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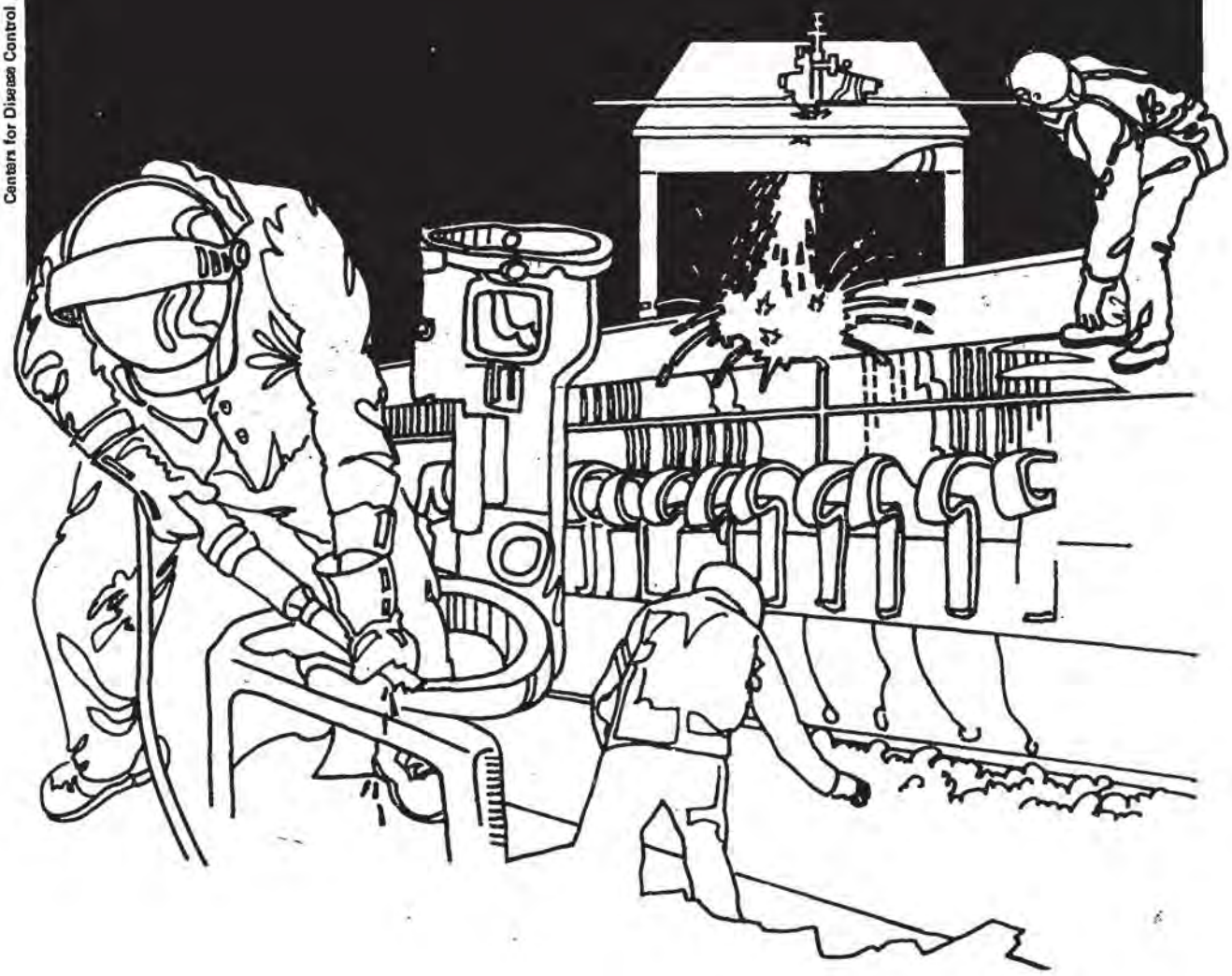
NIOSH



Health Hazard Evaluation Report

HETA 84-488-1793
J.R. SIMPLOT COMPANY
POCATELLO, IDAHO

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 84-488-1793
APRIL 1987
J.R. SIMPLOT COMPANY
POCATELLO, IDAHO

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I. SUMMARY

In September 1984, the National Institute for Occupational Safety and Health received a request from the Oil, Chemical and Atomic Workers International Union to determine if exposures to acid mists, ammonia, fluorides, nitrogen dioxide, free silica and sulfur dioxide were causing adverse health effects among workers at the J.R. Simplot Company, Pocatello, Idaho.

