U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES ■ Public Health Service
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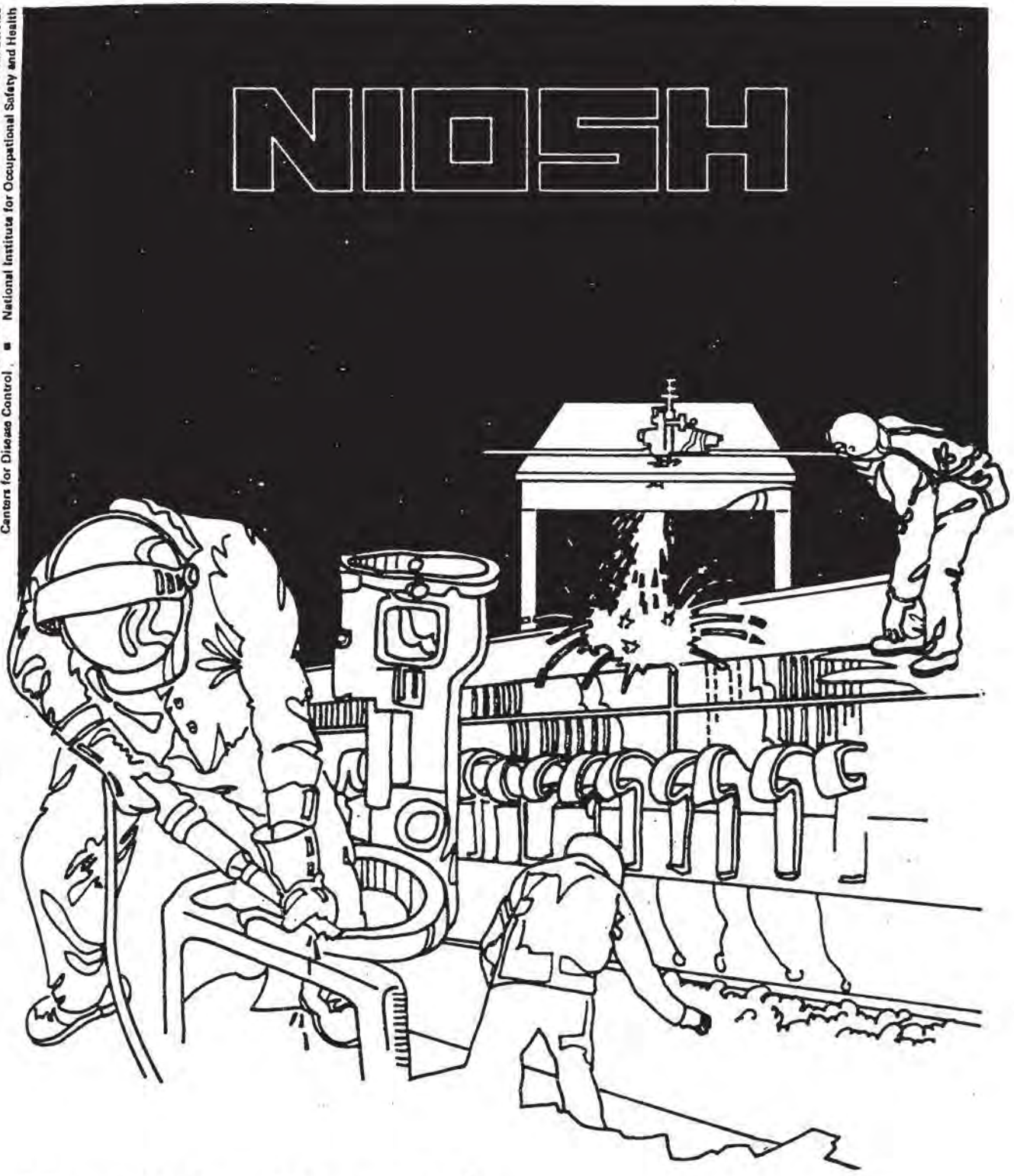
NIOSH



Health Hazard Evaluation Report

HETA 81-356-1183
SHERWIN WILLIAMS COMPANY
COFFEYVILLE, KANSAS

PREFACE

The Hazard Evaluations and Technical Assistance Branch of NIOSH conducts field investigations of possible health hazards in the workplace. These investigations are conducted under the authority of Section 20(a)(6) of the Occupational Safety and Health Act of 1970, 29 U.S.C. 669(a)(6) which authorizes the Secretary of Health and Human Services, following a written request from 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 Hazard Evaluations and Technical Assistance Branch also provides, upon request, medical, nursing, and industrial hygiene technical and consultative assistance (TA) to Federal, state, and local agencies; labor; industry and other groups or individuals to control occupational health hazards and to prevent related trauma and disease.

HETA 81-356-1183
SEPTEMBER 1982
SHERWIN WILLIAMS COMPANY
COFFEYVILLE, KANSAS

NIOSH INVESTIGATORS:
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I. SUMMARY

In June 1981 the National Institute for Occupational Safety and Health (NIOSH) received a request from the Oil, Chemical, and Atomic Workers International Union to evaluate possible health problems at the Coffeyville, Kansas plant of the Sherwin Williams Company. The request cited concern about a possible excess of kidney problems, prostate problems, and hypertension. In 1976, during a previous evaluation of lead exposure at the plant, NIOSH had found a high prevalence of hypertension and of abnormal serum creatinine concentrations among workers.

On August 10-11, 1981, a walk-through survey was performed, and environmental and medical evaluations were performed in February and April 1982. The environmental evaluation included personal air samples for barium, lead, zinc, and cadmium, and area air samples for total and respirable dust. Personal air samples performed in the "ozark process" area (bagging of zinc oxide powder) exceeded recommended standards in 1 of 11 (9%) instances for barium, 2 of 11 (18%) for lead, and 2 of 11 (18%) for zinc. Comparable samples in the "ozide process" area (blending of zinc oxide) had elevations in 1 of 5 (20%) instances for lead and 1 of 5 (20%) for zinc. Six of 7 (86%) personal samples for barium exceeded recommended levels in the "bayrite process" area (grinding and mixing of barium-containing ores). All cadmium samples were below recommended standards. Area air samples exceeded recommended standards for total dust in all three processes (range 29-64 mg/M^3). Respirable dust standards (5 mg/M^3) were exceeded in ozide (9.7 mg/M^3).

