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. 76-87-379

HERCULES, INC., GLENS FALLS PLANT
GLENS FALLS, NEW YORK

APRIL 1977

I. TOXICITY DETERMINATION

The following determinations have been made based on environmental air samples collected on October 4-6, 1976, confidential employee interviews, review of medical records, evaluation of ventilation systems, evaluation of work procedures, and available toxicity information.

The major focus of this investigation was on employee exposure to hexavalent chromium, but potential exposure to inorganic lead is a concern which should not be overlooked. Thus analyses were conducted for both elements. Employee exposures to these substances in certain areas of the chromate producation facility did constitute a potential health hazard at the time of the survey.

Seven employees were exposed to atmospheric levels of hexavalent chromium (Cr(VI)) exceeding the current NIOSH recommended ceiling standard of 1 microgram of Cr(VI) per cubic meter of air (ug(Cr(VI))/M^3). The employees - a grinder-hopperman, two grindermen, an independent bagger, drum drier operator/bagger, color loader, and a color dumper - were exposed to concentrations of 7.5, 10.7, 10.7, 11.7, 11.8, 45.1, and 98.2 ug(Cr(VI))/M^3, respectively.

Exposures to certain chromium (VI) materials, such as lead chromate, are now associated with the production of respiratory cancer[3,4,6]. Human contact with lead chromate should be kept to a minimum using appropriate local exhaust ventilation and good housekeeping. Areas in which lead chromates are handled should be designated with the warning - "Cancer Suspect Agent" - and all containers marked in a similar manner. Until engineering controls can be modified, employees should be equipped with respiratory protection.

Three employees - a color loader, color dumper, and a blenderman-dumper - were exposed to atmospheric levels of inorganic lead exceeding the current NIOSH recommended and proposed OSHA standards for lead - 150 ug(Pb)/M^3 (NIOSH) and 100 ug(Pb)/M^3 (OSHA). The three employees were exposed to concentrations of 200, 160, and 200 ug(Pb)/M^3, respectively.

No personal samples exceeded current OSHA standards for either hexavalent chromium or inorganic lead.

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) Hercules, Inc., Glens Falls, New York
b) Authorized Representative of Employees - United Steelworkers of America, Local 12962, Glens Falls, N. Y.
c) U.S. Department of Labor - Region II
d) NIOSH - Region II
e) United Steelworkers of America - Safety and Health Department, Pittsburgh, Pennsylvania

For the purpose of informing the approximately 80 "affected employees" the employer shall promptly "post" for a period of 30 calendar days the Determination Report in a prominent place(s) near where exposed employees work.

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 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 (industrial hygienist -USWA) regarding worker exposure to chromate pigments. The request originated after preliminary results from a Dry Color Manufacturer's Association-sponsored study showed a higher than expected incidence of lung cancer mortality among chromate pigment producers. This plant employed United Steelworkers of America members and was not included in the epidemiologic study.

IV. HEALTH HAZARD EVALUATION

A. Conditions of Use

Chrome Yellows (Lead Chromate)/Chrome Green (Lead Chromate/Iron Blue)

The chromate pigment production begins in the "Tank Rooms". Solutions of lead acetate, lead nitrate, and lead carbonate are metered into large vessels of several thousand gallon capacity from outside storage tanks. Stock solutions of sodium chromate or bichromate are metered into these "strike tanks", also, and the formation of the pigments begins. Various other chemicals of smaller quantity are added by "color builders" who also monitor factors such as temperature and pH of the mixture. The pigment, a slurry containing insoluble lead chromate is drawn off into the filter press area below the tank room. The slurry is pumped through "press plates" which remove much of the aqueous solution from the pigment precipitate. Tools are used to scrape off pigment from the cloth covered plates into a long box.

The wet pigment in the long box is further processed by one of three methods

(1) The material is transported and emptied into an enclosed system containing a spray drier and bagging unit.

(2) Drum dry method.

(3) Tray dry method

In the drum dried method, the wet pigment is dumped into a unit which conveys the pigment on a wire screen over steam heated drums. The dry pigment is then moved on a conveyor to a grinding hopper and bagging unit. One employee oversees the drum drier and also bags the pigment.

In the tray dried method, a "color loader" will pack wet pigment with a trowel or shovel into shallow trays. A large quantity of trays are placed on a mobile rack, which is moved to a small oven. Heated to temperatures of 160-180^{o}F for 24 to 36 hours, the pigment (with less than 1% moisture) is then removed from the individual trays and dumped into a large mobile bin by a "color dumper". The mobile bin is transported to a hammer mill grinder location. "Grinder-hoppermen" invert the bin into a hopper and after passing through the grinder, the pigment falls into drums. "Grindermen" fill and cover the drums and move them out of the way on a roller system. Most drums are transported to nearby hoppers, into which "bagger-hoppermen" invert the drums to allow pigment to fall into the bagging unit. "Baggers" must affix bags to automatic units which fill bags with a predetermined amount of pigment. Occasionally, though, the bagger must manually add or subtract pigment from the bag with a scoop when the unit works improperly. All of the Chrome Green pigment is processed by the latter method, i.e., filter pressed, tray dried, ground (and blended if necessary) and packaged.