An initial survey was conducted on January 8-9, 1985, to observe the production processes and gather preliminary information; definitive environmental and medical surveys were conducted from July 23-25, 1985. Seven 8-hour time-weighted average (TWA) breathing zone air concentrations of ammonia ranged from 5 to 34 parts per million parts of air (ppm). Three 5-minutes samples collected while the worker was in the compressor room had concentrations of 55, 65, and 75 ppm; these exceeded the NIOSH recommended exposure limit (REL) of 50 ppm. Thirteen fluoride concentrations ranged from 0.1 to 1.08 milligrams per cubic meter of air mg/cu m, all less than 50% of the NIOSH REL of 2.5 mg/cu m. Nine of 11 acid mist concentrations ranged from 0.8 to 0.21 mg/cu m; the other two, 5.05 mg/cu m in a phos-acid "A" belt filter operator and 7.98 mg/cu m in an evaporator tank farm helper, exceeded the NIOSH REL for hydrogen fluoride of 2.5 mg/cu m, and the latter also exceeded the OSHA standards for phosphoric acid and sulfuric acid, each 1 mg/cu m. All ten 8-hour TWA samples for nitrogen dioxide had concentrations less than 0.15 ppm (NIOSH REL: 1 ppm). One of 11 8-hour sulfur dioxide samples, 0.75 ppm in a #100 operator, had a concentration that exceeded the NIOSH REL of 0.5 ppm; the other ten had concentrations of 0.1 ppm or less. Four of nine sulfur samples for respirable free silica in the calciner area, 1 of 5 in rock areas, and 1 of 3 in the mill area had concentrations that exceeded the NIOSH REL of 0.05 mg/cu m; exposed workers wore respirators.

Seventy-four men, 25% of the target population, completed a medical and occupational history questionnaire. Some specific eye, nose, and sinus complaints were reported by 30% or more of participants to occur at least 1-2 days per week, and by 17% or more to occur on most days. Chronic cough, chronic bronchitis, and shortness of breath were not associated with length of employment independent of age and smoking. Forty workers, including 17 who did not participate in the questionnaire survey, had a chest X ray; none had X ray signs of pneumoconiosis.

Based on the environmental data obtained during this investigation, the NIOSH investigators concluded that workers were overexposed to ammonia, hydrogen fluoride, phosphoric acid, sulfuric acid, silica, and sulfur dioxide. Eye and upper respiratory tract irritation were commonly reported, but no association between work at the company and pulmonary disease was documented. Because of the low participation rate, the participants, and thus the results, may not be representative of the entire workforce. Recommendations to reduce workers' exposures to hazardous vapors, mists, and particulates are presented in Section VIII of this report.

KEYWORDS: SIC 2874 (Phosphatic Fertilizers), acid mists, ammonia, formaldehyde, nitrogen dioxide, free silica, sulfur dioxide.

II. INTRODUCTION

In September 1984, the National Institute for Occupational Safety and Health received a request from the Oil, Chemical and Atomic Workers International Union to determine if exposures to acid mists, ammonia, fluorides, nitrogen dioxide, free silica and sulfur dioxide were causing adverse health effects among workers at the J.R. Simplot Company, Pocatello, Idaho.

An initial survey was conducted January 8-9, 1985. Environmental and medical surveys were conducted July 23-26, 1985. An interim report was submitted to the Simplot Company and the Union in January 1986. Employees were notified of their chest X ray findings in July 1986.

III. BACKGROUND

The Simplot Company's Pocatello facility produces ammonium phosphate fertilizers. The plant produces the phosphoric acid, sulfuric acid and ammonia which are needed in the production of the fertilizer.

The phosphate-bearing ore, which is mined nearby, is transported to the plant via bottom dump railcars. Two ores are used. One, which is coarse, is crushed, sized, calcined, and milled to a fine powder at the plant. The other is milled off the premises and comes in as a fine flour-like dust; it requires only calcining. The fine, calcined ore is digested with sulfuric acid to produce phosphoric acid. The 30% phosphoric acid is extracted and is then concentrated to 42% by evaporating the water at low pressures. The phosphoric acid is stored until further use.

The sulfuric acid used in the processes is made at this plant. It is produced by burning liquid sulfur with air, converting the resultant sulfur dioxide to sulfur trioxide over a catalyst and absorbing the sulfur trioxide in water to form sulfuric acid.

The ammonia used in the production of ammonium phosphate fertilizer is also produced at this facility. Ammonia is made by reacting natural gas, steam and air together over catalysts at controlled high temperatures and pressures.

The ammonia and phosphoric acids are reacted together to produce the ammonium phosphate fertilizer. A number of other dry and liquid fertilizers are also produced at this facility.