Participants in the medical study answered a medical questionnaire, had blood pressure taken, and had blood and urine tests performed. Sixty-one of the 67 workers present at the time of the survey participated, as well as 26 previously employed and 9 salaried workers. There were no elevations above normal (< 7 ug/l) for blood cadmium and one elevated urine cadmium (6.8 ug/g creatinine, normal < 5). Ten blood lead concentrations were above 39 ug/dl, 9 of them in current workers and 5 of these in ozide or ozark workers. Seven of the 94 serum creatinine concentrations performed were outside the normal range ($\leq$ 1.5 mg/dl); these were not associated with any particular job grouping. A high prevalence of high blood pressure was found among current hourly workers (36%). Barium workers had a significantly higher prevalence of hypertension than did non-barium workers (58% vs. 20%), but otherwise hypertension was not be associated with job grouping.

Based upon the information gathered during this investigation, NIOSH determined that some employees in the ozark and ozide process areas are being exposed to excessive amounts of lead. In addition, barium exposures are excessive in the bayrite process area; dust exposures are excessive in the ozark, ozide, and bayrite process areas; and zinc exposures are excessive in the ozide process area. This study found no biochemical evidence of renal disease in this population, but the available tests cannot detect early renal disease. Recommendations for improving the workplace environment are detailed in Section VIII of this report.

KEYWORDS: SIC 2816 (Inorganic Pigments) Barium, Cadmium, Lead, Zinc, Dust, Hypertension, Renal Disease.

II. INTRODUCTION

In June 1981 the National Institute for Occupational Safety and Health (NIOSH) received a request from the Oil, Chemical, and Atomic Workers International Union and its Local 5-609 to evaluate possible health problems at the Coffeyville, Kansas plant of the Sherwin Williams Company. The request cited concern about a possible excess of kidney problems, prostate problems, and hypertension. NIOSH performed an evaluation of the plant in November 1976 at the request of the Occupational Safety and Health Administration (OSHA) which concentrated on the health effects of lead exposure. A report of the evaluation was released in July 1978 (1). One hundred seventy-eight workers received a zinc protoporphyrin test (ZPP). Those with ZPP levels greater than or equal to 90 micrograms per deciliter (ug/dl) or with jobs considered at high risk for lead exposure received further evaluation, including a medical questionnaire, neurologic examination, blood pressure, urinalysis, and blood tests, including hemoglobin, hematocrit, and a 24-test automated blood screen. In all, 62 workers were selected to have this further testing. The results of this testing, in brief, were as follows:

ZPP > 49 ug/dl	31 of 178 (17%)
ZPP > 89 ug/dl	7 of 178 (4%)
Lead level > 39 ug/l	10 of 62 (16%)
> 59 ug/l	3 of 62 (5%)
Blood pressure elevated (systolic > 139 and/or diastolic > 89)	31 of 62 (50%)
Creatinine > 1.4 mg/dl	24 of 61 (39%)
Blood urea nitrogen (BUN) > 20 mg/dl	5 of 61 (8%)

An initial visit was made to the plant on August 10-11, 1981 by a NIOSH industrial hygienist and physician. After an opening conference attended by representatives of management and the union, a walk-through survey of the facilities was conducted. A follow-up visit was made during the week of February 22, 1982, during which industrial hygiene and medical evaluations were performed. A further medical follow-up visit was made on April 15, 1982.

III. BACKGROUND

The Coffeyville, Kansas plant was built in 1903, the last structural addition being made in 1948. The plant, which covers about 70 acres with 350,000 square feet of covered buildings, performs grinding, blending, and mixing of mineral ores that become products used in oil field drilling and heavy industries. Four processes are currently in operation.

(1) The "ozide process" is the blending of several grades of zinc oxide. The mixture is used primarily as a filler in rubber compounding. (2) The "ozark process" is a bagging operation of a very pure zinc oxide powder. Ammonia is used in this department. Cadmium, lead, arsenic, and antimony are trace contaminants in the zinc oxide. (3) The "bayrite process" grinds and mixes several grades of barium containing ores to create a product called Sher-Bar which prevents well-heads from blowing out. (4) In the "Sher-tone process", inert clays are mixed with animal tallow to achieve a product that lubricates drill casings in the well.

Because of the age and the scale of the facility, local exhaust ventilation is non-existent, and general dilution ventilation is dependent upon prevailing wind conditions for the day. The grinding operations observed during the survey are essentially unchanged from the manner in which they were performed when the facility was constructed in 1903. Bagging operations utilize current technology.

In order to control worker exposures to the high concentrations of particulates generated by the grinding and bagging operations, personal protective equipment in the form of particulate respirators is provided.

IV. METHODS

A. Environmental

Over the two-day sampling period, 27 personal air samples for barium, lead, cadmium, and zinc were collected using DuPont P-2500 sampling pumps set at a flow rate of 1.7 liters per minute (lpm). The samples were collected on 0.8 micron mixed-cellulose-ester membrane filters. The filters were ashed in hot nitric acid and analyzed by atomic absorption spectroscopy according to NIOSH P&CAM 173.

Area air samples for total and respirable dusts were taken at representative locations in each manufacturing area using a Gast high-volume pump with in-line 9 lpm critical orifices. The samples were collected on M5 pre-weighed filters. Weights were determined by gravimetric analysis.

B. Medical

Participation in the medical testing was offered to all employees present in the plant on the survey days and all employees laid off or retired since the 1976 study. A letter was sent to all 130 individuals listed on the 1976 employment list who were no longer employed at the plant. Testing was also offered to salaried individuals with little or no daily exposure to the processes.