B. Evaluation Methods

1. Environmental

Exposures to chromium (VI) in lead chromate can be related to either an 8-hour TWA concentration (1976 TLV) or an acceptable ceiling concentration (recommended by NIOSH and enforced by OSHA).

Time-weighted averages (TWA) permit excursions above the limit provided they are compensated by equivalent excursions below the limit during the workday.

The ceiling limit places a definite boundry which concentrations should not be permitted to exceed.

a. 8-hour TWA Exposures

Atmospheric samples for chromium (VI) were collected on Millipore* Type AA filters with 0.8 micron pore size. The filters were encased in plastic three-piece field monitor cassettes with face caps on and small plugs removed. The personal samples were taken in the employee's breathing zone using battery-powered Mine Safety Appliance* (MSA) gravimetric pumps operating at a flow rate of 2 liters per minute (lpm), as recommended by the NIOSH publication "Criteria for a Recommended Standard...Occupational Exposure to Chromium (VI).[1] The pumps and samples were worn by the employees for as much of an 8-hour period as was possible.

b. Acceptable Ceiling Concentrations

It must be pointed out that some of the samples collected to assess ceiling concentrations were designated as "area" versus "personal". These air samples were collected (1) as close to the breathing zone of the employee as possible by following the worker about his work area, (2) clipping the collection media near the breathing zone, or (3) by positioning the collection media near the work location.

These methods were used on the basis of the recommendation in the NIOSH Criteria Document for a low acceptable exposure level (1 ug/M^3). In order to collect sufficient particulate matter for reliable analysis, an air pump capable of drawing a large column of air through a Millipore AA filter was employed - a Gast Pump, Model 1531. Air was drawn through the pump at a flow rate of 9 liters per minute, accomplished by maintaining a critical orifice in the sampling line. The size and weight of the pump made actual attachment of the pump to the employee unfeasible.

The samples were analyzed for total chromium (only chromium (VI) was present) and inorganic lead. The samples were treated in an ashing method and analyzed by atomic absorption spectrophotometry. The limit of detection was five micrograms (ug) per filter for both chromium (VI) and lead.

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

2. Medical

During the initial survey on August 3-4, 1976, (15) employees representing the areas of concern were interviewed with regard to their work history, medical history and symptomatology associated with the work environment. The interviews were conducted in a non-directed manner.

During the follow-up survey of October 4-6, 1976, all current employee medical files maintained by the company were reviewed (of those working in the chromate-production areas).

C. Evaluation Criteria

1. Toxic Effects

Chromium (VI)

"Chromate pigments" manufactured during the survey were basically lead chromates with or without other chemicals added to modify the color. The chromium ion in lead chromates is in the (VI) oxidation state or commonly termed hexavalent. Hexavalent chromium compounds have been known since the early 1800's to cause ulceration and perforation of the nasal septum and inflammation of the mucous membranes through inhalation. "Chrome holes", which are penetrating sores of the skin, result after contact of hexavalent chromium with the cutaneous layer of skin. Common sites include the backs of hands, forearms, skin folds over the knuckles, and the nail root areas. The NIOSH Criteria Document on Chromium (VI) reports that the literature has linked exposure to hexavalent chromium to other disorders, such as kidney and liver damage, tooth erosion and discoloration, and perforated eardrums. NIOSH, though, said "...it seems reasonable that sufficient contact with any chromium (VI) material could cause these effects."[1]

Approximately 30 years ago, the first study in the United States which showed a high incidence of lung cancer from the alkaline roasting and roast leaching operations was conducted by Machle and Gregorius[2]. However, there have been few reports of cancer associated with exposure to chromate pigments.

Recently published reports by Langard and Norseth[3], and Maltoni[4] prompted the Dry Color Manufacturer's Association (DCMA) in 1975 to sponsor a study of three lead and zinc chromate pigment producing plants including epidemiological and industrial hygiene studies.[5] The former report referred to a small Norwegian plant in which a high incidence of bronchial carcinoma was found. Employees there produced predominantly zinc chromate pigments but for a few years produced lead chromate pigment. Three cases of cancer were found among four workers with greater than three years experience.

In July, 1976, the DCMA-sponsored study was published and showed a three-fold excess of respiratory cancer for all employees in two of the plants producing only lead chromates.[6] Statistical tests were not used in the data analysis due to the small sample size. However, the hypotheses that lead chromate should be regarded as a human carcinogen was upheld, and is in agreement with NIOSH's position.

Based on current evidence, NIOSH has defined "non-carcinogenic chromium (VI)" to be the chromium (VI) in monochromates and dichromates (bichromates) of hydrogen, lithium, sodium, potassium, rubidium, cesium, ammonium, and chromium (VI) oxide.

"Carcinogenic chromium (VI)" comprises any chromium (VI) material not included in the group above, such as lead, zinc, and calcium chromates.

Inorganic Lead

Lead poisoning may occur through the inhalation and/or ingestion of lead fumes or dust. This results in the deposition of lead in the bones and tissues of the body and alterations in normal physiological functions.

No single sign or symptom may be considered diagnostic of lead poisoning. Lead poisoning may present such symptoms as a metallic taste in the mouth, loss of appetite, indigestion, nausea, vomiting, constipation, abdominal cramps, nervousness, and insomnia. Nephropathy is another effect of lead poisoning. A progressive or irreversible loss of kidney function may result. Children have developed renal dwarfism and hypertension after chronic exposure.