There are approximately 600 employees, including 400 hourly at the plant. Of these, approximately 200 workers operate the plant on a 24-hours/day, seven days/week schedule. In addition, there are 200 maintenance workers, the majority of whom work the day shift.

Each operation in the process is controlled by an operator who spends most of his work shift in a control room where the operation is monitored and controlled. In addition, there are one or more workers in each area who assist in keeping the equipment running smoothly and perform various clean-up duties. The maintenance crews work primarily in specific areas assigned to that crew. Labor pool employees can be assigned anywhere in the plant as needed.

The plant workers may be exposed to one or more of the following airborne contaminants while performing their jobs: acid mists (hydrogen fluoride, phosphoric acid and sulfuric acid), ammonia, fluorides, nitrogen dioxide, sulfur dioxide, free silica, other dust. The firm's industrial hygiene staff monitors each job classification for the appropriate contaminants.

Simplot Company has a respirator program to supplement the engineering controls in use on the various processes to reduce worker exposure to the airborne contaminants. In some work areas respirator usage is required; in others the individual worker uses his own judgment.

IV. EVALUATION DESIGN AND METHODS

A. Environmental

Environmental breathing zone air samples were collected to determine employees' exposure to the substances listed in Table 1. After reviewing the company's sampling results, the job classifications that had previous exposures were retested for sampling. Ten to 15 samples were collected for each contaminant.

B. Medical

Questionnaire interviews were offered to workers on the first and second shifts in the ammonia plant, the sulfuric acid plant, the phosphoric acid plant, the evaporator area, the liquid plant, the sulfur unloading area, the rock unloading area, the calciner area, and the mill area. Maintenance workers, some of whom were assigned to one area and others of whom were sent to various areas, were also offered interviews, as were laborers, who were sent to many areas of the plant. Some workers, who were not able to participate in interviews, were asked to complete their questionnaires themselves and send them to NIOSH.

The questionnaire inquired about basic demographic information, respiratory and other symptoms, occupational history, and cigarette smoking. For the purposes of this study, chronic bronchitis was defined as cough and phlegm on most days, for at least 3

consecutive months a year, for at least 2 years.[1] By analogy, chronic cough was defined as cough on most days, at least 3 consecutive months a year, for at least 2 years. Severity of shortness of breath was graded according to the responses to the five pertinent questions on the questionnaire.

Grade 1- Troubled by shortness of breath when hurrying on the level or walking up a slight hill.
Grade 2- Having to walk slower (on the level) than people of the same age because of shortness of breath.
Grade 3- Having to stop for breath when walking at one's own pace on the level.
Grade 4- Having to stop for breath after walking about 100 yards (or after a few minutes) on the level.
Grade 5- Too breathless to leave the house or breathlessness on dressing or undressing.

Chest X rays were offered by letter to all workers. Workers could have the X ray at a local medical facility any time from 9 a.m. to 5 p.m., from April through June 1985, without an appointment. This period was extended through August 1985 in an effort to bolster a low response rate.

Chest X rays were interpreted according the ILO 1980 International Classification of Radiographs of Pneumoconiosis.[2] Each X ray was read independently by two radiologists certified in the use of the ILO system ("B readers"). In case of a disagreement, the X ray was read independently by a third B reader, and the majority opinion (or median value) of a disputed finding was used for analysis. (Each participant was informed of all findings on his own X ray, not just the majority interpretation.)

V. EVALUATION CRITERIA

A. Environmental Criteria

As a guide to the evaluation of the hazards posed by workplace exposures, NIOSH field staff employ environmental evaluation criteria for assessment of a number of chemical and physical agents. These criteria are intended to suggest levels of exposure to which most workers may be exposed up to 10 hours per day; 40 hours per week for a working lifetime without experiencing adverse health effects. It is, however, important to note that not all workers will be protected from adverse health effects if their exposures are maintained below these levels. A small percentage may experience adverse health effects because of individual susceptibility, a pre-existing medical condition, and/or a hypersensitivity (allergy).

In addition, some hazardous substances may act in combination with other workplace exposures, the general environment, or with medications or personal habits of the worker to produce health effects even if the occupational exposures are controlled at the level set by the evaluation criterion. These combined effects are often not considered in the evaluation criteria. Also, some substances are absorbed by direct contact with the skin and mucous membranes, and thus potentially increase the overall exposure. Finally, evaluation criteria may change over the years as new information on the toxic effects of an agent becomes available.