Each participant was administered a directed questionnaire which elicited demographic information, the frequency of various symptoms over the preceding two months, chemical exposures, occupational history, smoking history, and history of renal disease, allergies, and hypertension.

Blood pressure was then taken; hypertension was considered present if either the systolic pressure was 140 mm Hg or above or the diastolic 90 or above. An individual receiving medication for hypertension was considered hypertensive whatever his reading.

Each participant provided a spot urine specimen and a blood specimen, which were analyzed for the following:

Test	Normal (adult males)
Urine	
Routine urinalysis	---
Protein	< 5 mg/dl
B2-microglobulin	< 200 ug/g creatinine
Cadmium	< 5 ug/g creatinine
Blood	
Hemoglobin	> 14 g/dl
Hematocrit	> 42 ml/dl
BUN	< 21 mg/dl
Creatinine	< 1.6 mg/dl
FEP	< 50 ug/dl
Lead	< 40 ug/dl (see preceding discussion)
Cadmium	< 7 ug/dl (see preceding discussion)

Because of an error in collection of the specimens, it was necessary to repeat the B2-microglobulin determination. All B2-microglobulin levels reported herein were measured on 55 specimens collected on April 15, 1982.

Urine levels for cadmium and B2-microglobulin were corrected for urine concentration differences by adjustment using urine creatinine concentrations.

V. EVALUATION CRITERIA

Cadmium

Cadmium may enter the human body either by ingestion or inhalation of cadmium metal or oxide. It is deposited in organs throughout the body, but major depositions occur in the liver and kidneys. Cadmium is excreted from the body only very slowly and thus accumulates in the cortex of the kidneys.

The blood cadmium concentration is the best biological indicator of recent cadmium exposure and absorption.(2,3) The normal blood cadmium level is below 7 micrograms per liter (ug/l) of whole blood. The urine cadmium concentration is primarily an indicator of cadmium-induced kidney damage: the urine cadmium concentration does not ordinarily begin to increase until after injury has occurred to the kidneys. However, individuals without occupational exposure to cadmium generally have been found to have urine cadmium levels below 5 ug/gram creatinine (ug/g).(4)

Acute inhalation exposure to cadmium can cause pneumonia or pulmonary edema, as well as liver and kidney damage. Ingestion of toxic quantities can produce nausea, vomiting, and diarrhea. Exposure to an airborne concentration of cadmium of 40 milligrams per cubic meter (mg/M^3) is considered immediately dangerous to life.(5)

Occupational exposure to cadmium is usually chronic and can produce several toxic effects, of which the most important are emphysema of the lungs and chronic kidney disease.(6) Occupational cadmium exposure has been associated with cancer of the prostate gland, and there is limited evidence that exposure may be associated with lung cancer.(7,8)

Apart from malignancy, kidney disease is the toxic effect of chronic cadmium exposure which is of principal concern.(6) Cadmium nephropathy develops gradually--there are usually no symptoms in the early stages, and kidney function test results (blood urea nitrogen (BUN), serum creatinine) may still be within the reported normal range, although they will tend over time to move toward the high end of the normal range. B2-microglobulin is a low molecular weight protein whose presence in urine has been associated with early cadmium toxicity. Normal urine B2-microglobulin levels are generally below 200 ug/g creatinine.(9)

NIOSH recommends that worker exposures to cadmium dust or fume not exceed 200 micrograms per cubic meter (ug/M^3) during a 15-minute ceiling period or 40 ug/M^3, as a time-weighted average (TWA) over a 10-hour shift. The Occupational Safety and Health Administration (OSHA) standard for cadmium dust exposure is 200 ug/M^3, and for cadmium fume exposure 100 ug/M^3, using an 8-hour TWA for each.

Lead

Inhalation of lead dust and fume is the major route of lead exposure in industry. A secondary source of exposure may be from ingestion of lead dust deposited on food, cigarettes, or other objects. Once absorbed, lead is excreted from the body very slowly. Absorbed lead can damage the kidneys, peripheral and central nervous systems, and the blood forming organs (bone marrow). These effects may be felt as weakness, tiredness, irritability, digestive disturbances, high blood pressure, kidney damage, or slowed reaction times. Chronic lead exposure is associated with infertility and with fetal damage in pregnant women.

Lead has been shown to cause chronic kidney disease in persons with long-term occupational exposure.(12) The process is gradual and dose related. Persons who experience the greatest risk of lead-induced kidney disease are those who have experienced the most lead absorption over their working career. As with cadmium, affected workers will usually have no symptoms in the early stages.

Blood lead levels below 40 ug/dl whole blood are considered to be normal levels that may result from daily environmental exposure.(10) However, fetal damage in pregnant women may occur at blood lead levels as low as 30 ug/dl. Lead levels between 40-60 ug/dl in lead-exposed workers indicate excessive absorption of lead and may result in some adverse health effects. Levels of 60-100 ug/dl represent unacceptable elevations that may cause serious adverse health effects. Levels over 100 ug/dl are considered dangerous and often require hospitalization and medical treatment.

Another test of lead exposure is free erythrocyte protoporphyrin (FEP), which measures the effect of lead on hemoglobin synthesis and thus can reflect lead exposure during the three months prior to measurment. While normal values for FEP are not well established, the Centers for Disease Control (CDC) considers an FEP equal to or greater than 50 ug/dl of whole blood as an indication of lead toxicity.(11)

The new Occupational Safety and Health Administration (OSHA) standard for lead in air is 50 ug/M(3) calculated as an 8-hour time-weighted average for daily exposure.(10) The standard also dictates that workers with blood lead levels greater than 60 ug/dl must be immediately removed from further lead exposure and, in some circumstances, workers with lead levels of less than 60 ug/dl must also be removed. Removed workers have protection for wage, benefits, and seniority for up to 18 months until their blood levels decline to below 50 ug/dl and they can return to lead exposure areas.