Many of the sources of lead poisoning are industrial, but man also absorbs lead in small amounts not normally leading to poisoning from his food and water, and from the air. These sources lead to the "normal" body burden of lead. Goldwater and Hoover have reported a worldwide blood lead mean of 17 micrograms of lead per 100 milliliters of whole blood (ug/100 ml). Thus, the lead absorbed in the course of occupational exposure is superimposed on lead absorbed from other sources. Lead poisoning is preceded by a stage of lead absorption, but lead absorption is not always followed by lead poisoning.

2. Environmental 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-hour per week basis over a normal working lifetime. For this investigation, the criteria used to assess the degree of health hazards to workers were selected from three sources:

a. NIOSH: Criteria for a Recommended Standard...Occupational Exposure to Chromium (VI), 1976, and Inorganic Lead, 1972.

b. Threshold Limit Value (TLV): Guide lines for airborne exposures recommended by the American Conference of Governmental Industrial Hygienists (ACGIH) for 1976.

c. OSHA Standard: The air contaminant standards for chromates (chromium (VI)) and inorganic lead enforced by the U.S. Department of Labor as found in the Federal Register - 29 CFR 1910.1000(b) (Table Z-2).

d. OSHA Proposed Standard for Inorganic Lead

Source	Substance	8-hour Time Weighted Average Concentration (TWA)	Acceptable Ceiling Concentration**
NIOSH Criteria Document	Carcinogenic Chromium(VI) Inorganic Lead	 150 ug/M^3*	1 ug/M^3
1976 TLV	Chromates (Cr(VI)) Inorganic Lead	100 ug/M^3 150 ug/M^3	 450 ug/M^3
OSHA Standard -Current	Chromates Inorganic Lead	 200 ug/M^3	100 ug/M^3
OSHA Standard -proposed (1975)	Inorganic Lead	100 ug/M^3	

* - micrograms of substance per cubic meter of air; (1 ug = 0.001 milligrams)
** - this value should never be exceeded during an 8-hour period; it is commonly measured in a 15-minute sampling period.

D. Evaluation Results and Discussion

1. Environmental

A. Color Building/Filter Pressing

One personal and three area samples each were collected on a color builder and a pressman. One personal sample also was collected on another color builder. All samples were below evaluation criteria for chromium (VI) and inorganic lead (Table 1). No health hazard to employees is considered from atmospheric chromate dust or mist here.

B. Color Loading

Besides one personal 8-hour sample, three ceiling samples were also collected on one color loader. The personal 8-hour samples (45.1 ug/M^3* for chromium (VI) and 200 ug/M^3 for lead) both exceeded the recommended NIOSH criteria of 1 ug/M^3 and 150 ug/M^3 for chromium (VI) and lead, respectively. Two of three ceiling samples exceeded the NIOSH recommended chromium (VI) standard (Table 1A).

* micrograms of substance per cubic meter of air.

Two ceiling samples for inorganic lead (480 and 530 ug/M^3) collected on a color loader exceeded the short term exposure limit (stel) of 450 ug/M^3 for lead as recommended by the ACGIH. This latter value should not be exceeded in any 15-minute sampling period.

It would not be expected that significant atmospheric levels of chromium (VI) or lead would be found here. The employees handle wet pigment from the filter presses and dust should not become airborne readily. However, dust may accumulate on bins or on other objects after wet pigment has dried, and then become airborne. Local exhaust ventilation should be instituted at places where wet pigment is loaded from bins onto the drying trays. Capture velocities of 100-200 fpm may be desirable to control the spread of dried pigment. Housekeeping should be improved to eliminate dust buildup on objects.

C. Color Dumping

Two personal samples collected on the color dumper exceeded the NIOSH recommended standard for chromium (VI). These personal samples also exceeded evaluation criteria for inorganic lead. One sample (160 ug/M^3) exceeded the NIOSH recommended 8-hour standard for lead (150 ug/M^3) and the other (1270 ug/M^3) exceeded the short term exposure limit (stel) of 450 ug/M^3 as recommended by the ACGIH. (Table 1B).

Ventilation measurements were taken at the bin where the dried pigment is transferred to the conveying box. An average of 100 feet per minute (fpm) was recorded at the face of the bin. Capture velocities of 200-500 fpm may be necessary for this material transfer.

D. Grinder - Hoppers

The personal sample results of two grinder-hoppermen indicate one concentration (7.5 ug/M^3) exceeded the NIOSH recommended standard of 1 ug/M^3 for chromium (VI). All six area samples collected nearby the two workers were below the analytical limit of detection. Lead concentrations were below evaluation criteria in both personal and area samples (Table 1C).

Local exhaust ventilation is maintained in the grinder-hoppers to control the dust spread when pigment boxes are overturned. Face velocities were measured at five hoppers, and each averaged approximately 100 fpm. Examples of bin and hopper ventilation are illustrated in Figure 1. It was observed that these employees spent only approximately 20 percent of the time near the hoppers.

E. Grinders

Two personal samples (each 10.7 ug/M^3) of grindermen (at grinders #1 and #6) exceeded the NIOSH recommended standard of 1 ug/M^3 for chromium (VI) (Table 1C). All five area samples, collected close to the work stations were below the analytical limit of detection. All personal and area samples for inorganic lead were below evaluation criteria.