The primary sources of environmental evaluation criteria for the workplace are: 1) NIOSH Criteria Documents and recommendations; 2) the American Conference of Governmental Industrial Hygienists' (ACGIH) Threshold Limit Values (TLV's); 3) the U. S. Department of Labor (OSHA) occupational health standards; and 4) the American Industrial Hygiene Association's Hygiene Guide Series. Often, the NIOSH recommendations and ACGIH TLV's are lower than the corresponding OSHA standards. Both NIOSH recommendations and ACGIH TLV's usually are based on more recent information than are the OSHA standards. The OSHA standards also may be required to take into account the feasibility of controlling exposures in various industries where the agents are used; the NIOSH recommended exposure limits, by contrast, are based primarily on concerns relating to the prevention of occupational disease. In evaluating the exposure levels and the recommendations for reducing these levels found in this report, it should be noted that industry is legally required to meet those levels specified by an OSHA standard.

A time-weighted average (TWA) exposure refers to the average airborne concentration of a substance during a normal 8- to 10-hour workday. Some substances have recommended short-term exposure limits or ceiling values which are intended to supplement the TWA where there are recognized toxic effects from high short-term exposures.

B. Specific substances

Environmental evaluation criteria and health effects of substances measured during this investigation are presented in Table 2.

VI. RESULTS AND DISCUSSION

A. Environmental

The evaluation request included all job descriptions in the plant processes. Evaluation of the occupational health exposures for

each job description would entail extensive sampling. The company's industrial hygiene staff has performed these evaluations over the last few years. Based on the their results, we selected various job descriptions and collected breathing zone samples for the airborne contaminants workers were exposed to. The company's data were reviewed and compared to the sampling data collected by NIOSH.

Ammonia - The ammonia sample results collected in the ammonia plant are shown in Table 3. The 8-hour TWA personal sample results ranged from 5 to 34 ppm. The worker doing the "assistant control compressor" job had exposures of 27, 33 and 34 ppm for 3 shifts. Eleven of 12 8-hour TWA samples collected by the company during 1984 for this job ranged from 30 to 84 ppm, with an average of 43 ppm. During one shift, several 5-minute general area samples were collected in the ammonia compressor room, where the worker spends a portion of the work shift. These concentrations were 55, 65, and 75 ppm. The NIOSH evaluation criterion for ammonia is 50 ppm for any 5-minute period. Although the 8-hour TWA exposures were 27 to 34 ppm, a portion of the work shift was spent in concentrations that exceeded 50 ppm. It appeared that a good portion of the ammonia released from the equipment was from repairable leaks. (Equipment may have to be shut down before the repairs can be made.) The NIOSH ammonia sample results compared very well with the company's past sampling data for all job categories.

Fluorides - The fluoride sample results are shown in Table 4. The samples were collected in the evaporator area, phos-acid area, and in the liquid plant. The total fluoride concentrations, which consisted of both gaseous and particulate fluoride, ranged from 0.17 to 1.08 mg/cu m. Twelve of the 13 sample results were less than 33% of the evaluation criterion of 2.5 mg/cu m. The other one was 43% of the criterion. The NIOSH fluoride results compared very well with the company's past data.

Hydrogen Fluoride, Phosphoric Acid, and Sulfuric Acid - Samples were collected in the evaporator and phos-acid area for acid mists. The samples were analyzed for the fluoride, phosphate, and sulfate ions and calculated as hydrogen fluoride, phosphoric acid, and sulfuric acid. The sample results are shown in Table 5. Nine of the eleven personal breathing zone total acid concentrations ranged from 0.08 to 0.21 mg/cu m. The phos-acid "A" belt filter operator had a total acid exposure of 5.05 mg/cu m, and the evaporator tank farm helper had an exposure of 7.98. Both of these workers' exposures exceeded the evaluation criterion for hydrogen fluoride (2.5 mg/cu m), and the evaporator tank farm helper's

exposure also exceeded the evaluation criteria for phosphoric acid and sulfuric acid (1.0 mg/cu m). During a second shift sampling, these jobs had exposures of 0.18 and <0.08 mg/cu m total acid.

The job duties that these workers performed that produce these high total acid exposures were not documented. These jobs need to be evaluated to determine what duties produce high exposures and then respiratory protection should be worn by the workers when these duties are performed.

The NIOSH data and the company data correlate fairly well for hydrogen fluoride and phosphoric and sulfuric acids.