Zinc and zinc oxide (5,13)

The syndrome of metal fume fever is the only important effect of exposure to zinc oxide fumes and dusts. During exposure to freshly formed zinc oxide fume, the symptoms are dryness and irritation of the throat, a sweet or metallic taste, substernal tightness, and a dry cough. Several hours following exposure, the worker develops chills, fever, lassitude, malaise, fatigue, frontal headache, and muscle pain. An attack usually subsides after 6-12 hours, but may last up to 24 hours. Recovery is usually complete. Most workers develop an immunity to the attacks, but it is quickly lost. Hence, attacks tend to be more severe on the first day of the work week.

Zinc oxide powder may produce a dermatitis. Zinc oxide dust is usually classed as a nuisance particulate, but the high concentrations found at Sherwin-Williams and the relatively high percentage of respirable zinc oxide in the products make it prudent to maintain levels below the NIOSH and OSHA criteria of 5 mg/M^3 prescribed for the smaller particle size zinc oxide fume.

Soluble barium (5,13)

Barium salts such as the sulfate, carbonate, or hydroxide are irritants of the eyes, mucous membranes, and skin. Chronic inhalation may cause a form of pneumoconiosis known as baritosis. Baritosis is generally considered benign, but there have been reports of mild bronchial irritation. Chest x-rays will show disseminated nodular opacities in the lung fields. The American Conference of Governmental Hygienists (ACGIH) recommends a threshold limit value (TLV) of 0.5 (mg/M^3), which is also the OSHA standard.

Ammonia (5,13)

At room temperature, ammonia is a gas that is highly irritating to the mucous membranes, eyes, skin, and respiratory tract. It can cause corneal ulceration, blister formation, headache, salivation, burning of the throat, nausea, vomiting, and chest pain. Severe exposure can lead to cough, bronchospasm, pulmonary edema, or respiratory arrest. The NIOSH recommended standard and the OSHA standard are both 50 parts per million (ppm) for a full-shift TWA.

VI. RESULTS AND DISCUSSION

A. Environmental

The results of the personal air samples collected for barium, lead, zinc and cadmium are presented in Tables 1 and 2.

Zinc exposures were greater than the evaluation criterion of 5000 ug/M^3 in 6 of 11 samples collected in the ozark and ozide areas, and 3 exceeded the OSHA nuisance dust standard of 15 mg/M^3. Negligible exposures were measured in bayride and Sher-tone. Average exposures to zinc oxide dust (10,195 ug/M^3) were in excess of the evaluation criterion 5 mg/M^3 in the ozide bagging area. Average exposures were approximately 4000 ug/M^3 in the ozark area, but could conceivably exceed the standard based on the calculated standard deviation.

Soluble barium compounds were measured in the bayrite area at levels in excess of the evaluation criterion of 0.5 mg/M^3. Of seven samples collected during the two days, six were approxinately twice this level. One overexposure was noted in the ozark area, but the remaining values were all well under 0.5 mg/M^3.

Two of 11 samples collected for lead in the ozark, and one of five collected in the ozide areas were over the OSHA standard of 50 ug/M^3. On the average, exposures were below this level.

Cadmium enviromental levels were predominantly at the non-detectable level.

The greatest environmental concern for the entire facilty is the level of total and respirable dusts measured in all of the previously mentioned work areas (Table 3). The ozide bagging operation had a dust concentration of 64 mg/M^3, which greatly exceeds both the ACGIH TLV and the OSHA standard. In the bayrite grinding and milling areas, a concentraion of 35 mg/M^3 was determined, while 29 mg/M^3 was measured in the ozark bagging area. The allowable respirable dust level (5 mg/M^3) was exceeded in the ozide area (9.7 mg/M^3), and closely approached in the bayrite area (4.7 mg/M^3). Previous environmental data from an OSHA inspection showed dust levels as high 120 mg/M^3 in the ozide area. These levels probably account for the relatively high prevalence of irritative symptoms, especially stuffy nose, among non-salaried employees. Therefore, an initial effort toward contaminant reduction should be directed toward an inspection, upgrading or repair, and reassessment of the local exhaust ventilation capacities of existing milling and bagging equipment in all departments.

During the NIOSH site visit it was noticed that ammonia concentrations in the filter area of the ozark department were sufficient to cause tearing and somewhat labored breathing. Accordingly, detector tube samples for ammonia were taken which showed ambient concentrations in the range from 60 to 90 ppm. Both NIOSH and OSHA recommend that exposures to ammonia be kept below 50 ppm.

B. Medical

Of the 67 hourly employees present on the days of the survey, 61 (91%) participated. Of the 130 letters sent to laid off or retired workers, 16 were returned as undeliverable. Of the remaining 114 letter recipients, 42 (37%) indicated a desire to participate, and 35 (83%) of them were eventually tested. (Nine of the 35 had returned to work by the time of the survey and 26 were still not employed at Sherwin Williams). Table 5 categorizes by job the participants in the medical study.

The decrease in plant population within the past year or two, combined with process changes within the past several years, has resulted in a greater than usual number of transfers of personnel between jobs. For this reason, the data have been analyzed for groups of workers based both on their current assignments and on their past job assignments.

The following groups were based on current assignments:

Group 1
those employees working in ozide or ozark at the time of the survey (19 workers);

Group 2
those employees working in bayrite at the time of the survey (14 workers);

Group 3
those employees working in maintenance at the time of the survey (16 workers);

Group 4
those working other areas (includes janitorial, yard and equipment, warehouse, special chemicals, and labor pool) (12 workers);

Group 5
salaried employees (9 workers)

The data from salaried or former workers were not analyzed statistically because these groups were small, self-selected samples, in contrast to the group of present workers, 91% of whom participated. As shown in Table 6, present, former, and salaried workers appear comparable in terms of age and smoking history, but the salaried group has fewer Blacks and less seniority at the plant than do the other groups.