Pigment dust spread is controlled by allowing the ground pigment to fall from the grinders through a long cloth sleeve into the receiving drum. A lateral exhaust slot is maintained to collect dust rising from the drum before it can reach the employees' breathing zone. Slot velocities at Grinders #1 and #6 averaged 230 fpm and 260 fpm, respectively.

Capture velocities of up to 500 fpm may be necessary for barrel filling. Examples of barrel filling operations are illustrated in Figure 2. These designs attempt to enclose the operation as much as possible. Employees spend approximately 80 percent of workday near the bag-filling operation.

F. Forklift Operator - Grinder Floor

The forklift operator was monitored due to the potential exposure to chromate pigment dust from transfer of the material around the grinder floor. One personal sample collected on the operator was below evaluation criteria for chromium (VI) and inorganic lead (Table 1C).

G. Bagger-Hoppers

One personal and three area samples were collected on one bagger-hopperman. All atmospheric concentrations were below the evaluation criteria for chromium (VI) and inorganic lead. The area samples were collected close to the employee's breathing zone during the sampling period. (Table 1D).

Ventilation measurements were taken at the bagger-hoppers. For units #1-#4, the average face velocities ranged from approximately 100-125 fpm.

The air release from the barrel conveyor system braking mechanism may be a source of chromium (VI) exposure. Since the air release is directed towards the floor below the bagger-hoppers, settled dust may become airborne again. The air should be released in a more desirable location and housekeeping improved near the bagger-hoppers. These employees spend most of their work time near the hoppers.

H. Independent Bagging Units

Two baggermen were monitored during the survey, and one personal and three area samples were collected on each. One personal sample (11.7 ug/M^3) exceeded the NIOSH recommended standard of 1 ug/M^3 for chromium (VI). All other personal and area samples were below evaluation criteria for chromium (VI) and inorganic lead. The area samples were taken close to the employee's work area during the sampling period (Table 1D).

Ventilation measurements were taken at the automatic bagging units. Exhaust slots were positioned near where supplementary pigment was added to the bag. The average slot velocity at the bagging unit (#7) where the chromium (VI) overexposure occurred was approximately 330 fpm, whereas the average slot velocity at the bagging unit (#4) not causing an overexposure was higher, approximately 600 fpm. This would indicate that the ventilation should be increased at unit #7 to decrease employee exposure.

The bag filling operation could be modified to minimize employee exposure to chromate pigment dust. A design such as is illustrated in Figure 3 could be used with a weight scale underneath the bag. After the bag is filled to approximately the desired weight, the operator could manually control the addition of small amounts of the material through the bagging unit until the desired weight is attained. Employees spend most of their work time near the bagging units unless a unit breaks down.

I. Drum Drying/Bagging

One personal and three area samples were collected on the drum dryer/bagger. The personal sample (11.8 ug/M^3) and the area sample judged to be the closest of the three area samples to a personal exposure (44.8 ug/M^3) both exceeded the NIOSH recommended standard of 1 ug/M^3 for chromium (VI).*

The two other area samples, one of which (52.2 ug/M^3) exceeded the NIOSH recommended standard, might have been higher if the employee had not left the drum drier area so often (Table 1D). This employee claims he spends about 40% of a working day in bagging procedures.

Evaluation criteria for inorganic lead were not exceeded.

Piles of chromate pigment were observed on ledges of one drum drying unit indicating leaks in the unit.

Ventilation measurements were taken at the local exhaust slot for the drum drier bagging unit in use. The average slot velocity for unit #2 was approximately 650 fpm. The actual velocity at the point of dust evolution may not be sufficient in controlling employee exposure to the chromate dust. Recommended bag filling designs for independent bagging units could be considered here.

J. Blending

One personal and one area sample for chromium (VI) were collected on the blenderman-loaders. Both personal samples were negative, and the area sample (41.1 ug/M^3) was not representative of a personal sample.

One personal sample was collected on a blenderman-dumper, and one personal and three area samples were collected on a second blenderman-dumper. All samples were below the NIOSH recommended standard for chromium (VI). (Table 1B). One personal sample (200 ug/M^3) exceeded the recommended NIOSH standard of 150 ug/M^3 for lead for an 8-hour workday. All other atmospheric samples for lead were within acceptable levels. Ventilation measurements were taken at the hoppers leading into the blending vessel. Hoppers #3-6 had average face velocities of 150, 175, 175, 160 fpm, respectively.

Ventilation measurements were also recorded at the receiving drum, at about the the blenderman's position. Capture velocities averaged 100 fpm here. Recommended barrel filling operations could be considered here.

*This area sample was taken during a period when the employee performed bagging duties.

2. Medical

An epidemiologic study done recently, as well as the NIOSH criteria document on chromium (VI), suggests that exposure to said compounds may lead to a higher than usual incidence of respiratory cancer. The data in these documents prompted the submission of a health hazard evaluation from the union (United Steelworkers) at Hercules, Inc., Glens Falls, New York.

A member of the NIOSH Hazard Evaluations and Technical Assistance Branch, Medical Section accompanied an industrial hygiene team to the Glens Falls facility on October 4-6, 1976. The purpose of this part of the visit was to evaluate medical and other company records to ascertain whether or not they would be useful in establishing the presence of an excess cancer problem.

