there is an indication that good industrial practices and personal hygiene care is needed to prevent the development of nasal lesions. Even with ambient levels of chromic acid below that of 0.05 mg/m^3, there is a possibility of physical transfer of chromic acid from the work surfaces to the nasal tissues.

Since there is a need to advance the knowledge of whether the NIOSH recommended health standard of 0.05 mg/m^3 is in fact a "safe" level, and since personal exposures on an 8-hour time weighted average basis appear to be in this range in this plant, more comprehensive industrial hygiene and companion medical studies will be conducted in this plant. These more comprehensive surveys will then be utilized to substantiate or refute the above stated recommended standard and to assist the plant in realizing any controls and work practices that may be needed to improve the plants work environment.

Prior to obtaining the results of this comprehensive study, plant management should understand and implement the present requirements of the OSHA regulations for workers exposed to chromic acid[3], including development and utilization of appropriate safety, industrial hygiene and medical programs. It is recommended that you refer to the NIOSH standards for medical, labeling, personal protective equipment and clothing, informing the employee and work procedures[4].

Table 1

AIR SAMPLE RESULTS

Ohio Valley Graphic Arts
Cincinnati, Ohio
November 20, 1973

Location	Sample Number	Volume of air sampled Liters/Minute	Cr(VI) µg	CrO_3 µg	Concentration mg/m^3 Cr(VI)	Concentration mg/m^3 CrO_3
Personal Sample Plating Area	1.	48	0.85	1.63	.0177	.034
Personal Sample Plating Area	2	42	0.64	1.229	.0152	.0292
General Area Sample 2 tank-4 ft. from tank, 4 ft. high	3	92	2.39	4.589	.0252	.0498
General Area Sample 1 tank-4 ft. from tank, 4 ft. high	4	198	6.27	12.038	.0317	.0608
General Area Sample on work assembly table	5	368	11.63	22.33	.0316	.0607
General Area Sample same area as 3 sample	6	318	7.00	13.44	.022	.0423
General Area Sample 3 & 4 tanks- 4 ft. from tanks, 6 ft. high	7	314	2.85	5.47	.0091	.0174
General Area Sample between 1 & 2 tanks 2 ft. from tank, 2 ft. high	8	292	93.9	180.29	.3216	.6174
Personal Sample 2 tank only	9	48	1.13	2.169	.0235	.0452
General Area Sample same area as 8	10	40	19.3	37.056	.4825	.9264

Table 2

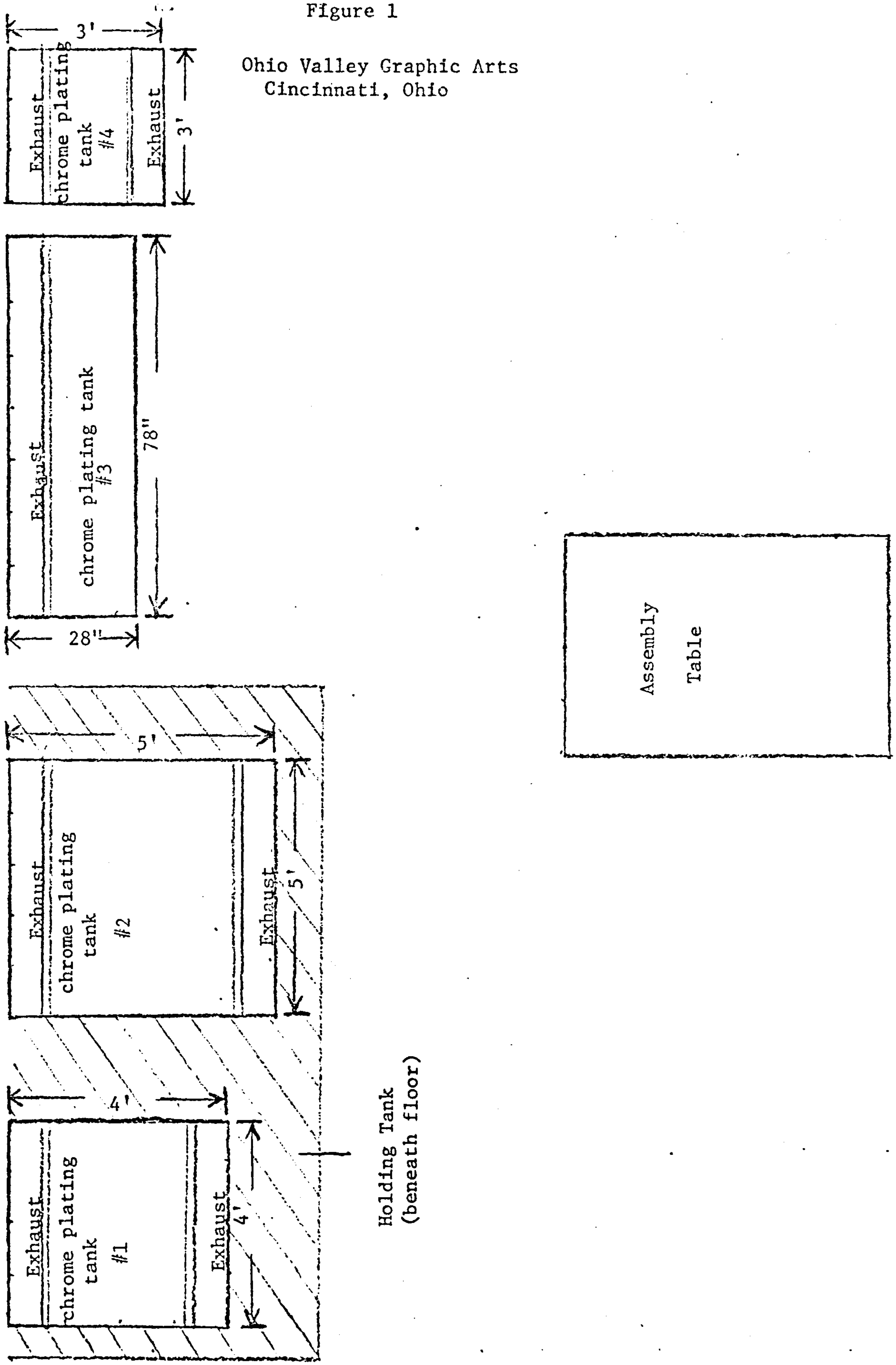
VENTIALTION MEASUREMENTS

Ohio Valley Graphic Arts
Cincinnati, Ohio
November 20, 1973

Location	Face Velocities Ft./Min.
Tank No. 1	500-900
Tank No. 2	500-900
Tank No. 3	900-1000
Tank No. 4	600-700

Figure 1

Ohio Valley Graphic Arts
Cincinnati, Ohio



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2. Abnell, M. T. and Carlberg, J.R., A Sample Reliable Method for the Determination of Airborne Hexavalent Chromium, American Industrial Hygiene Association Journal (In Press).

3. Federal Register, 29 CFR Part 1910.94 (d)(9)(VII) and (VIII) October 18, 1972.

4. NIOSH, U.S. Department of H.E.W., 1973 "Occupational Exposure to Chromic Acid" Criteria for a Recommended Standard.