Results of the questionnaire and laboratory tests for Groups 1-5 are shown in Table 7. Although not analysed statistically, Group 5 data are included for comparison. Maintenance workers are significantly younger than ozide/ozark workers ($p=0.040$, Student's t test). Bayrite workers are significantly older than ozide/ozark, maintenance, and "other" workers ($p=0.0064$, $p=1.2 \times 10^{-5}$, and $p=0.00046$, respectively, Student's t test).

There were no significant differences between the groups for smoking or for time spent on the job they had at the time of the survey. All individuals had worked for at least one month on their current job. Maintenance workers had spent significantly less time employed at the plant than had barium workers ($p=0.00076$, Student's t test). There were fewer Blacks in maintenance than in either ozide/ozark or the "other" group ($p=0.024$ and $p=0.022$, respectively, Fisher's Exact Test, 2-tailed).

Ozide/ozark workers reported less headache than did the maintenance or "other" groups ($p=0.035$ and $p=0.016$, respectively, Fisher's Exact Test, 2-tailed). There were no significant differences between the groups for any other symptom. Stuffy nose had the highest prevalence of any symptom over all the groups.

Four current employees, two primarily in maintenance and one each in ozark/ozide and zinc sulfate, reported having kidney stones. Four current employees, two in bayrite and one each in yard and in maintenance, reported having had prostate infections. Because of uncertainty as to the prevalence of these two conditions in the general population, no conclusion can be drawn as to an occupational etiology for either.

Nine current workers had a blood lead level greater than 39 ug/dl; one of these, 64 ug/dl, exceeded 60 ug/dl. Five of the nine were in workers in the ozark or ozide areas. While these two areas (which constitute Group 1) had the highest mean blood lead and FEP, the differences between the groups were not statistically significant.

Maintenance workers had significantly fewer individuals with hypertension than did ozide/ozark workers ($p=0.017$, Fisher's Exact Test, 2-tailed).

All blood cadmium levels for these groups were at or below the limit of detection for the test. While maintenance workers had a mean urine cadmium significantly lower than that for ozide/ozark workers, all urine cadmiums were below 10 ug/g creatinine, the highest being 6.8 ug/g in an ozide/ozark worker.

While the data for salaried workers was not analyzed statistically, it can be noted that they report very few symptoms and have much lower lead and FEP levels than other workers. Otherwise, their results are quite comparable to the other groups.

The following groupings are based on past job assignments of workers. Workers not presently employed at Sherwin Williams are included only in group 12.

Group 6
workers who had spent at least five years in ozide and ozark (14 workers);

Group 7
workers who stated that they have had no exposure to ozide or ozark (27 workers);

Group 8
workers with at least five years as maintenance workers (14 workers);

Group 9
workers stating that they had never worked in maintenance (40 workers);

Group 10
workers with at least five years working in barium processes (12 workers);

Group 11
workers stating that they had never worked in barium processes (25 workers); and

Group 12
workers no longer employed at Sherwin Williams (26 workers).

Other groups of workers, such as zinc workers, were not included in these analyses because there were too few individuals with significant exposure.

Tables 8 and 9 list comparisons between three pairs of groups. Table 8 has comparisons between workers exposed and not exposed on ozark and ozide, and between those who have and have not worked on maintenance. Table 9 has comparisons between those who have and have not worked on barium processes, including such processes as ground bayrite and barium carbonate. Also listed in Table 9, for purposes of comparison, is the data for past workers and salaried workers.

Ozark/ozide (oz/oz) workers had less seniority than did non-oz/oz workers ($p=0.046$, Student's t Test). Otherwise, demographic characteristics are similar between the two groups. Oz/oz workers reported significantly less headache than did non-oz/oz workers ($p=0.017$, Fisher's Exact Test, 2-tailed). There was no significant difference between these two groups for any other symptom. There was no significant difference between these groups for lead levels, but oz/oz workers did have a significantly higher mean FEP level ($p=0.032$, Student's t test). There were no other significant differences between these groups.

There are significantly fewer Blacks who have been maintenance workers (p=0.048, Fisher's Exact Test, 2-tailed); otherwise, there were no statistically significant differences between maintenance and non-maintenance workers for any parameter mentioned.

Significantly more barium workers than non-barium workers had hypertension (p=0.029, Fisher's Exact Test, 2-tailed), while significantly fewer had elevated blood leads (p=0.072, Fisher's Exact Test, 2-tailed).

Although statistical analyses were not done on data from past workers, it can be noted that they do not differ markedly from other groups for any symptom or parameter.

In all, only 7 of the 94 (7%) serum creatinines performed in this survey were elevated, the highest being 1.8 mg/dl. This is little more than would have been expected statistically in the general population and is strikingly less than that found in the 1976 study. Thirty-eight individuals had a serum creatinine performed both in 1976 and 1982. Using a criterion of 1.5 mg/dl as top normal, 12 of these 38 had an abnormal result in 1976 and only 3 in 1982. It is plausible either that the 1976 survey overestimated the creatinines in this population or that the present survey underestimated them. However, no individual with an abnormal creatinine in 1976 suffered an increase in serum creatinine in the 6-year interim. Hence, even if the 1982 study underestimated the true creatinine slightly, it would seem very unlikely that any progressive kidney disorder is present in this population.

The present study reconfirms the high prevalence of hypertension at the plant. Of the 61 current employees tested, 22 (36%) had an elevated blood pressure or were known to be hypertensive. Comparing workers with several years of exposure to ozide/ozark, barium, and maintenance to their unexposed comparison groups, only barium workers had a significantly higher percentage of hypertensives. (Barium is not known to have a hypertensive effect.) Prevalence was also high among salaried employees (56%). Given the high prevalence of hypertension in the general population, (25%) (14), the relationship of the high prevalence at this plant to any processes at the plant is uncertain.