One hundred and fifty medical records were reviewed and pertinent findings noted. The record review established that Hercules provides physical examinations for the workers based on age. Those workers from 18-25 years of age receive the exams once every three years, those 26-35 years of age once every two years and those over 35 once a year. Physicals are offered to retired employees once a year, chest x-rays are offered to those employees who work in the bichromate areas once a year. Pre-employment examination and termination evaluation are also provided. No reports/records of cancer or other significant diseases were discovered by this search.

The union representatives were unable to provide names of any employees who had died recently and employee health information was not available through other sources. It is apparent from the information available at the time of this evaluation that it is impossible to ascertain the incidence of cancer at Hercules and therefore to state whether or not it is a problem.

3. Conclusions

Seven employees were exposed to atmospheric levels of hexavalent chromium (Cr(VI)) exceeding the current NIOSH recommended ceiling standard of 1 microgram of Cr(VI) per cubic meter of air (ug(Cr(VI))/M^3). The employees - a grinder-hopperman, two grindermen, an independent bagger, drum drier operator/bagger, color loader, and a color dumper - were exposed to concentrations of 7.5, 10.7, 10.7, 11.7, 11.8, 45.1, and 98.2 ug(Cr(VI))/M^3, respectively.

Three employees - a color loader, color dumper, and a blenderman-dumper - were exposed to atmospheric levels of inorganic lead exceeding the current NIOSH recommended and proposed OSHA standards for lead - 150 ug(Pb)/M^3 (NIOSH) and 100 ug(Pb)/M^3 (OSHA). The three employees were exposed to concentrations of 200, 160, and 200 ug(Pb)/M^3, respectively.

No personal samples exceeded current OSHA standards for either hexavalent chromium or inorganic lead.

A typical workday at the Hercules facility in the handling of lead chromate pigments is difficult to define. Besides handling these materials, employees come into contact with other materials, such as organic pigments. Thus the amount of lead chromate pigments handled may vary from day to day.

V. RECOMMENDATIONS

1. Environmental

It is with the above knowledge that a recommendation is made that all local ventilation systems operate according to recommended design features, such as those mentioned in the Discussion Section, and not only those where atmospheric levels exceeded evaluation criteria for chromium (VI) or inorganic lead.

To control employee exposures, the following criteria should be used:

(1) Labeling - The words "Cancer-suspect Agent" should be evident in areas where lead chromates are handled. Containers should be similarly identified; these should be considered a minimum need.

(2) Personal Protective Equipment - Coveralls, or aprons, impervious gloves, and footwear should be worn by employees in operations where they may come into contact with chromates. Eye protection is, of course, necessary also. All clothing should be laundered on a regular basis. Until engineering controls can be modified, a self contained breathing apparatus or half-mask respirator with a high efficiency particulate filter (HEPA) should be used by employees.

(3) Work Practices - Good personal hygiene practices should be followed by employees; dry sweeping of chromates should be prohibited.

These and other recommendations can be found in NIOSH's publication on Chromium (VI)[1].

2. Medical

NIOSH[1] recommends that the following measures be instituted to provide for worker health in the future.

A. Hercules should continue to provide medical examinations with the frequency currently practiced. These examinations should include the following:

1. Previous comprehensive work history.
2. Smoking history.
3. Physical examination.
4. Chest X-ray.
5. Complete blood count.
6. Urinalysis.

B. Medical records with pertinent supporting documents should be kept for at least a period of 30 years after an individual's employment is terminated.

VI. REFERENCES

1. Criteria for a Recommended Standard...Occupational Exposure to Chromium (VI), USDHEW, PHS, CDC, NIOSH., HEW Publication No.(NIOSH) 76-129.

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3. Langard, S. and Norseth, T.: A Cohort Study of Bronchial Carcinoma in Workers Producing Chromate Pigments. Brit. Journ. Indus. Medicine 32: 62-65 (1975).

4. Maltoni, C.: Occupational Carcinogeneses, Int. Congress Series No. 332 (ISBN 90 219 02281) Cancer Detection and Prevention, Proc. of Sec. Int. Symposium, Bologna, (April 1973).

5. Written Communication from Mr. James F. Morgan to Mr. Ed. Baier, NIOSH, 6/8/75.

6. Equitable Environmental Health, Inc.: An Epidemiological Study of Lead Chromate Plants: Final Report. Berkley, California, July 1976.

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TABLE 1 A

Results of Air Samples for
Hexavalent Chromium and Lead

Hercules, Inc.
Glens Falls, New York

October 5-6, 1976

Location	Employee/Date	Sample Number	Type Sample[1]	Sampling Period (hrs./min.)	Concentration[2] ug/M^3 Cr(VI)	Lead
Building 44	Color Builder (10/6)	45	P	7/33	N.D.[3]	90
	Color Builder	23	A	0/16	N.D.	30
	Color Builder	16	A	0/16	N.D.	40
	Color Builder	60	A	0/15	N.D.	N.D.
Building 2	Color Builder	44	P	7/27	0.01	30
Building 44	Pressman (10/6)	47	P	7/45	0.01	80
	Pressman	14	A	0/14	N.D.	N.D.
	Pressman	59	A	0/13	N.D.	N.D.
	Pressman	66	A	0/15	N.D.	40
ilding 41	Color Loader (10/5)	7	P	7/35	45.1	200
	Color Loader	12	P	0/16	106.4	480
	Color Loader	26	P	0/17	N.D.	310
	Color Loader	27	P	0/17	122.6	530