VII. RECOMMENDATIONS

1. All employees should be provided with properly fitting, NIOSH-approved, half-face particulate respirators. Maintenance of these respirators should be the joint responsibility of the employee and the company. Replacement particulate filters should be provided on an as-needed basis at no cost to the employee. Respirator integrity should be assessed on a weekly basis by the employee, and all inadequacies reported to the appropriate

authority with the understanding that another respirator will be provided for the employee until the necessary repairs or corrections are made. Employees should have a medical evaluation to determine whether they are medically fit to use a respirator.

2. Although respiratory protection is made available to production employees, nuisance, and some respirable dust levels measured during the NIOSH survey are unacceptable. Engineering re-assessment of ventilatory capacity shoule be made for all local exhaust ventilation. Once the indicated repairs or corrections have been accomplished, another industrial hygiene assessment of environmental levels should be performed to document the effectiveness of the ventilation in controlling exposures.

3. Ammonia levels should be evaluated on a periodic basis in the filter area of the ozark department. An inspection and correction of any deficiencies in the process should be undertaken to ensure that respiratory irritation due to ammonia exposures do not occur.

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XI. DISTRIBUTION AND AVAILABILITY OF REPORT

Copies of this report are currently available upon request from NIOSH, Division of Standards Development and Technology Transfer, 4676 Columbia Parkway, Cincinnati, Ohio 45226. After 90 days, the report will be available through the National Technical Information Service (NTIS), 5285 Port Royal, Springfield, Virginia 22161. 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:

1. Oil, Chemical, and Atomic Workers, Local 5-609
2. Sherwin Williams Company, Coffeyville, Kansas
3. NIOSH, Region VII
4. OSHA, Region VII

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

Table 1

Results for personal breathing-zone samples for
barium, lead, zinc, and cadmium

Sherwin Williams
Coffeyville, Kansas
HETA 81-356
February 24, 1982

WORK AREA	Sampling Period (min)	soluble BARIUM (ug/M^3)	LEAD (ug/M^3)	ZINC (ug/M^3)	CADMIUM (ug/M^3)
Ozark	497	10.6	9.4	448.4	ND
Ozark	485	42.4	15.7	665.5	ND
Ozark	482	244.0	96.4	15860.0	3.66
Ozark	485	23.0	12.1	1040.6	ND
Ozark	473	198.4	48.4	7564.0	ND
Ozide	502	99.5	67.9	15210.0	2.34
Ozide	485	39.9	23.0	5082.0	ND
Bayrite	497	87.3	ND	22.4	ND
Bayrite	491	1320.0	14.4	132.0	ND
Bayrite	490	996.0	7.2	56.4	ND
Bayrite	469	1162.5	15.0	71.3	ND
Sher-Tone	420	262.5	7.5	21.3	ND
Sher-Tone	469	225.0	ND	45.0	
Evaluation Criteria:					
NIOSH (8-hour TWA)			50		40/10 hr TWA
OSHA (8-hour TWA)		500	50	5000	100
Limit of detection/filter		5	5	2	2

* ND = None Detected

Table 2

Results for Personal Breathing-Zone Samples for
barium, lead, zinc, and cadmium

Sherwin Williams
Coffeyville, Kansas
HETA 81-356
February 25, 1982

WORK AREA	Sampling Period (min)	soluble BARIUM (ug/M^3)	LEAD (ug/M^3)	ZINC (ug/M^3)	CADMIUM (ug/M^3)
Ozark	480	24.6	11.1	1968.0	ND
Ozark	470	63.8	23.8	3125.0	ND
Ozark	464*	1397.0	77.5	1524.0	ND
Ozark	464*	20.3	11.4	3175.0	ND
Ozark	465	72.4	19.1	4138.0	ND
Ozark	455	60.6	36.1	2709.0	ND
Ozide	459	49.9	44.8	19200.0	ND
Ozide	455	11.6	15.5	7482.0	ND
Ozide	473	33.6	20.6	3999.0	ND
Bayrite	490	1920.0	14.4	68.4	ND
Bayrite	464*	1193.8	10.2	108.0	ND
Bayrite	464*	800.1	ND	45.7	ND
Sher-Tone	438	167.5	ND	95.1	ND
Sher-Tone	464*	114.3	ND	47.0	ND
Evaluation Criteria:					
NIOSH (8-hour TWA)			50		40/10 hr TWA
OSHA (8-hour TWA)		500	50	5000	100
Limit of detection/filter		5	5	2	2

ND = None Detected 8* - Pump was dead when returned from sampling period. Duration of sampling period estimated from mean sampling time for that day.

Table 3

Results for AREA Samples for
Total and Respirable nuisance dusts

Sherwin Williams
Coffeyville, Kansas
HETA 81-356
February 23-25, 1982

DEPARTMENT/JOB AREA	Sampling Period (min)	VOLUME (liters)	TOTAL DUST (mg/M^3)	RESP DUST (mg/M^3)	% RESP DUST
BAYRITE/ Grinding and Milling	79	711	34.7	4.7	14%
SHER-TONE/ Bagging	102	918	5.1	1.1	21%
OZIDE/ Bagging	123	1107	63.9	9.7	15%
OZARK/ Pigtail Bagging	113	1017	29.0	3.2	11%
Evaluation Criteria:					
ACGIH (8-hour TWA)			10.0	5	
OSHA (8-hour TWA)			15.0	5	

Table 4

Descriptive statistics for environmental sampling
(in micrograms per cubic meter)

Sherwin Williams
Coffeyville, Kansas
HETA 81-356
February 23-25, 1982

DEPARTMENT		BARIUM	LEAD	ZINC	CADMIUM
OZARK n=11	range	11-1397	9-96	448-15,860	ND*-4
	mean	196.1	32.8	3837	0.4
	s.d.	405.5	29.6	4461	-----
OZIDE n=5	range	12-100	16-68	3999-19,200	ND-2
	mean	46.9	34.4	10,195	0.5
	s.d.	32.6	21.8	6673	-----
BAYRITE n=7	range	87-1920	ND-15	22-132	ND
	mean	1068.4	8.7	72.0	-----
	s.d.	555.7	6.6	37.2	-----
SHER-TONE n=4	range	114-263	ND-8	21-95	ND
	mean	192.3	1.9	52.0	-----
	s.d.	65.1	-----	31.0	-----