1. P=Personal A=Area
2. ug/M^3 - Micrograms of chromium (+6) per cubic meter of air (or micrograms of lead per cubic meter of air)
3. N.D.=non-detectable

HYGIENIC STANDARDS:

Source	Substance	8-hour Time Weighted Average Concentration (TWA)	Acceptable Ceiling Concentration
NIOSH	Carcinogenic chromium (VI)		1 ug/M^3
	Inorganic lead	150 ug/M^3	
1976 TLV	Chromates (Cr(VI))	100 ug/M^3	
	Inorganic lead	150 ug/M^3	450 ug/M^3
OSHA Standard - Current	Chromates		100 ug/M^3
	Inorganic lead	200 ug/M^3	
OSHA Standard proposed (1975)	Inorganic lead	100 ug/M^3	

TABLE 1 B

Results of Air Samples for
Hexavalent Chromium and Lead

Hercules, Inc.
Glens Falls, New York

October 5-6, 1976

Location	Employee/Date	Sample Number	Type Sample[1]	Sampling Period (hrs./min.)	Concentration[2] (ug/M^3) Cr(VI)	Lead
Building 41	Color Dumper (10/5)	8	P	7/33	98.2	160
	Color Dumper	17	P	0/12	135.1	1270
Building 33	Blenderman-Loader (10/5)	6	P	8/0	N.D.[3]	20
	Blenderman-Loader	18	A	0/16	41.1	180
	Blenderman-Loader (10/6)	48	P	7/38	N.D.	30
	Blenderman-Loader	68	A	0/15	N.D.	60
Building 33	Blenderman-Dumper (10/5)	9	P	7/49	N.D.	60
	Blenderman-Dumper (10/6)	46	P	7/39	0.02	200
	Blenderman-Dumper	21	A	0/17	N.D.	340
	Blenderman-Dumper	10	A	0/15	N.D.	160
	Blenderman-Dumper	57	A	0/15	N.D.	100

1. P=Personal A=Area
2. ug/M^3= Micrograms of chromium (+6) per cubic meter of air (or micrograms of lead per cubic meter of air)
3. N.D.=non-detectable

TABLE 1 C

Results of Air Samples for
Hexavalent Chromium and Lead

Hercules, Inc.
Glens Falls, New York

October 5-6, 1976

Location	Employee/Date	Sample Number	Type Sample[1]	Sampling Period (hrs./min.)	Concentration[2] (ug/M^3) Cr(VI)	Lead
Building 10	Grinder-Hopperman (10/5)	3	P	7/47	7.5	20
	Grinder-Hopperman	11	A	0/15	N.D.[3]	N.D.
	Grinder-Hopperman	31	A	0/15	N.D.	N.D.
	Grinder-Hopperman	32	A	0/15	N.D.	N.D.
	Grinder-Hopperman (10/6)	38	P	7/53	N.D.	20
	Grinder-Hopperman	43	A	0/15	N.D.	N.D.
	Grinder-Hopperman	55	A	0/15	N.D.	N.D.
	Grinder-Hopperman	63	A		N.D.	N.D.
	Grinderman (10/5)	1	P	7/47	10.7	60
	Grinderman	28	A	0/15	N.D.	50
	Grinderman	24	A	0/15	N.D.	40
	Grinderman (10/5)	2	P	7/49	10.7	30
	Grinderman	19	A	0/15	N.D.	N.D.
	Grinderman	29	A	0/15	N.D.	70
	Grinderman	33	A	0/15	N.D.	40
	Forklift Operator-Grinder Floor (10/6)	40	P	7/32	N.D.	20

1. P=Personal A=Area
2. ug/M^3=Micrograms of chromium (+6) per cubic meter of air (or micrograms of lead per cubic meter of air)
3. N.D.=Non-detectable