ND- means not detected

Table 5

Workers participating, by job

Sherwin Williams
Coffeyville, Kansas
HETA 81-356
February 1982

Job on day of survey	Total present	Participating
Workers still employed:		
ozide	7	7 (100%)
ozark	14	12 (86%)
maintenance	19	16 (84%)
bayrite	14	14 (100%)
special chemicals	2	2 (100%)
janitor	2	1 (50%)
warehouse	5	5 (100%)
yard and equipment	3	3 (100%)
labor pool	1	1 (100%)
	67	61 (91%)
Workers no longer employed (primary job when employed):		
ozide		6
ozark		3
maintenance		6
black ash		2
barium carbonate		2
zinc sulfate		1
warehouse		3
other		3
		26
Salaried employees		9

Table 6

Comparisons of participating workers

Sherwin Williams
Coffeyville, Kansas
HETA 81-356
February 1982

	Past (26 workers)	Present (61 workers)	Salaried (9 workers)
Mean age (years)	50 (12.8)[a]	47 (7.8)	45 (8.9)
Mean seniority (years)	20 (13.5)	21 (7.9)	11 (11.9)
Whites/blacks	22/4	49/12	9/0
Smokers	11 (42%)	20 (33%)	3 (33%)

[a]standard deviation

Table 7

Comparison of workers by job assigned
as of time of survey

Sherwin Williams
Coffeyville, Kansas
HETA 81-356
February 1982

	Group 1 oz/oz 19 people	Group 2 bayrite 14 people	Group 3 maint. 16 people	Group 4 "other" 12 people	Group 5 salaried 9 people
mean age[1] (years)	47 (7.3)[a]	54 (6.0)	42 (6.3)	44 (6.6)	45 (8.9)
mean years at plant[2]	20 (8.6)	26 (7.6)	17 (5.4)	20 (6.8)	11 (11.9)
mean years on job	6 (7.3)	3 (9.6)	8 (4.1)	7 (6.6)	7 (10.2)
Whites/Blacks[3]	13/6	12/2	16/0	8/4	9/0
smokers	6 (32%)	3 (21%)	7 (44%)	4 (33%)	3 (33%)
past smokers	8 (42%)	5 (36%)	4 (25%)	5 (42%)	3 (33%)
symptoms (twice or more per week, within past two months):					
headache[4]	0	3 (21%)	4 (25%)	4 (33%)	0
cough	4 (21%)	3 (21%)	3 (19%)	2 (17%)	1 (11%)
phlegm	3 (16%)	2 (14%)	1 (6%)	1 (8%)	0
wheezing	0	3 (21%)	0	1 (8%)	1 (11%)
short of breath	3 (16%)	1 (7%)	1 (6%)	1 (8%)	1 (11%)
chest pain	0	1 (7%)	1 (6%)	1 (8%)	0
stuffy nose	2 (11%)	5 (36%)	6 (38%)	4 (33%)	2 (22%)
eye irritation	1 (5%)	1 (7%)	2 (12%)	1 (8%)	1 (11%)
chills	0	0	0	0	0
diarrhea	0	0	2 (12%)	0	0
nausea	0	0	0	0	0
skin prob.	2 (11%)	1 (7%)	1 (6%)	1 (8%)	1 (11%)
drowsiness	0	2 (14%)	0	1 (8%)	0
sore throat	0	2 (14%)	2 (12%)	0	1 (11%)

Table 7 (cont.)

Comparison of workers by job assigned
as of time of survey

Sherwin Williams
Coffeyville, Kansas
February 1982

	Group 1 oz/oz 19 people	Group 2 barium 14 people	Group 3 maint. 16 people	Group 4 "other" 12 people	Group 5 salaried 9 people
mean blood lead (ug/dl)	32 (11.9)	24 (13.0)	27 (6.6)	29 (12.1)	8 (2.3)
blood lead > 39	5	1	1	2	0
mean FEP (ug/dl)	54 (54.3)	38 (21.7)	32 (17.0)	45 (22.2)	24 (3.2)
blood cadmium	--[b]	--	--	--	--
elevated blood pressure[5] (defined in text)	10 (53%)	5 (36%)	2 (12%)	5 (56%)	5 (42%)
mean hematocrit	45.4 (4.9)	45.7 (4.2)	45.7 (3.0)	47.0 (3.7)	46.8 (3.5)
mean urine cadmium (ug/g creat.)	1.3 (1.4)	1.3 (0.6)	0.7 (0.4)	1.0 (0.5)	1.1 (0.7)
mean serum creatinine (mg/dl)	1.2	1.3	1.2	1.1	1.3
elevated serum creatinine (> 1.5 mg/dl)	2	1	0	1	0
elevated BUN (> 20 mg/dl)	1	3	2	3	2

---

[a]standard deviation
[b]all values at or below the limit of detection

[1]p=0.0046, groups 2 vs. 1
p=0.044, groups 3 vs. 1
p=1.2 x 10^{-5}, groups 2 vs. 3
p=0.00046, groups 2 vs. 4
p=0.0040, groups 1 vs. 3
Student's t test

[2]p=0.00076, groups 2 vs. 3
Student's t test

[3]p=0.024, groups 3 vs. 4
Fisher's Exact Test, 2-tailed

[4]p=0.016, groups 1 vs. 4
p=0.035, groups 1 vs. 3
Fisher's Exact Test, 2-tailed

[5]p=0.017, groups 1 vs. 3
Fisher's Exact Test, 2-tailed

Table 8

Comparison of workers by jobs worked

Sherwin Williams
Coffeyville, Kansas
HETA 81-356
February 1982

	Group 6 oz/oz 14 workers	Group 7 no oz/oz 27 workers	Group 8 maint. 14 workers	Group 9 non-maint. 40 workers
mean age (years)	45 (8.9)[a]	47 (7.8)	44 (7.1)	49 (7.3)
Whites/Blacks	11/3	23/4	14/0	29/11[b]
mean seniority (years)	17 (6.5)	22[c] (7.8)	20 (5.2)	22 (8.2)
smokers	5	9	4	12
past smokers	5	9	3	17
symptoms (twice or more per week, within past two months):				
headache	0[d]	9 (33%)	4 (19%)	6 (15%)
cough	2 (14%)	5 (19%)	4 (19%)	6 (15%)
phlegm	2 (14%)	1 (4%)	3 (21%)	3 (8%)
wheezing	0	3 (11%)	0	3 (8%)
short of breath	0	3 (11%)	2 (14%)	4 (10%)
chest pain	0	3 (11%)	1 (7%)	2 (5%)
stuffy nose	2 (14%)	11 (41%)	6 (43%)	9 (22%)
eye irritation	1 (7%)	2 (7%)	2 (14%)	3 (8%)
chills	0	0	0	0
diarrhea	0	2 (7%)	2 (14%)	0
nausea	0	0	0	0
skin problems	0	3 (11%)	10 (7%)	3 (8%)
drowsiness	0	3 (11%)	0	5 (12%)
sore throat	0	4 (15%)	2 (14%)	2 (5%)

Table 8 (cont.)

Comparison of workers by jobs worked

Sherwin Williams
Coffeyville, Kansas
February 1982

	Group 6 oz/oz 14 workers	Group 7 no oz/oz 27 workers	Group 8 maint. 14 workers	Group 9 non-maint. 40 workers
mean blood lead (ug/dl)	32 (9.5)	27 (10.2)	26 (7.3)	29 (12.9)
blood lead > 39	3 (21%)	3 (11%)	1 (7%)	6 (15%)
mean FEP (ug/dl)	64 (61.4)	36[e] (17.5)	28[f] (9.6)	48 (40.9)
elevated blood pressure (defined in text)	5 (36%)	7 (26%)	3 (21%)	17 (42%)
mean hematocrit	45.1 (4.4)	46.1 (3.4)	46.6 (3.8)	45.5 (4.2)
mean serum creatinine	1.2	1.2	1.2	1.2
elevated serum creatinine (> 1.5 mg/dl)	1 (7%)	1 (4%)	1 (7%)	3 (8%)
elevated BUN (> 20 mg/dl)	1 (7%)	6 (22%)	2 (14%)	5 (12%)
mean urine cadmium (ug/g creat.)	1.0	1.1	0.9	1.2
elevated urine protein	2 (14%)	2 (7%)	0	4 (40%)
mean B2-microglobulin (ug/g creatinine)	91	64	69	66

---

[a]standard deviation
[b]p=0.048, Fisher's Exact Test, 2-tailed
[c]p=0.046, Student's t Test
[d]p=0.017, Fisher's Exact Test, 2-tailed
[e]p=0.032, Student's t Test
[f]p=0.078, Student's t Test

Table 9

Comparison of workers by jobs worked

Sherwin Williams
Coffeyville, Kansas
HETA 81-356
February 1982

	Group 10 barium 12 workers	Group 11 non-barium 25 workers	Group 12 past 26 workers	Group 5 salaried 9 workers
mean age (years)	47 (6.4)[a]	43 (7.6)	50 (12.8)	45 (8.9)
Whites/Blacks	10/2	20/5	22/4	9/0
mean seniority (years)	21 (7.5)	18 (7.2)	20 (13.5)	11 (11.9)
smokers	4	9	11	3
past smokers	4	9	7	3
symptoms (twice or more per week, within past two months):				
headache	0	5 (20%)	2 (8%)	0
cough	3 (25%)	3 (12%)	8 (31%)	1 (11%)
phlegm	3 (25%)	1 (4%)	7 (27%)	0
wheezing	0	1 (4%)	5 (19%)	1 (11%)
short of breath	2 (17%)	2 (8%)	4 (15%)	1 (11%)
chest pain	0	2 (8%)	2 (8%)	0
stuffy nose	3 (25%)	5 (20%)	10 (38%)	2 (22%)
eye irritation	1 (8%)	2 (8%)	6 (23%)	1 (11%)
chills	0	0	0	0
diarrhea	0	0	0	0
nausea	0	0	2 (8%)	0
skin problems	2 (17%)	2 (8%)	0	1 (11%)
drowsiness	0	1 (4%)	1 (4%)	0
sore throat	0	1 (4%)	1 (4%)	1 (11%)

Table 9 (cont.)

Comparison of workers by jobs worked

Sherwin Williams
Coffeyville, Kansas
February 1982

	Group 10 barium 12 workers	Group 11 non-barium 25 workers	Group 12 past 26 workers
mean blood lead (ug/dl)	24 (8.4)	32 (10.5)	20 (9.2)
blood lead > 39	0[b]	7 (28%)	1 (4%)
mean FEP (ug/dl)	40 (23.0)	51 (48.7)	31 (22.2)
elevated blood pressure (defined in text)	7 (58%)	5 (20%)[c]	13 (50%)
mean hematocrit	46.3 (5.4)	45.7 (3.6)	46.9 (4.1)
mean serum creatinine	1.2	1.2	1.3
elevated serum creatinine (> 1.5 mg/dl)	0	2 (8%)	3 (12%)
elevated BUN (> 20 mg/dl)	1 (8%)	3 (12%)	3 (12%)
mean urine cadmium (ug/g creat.)	1.3	1.0	1.3
elevated urine protein	0	2 (8%)	2 (8%)
mean B2-microglobulins (ug/g creatinine)	33	56	47

[a]standard deviation
[b]p=0.072, Fisher's Exact Test, 2-tailed
[c]p=0.029, Fisher's Exact Test, 2-tailed

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