TABLE 1 D

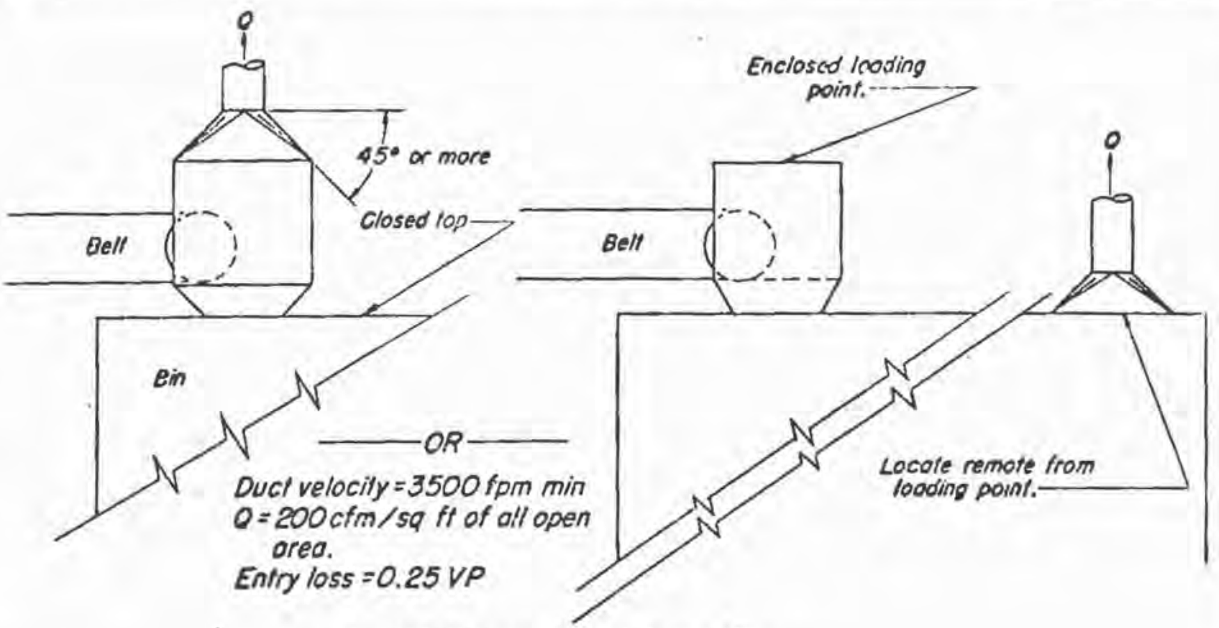
Results of Air Samples for
Hexavalent Chromium and Lead

Hercules, Inc.
Glens Falls, New York

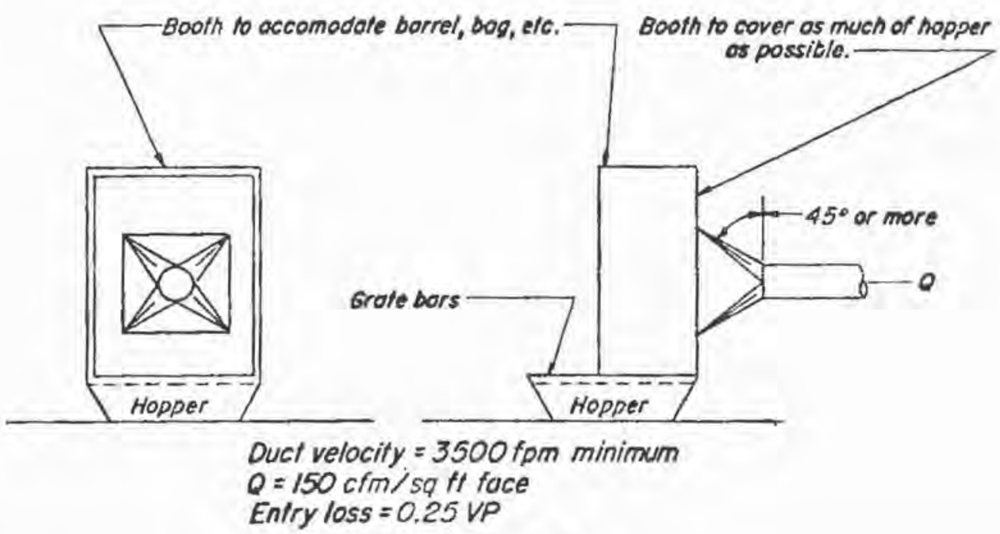
October 5-6, 1976

Location	Employee/Date	Sample Number	Type Sample[1]	Sampling Period (hrs./min.)	Concentration[2] (ug/M^3) Cr(VI)	Lead
Building 10	Bagger-Hopperman (10/6)	37	P	7/45	0.03	80
	Bagger-Hopperman	42	A	0/15	N.D.[3]	N.D.
	Bagger-Hopperman	54	A	0/15	N.D.	270
	Bagger-Hopperman	65	A	0/15	N.D.	50
	Independent Bagger (10/5)	4	P	7/52	11.7	60
	Independent Bagger	20	A	0/15	N.D.	N.D.
	Independent Bagger	25	A	0.15	N.D.	N.D.
	Independent Bagger	35	A	0/15	N.D.	N.D.
	Independent Bagger (10/6)	39	P	7/29	N.D.	50
	Independent Bagger	41	A	0/15	N.D.	N.D.
	Independent Bagger	53	A	0/15	N.D.	50
	Independent Bagger	64	A	0/15	N.D.	120
	Drum Drier Operator/ Bagger (10/5)	5	P	7/48	11.8	60
	Drum Drier Operator/Bagger	13	A	0/15	N.D.	70
	Drum Drier Operator/Bagger	30	A	0/15	44.8	220
	Drum Drier Operator/Bagger	36	A	0/15	52.2	150

1. P=Personal A=Area
2. ug/M^3=Micrograms of chromium (+6) per cubic meter of air (or micrograms of lead per cubic meter of air)
3. N.D.=Non-detectable



MECHANICAL LOADING*



MANUAL LOADING

*BELT SPEED	VOLUME
Less than 200 fpm -	350 cfm/ft of belt width. Not less than 150 cfm/ft of opening.
Over 200 fpm -	500 cfm/ft of belt width. Not less than 200 cfm/ft of opening.

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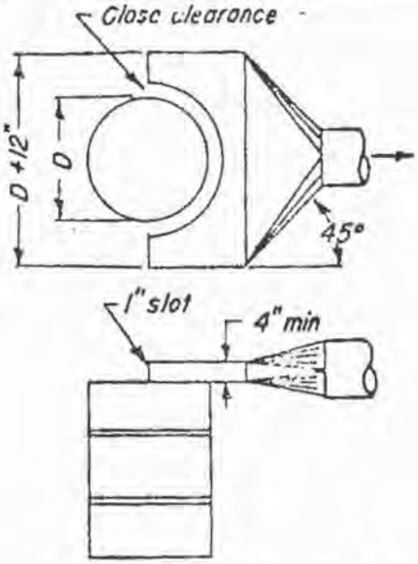
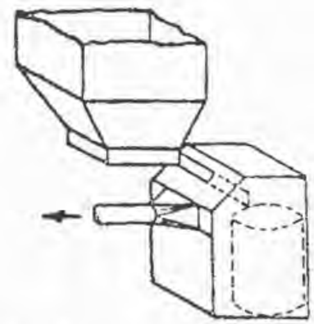
BIN & HOPPER VENTILATION

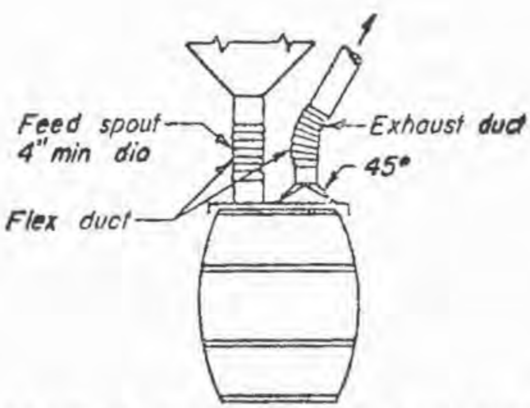
DATE 1-72 | VS-304



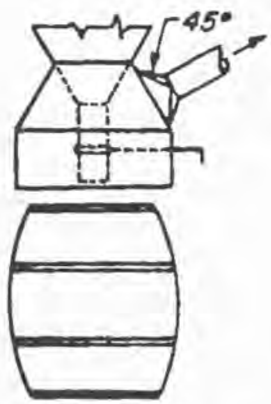
Q = 100 cfm/sq ft barrel top min
Duct velocity = 3500 minimum
Entry loss = 0.25 VP + 1.78 slot VP
Manual loading.



Q = 150 cfm/sq ft open face area
Duct velocity = 3500 fpm minimum
Entry loss = 0.25 VP for 45° taper



Q = 50 cfm × drum dia (ft) for weighted lid
150 cfm × drum dia (ft) for loose lid
Duct velocity = 3500 fpm minimum
Entry loss = 0.25 VP



Q = 300-400 cfm
Duct velocity = 3500 fpm min
Entry loss = 0.25 VP

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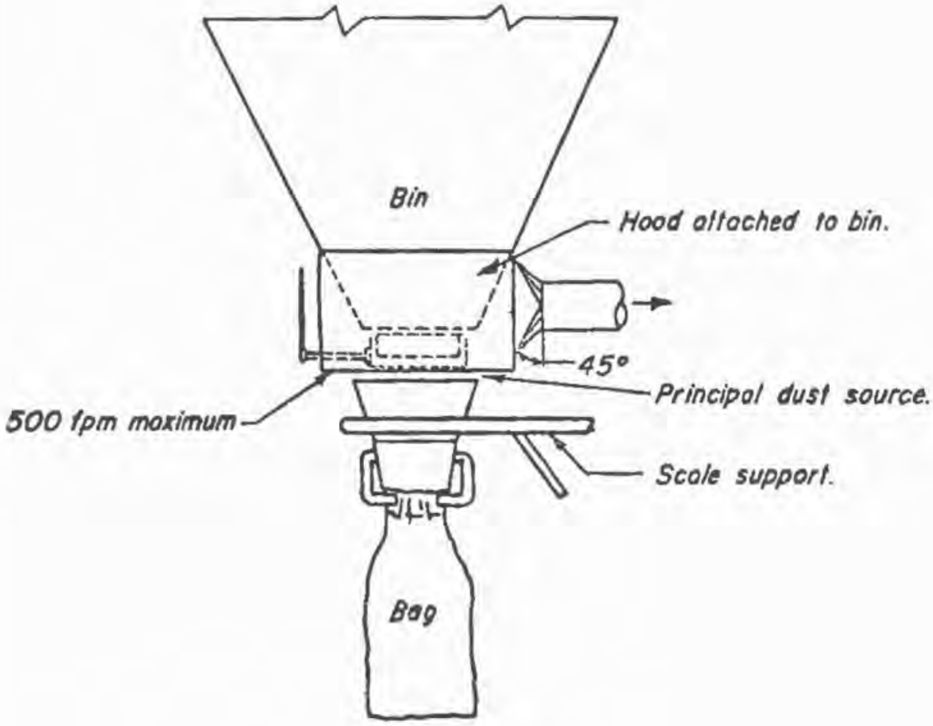
BARREL FILLING

DATE	1-64	VS-303



Q = 400-500 cfm - non-toxic dust
1000-1500 cfm - toxic dust
Duct velocity = 3500 fpm minimum
Entry loss = 0.25 VP

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BAG FILLING

DATE	1-64	VS-301