Nitrogen Dioxide - The nitrogen dioxide samples collected in the ammonia plant are shown in Table 6. All ten 8-hour TWA personal breathing zone sample results were less than 0.15 ppm. This is much less than the evaluation criterion of 1 ppm (ceiling) for nitrogen dioxide. There results do not compare at all with the past company results. The 15 nitrogen dioxide samples collected by Simplot during 1984 ranged from 0.5 to 3.7 ppm with 12 that exceeded 1 ppm. The NIOSH and the Simplot sampling methods were different; the method used by Simplot was a direct-reading device. It is possible that this method had a positive interference from the nitrogen in the ammonia that is present in this area. Simplot has changed sampling methods and recent samples reportedly showed no detectable nitrogen dioxide.

Respirable Free Silica - Respirable free silica (quartz) samples collected in the calciner, rock and mill areas are shown in Table 7. There were nine personal samples collected in the calciner area. Four of these exceeded the NIOSH recommended exposure limit for respirable free silica (0.05 mg/cu m). Three of the four were from the utility helper, and the fourth was from a maintenance worker. There is a mandatory respirator requirement in effect in this area.

One of five personal samples in the rock area exceeded the OSHA permissible exposure level. That sample was collected on the heavy equipment operator. Three personal samples were collected in the mill area. One of the three samples, from the "A" operator, had a concentration that exceeded the OSHA permissible exposure level for respirable free silica. The Simplot data collected in 1984 compares favorably with the NIOSH data. The company data showed many days when workers in these three areas were potentially exposed to air concentrations of silica that exceeded the NIOSH recommended exposure limit.

Sulfur Dioxide - Eleven personal samples were collected for sulfur dioxide in the sulfuric acid plant areas and the sulfur unloading operation (Table 8). The sulfur dioxide concentrations ranged from <0.01 to 0.75 ppm. One sample result exceeded the sulfur dioxide evaluation criterion of 0.5 ppm. That job was the #100 operator. The Simplot results for 1984 showed three of six sample results collected from the operators of the three sulfuric acid units greater than 0.5 ppm.

B. Medical

Seventy-four workers, all men, completed the questionnaire. They ranged in age (to nearest year) from 20 to 65 years, with a mean of 38 and a median of 36. They had worked at the company from 3 months to 33 years, with a mean of 11 1/2 years and a median of 9 years. They worked at their current job from 1-month to 23 years, with a mean of six and a median of 5 years. Twenty-two (30%) were current cigarette smokers; 29 (39%) had never smoked. The 74 participants represented approximately 25% of those invited to participate in the survey.

Forty workers had a chest X ray, including 17 who did not submit a questionnaire. All X rays were negative for signs of pneumoconiosis. [In two cases, one radiologist reported small, irregular opacities (size s and t) in the lower and middle lung fields, with profusion 0/1--the lowest category. In both cases, however, the other two radiologist reported no signs of pneumoconiosis.]

Among the questionnaire survey participants, eye, nose, and sinus complaints were the most prevalent work-related symptoms (Table 9). Other symptoms, somewhat less frequently reported, included skin itching, cough, headache, and shortness of breath.

Nine workers (12% of the 74 participants) reported symptoms that met the epidemiologic case definition for chronic cough, and seven of these (9% of the participants) met the criteria for chronic bronchitis. All seven of the latter reported shortness of breath, as did nine of those without chronic cough or bronchitis, for a total of 22% of the participants. All but five of the 16 had grade 1 shortness of breath, three had grade 2, and one each had grade 3 and 4. Chronic cough, chronic bronchitis, and shortness of breath each appeared to be associated with age and cigarette smoking, and shortness of breath appeared to be associated with years at the company (Table 10). Since all three of these variables, however, are correlated (Pearson correlation coefficients: for age and length-of employment, $r=0.73$, $p=0.001$; for age and pack-years, $r=0.42$, $p=0.0005$; for length of employment and pack-years, $r=0.33$, $p=0.0074$), the relationship between length of employment and each of the three health outcomes was analyzed by

logistic regression using age and smoking as covariates. Length of employment was not, independent of age and smoking, associated with chronic cough, chronic bronchitis, or shortness of breath.

Analysis of health outcomes by specific jobs, or by categories of jobs with comparable exposures, was not done because too many of the questionnaires contained ambiguous or inaccurate job history information.

VII. CONCLUSION

Workers in the following jobs were exposed to the substances indicated at levels that exceeded their evaluation criteria: compressor room workers--ammonia; belt filter operator--hydrogen fluoride; tank farm helpers--hydrogen fluoride, phosphoric acid, and sulfuric acid; #100 operator--sulfur dioxide; and calciner utility helper, calciner maintenance, heavy equipment operator, and mill operator--respirable free silica. The workers exposed to concentrations of silica that exceeded the NIOSH REL wore respirators.

With the exception of the nitrogen dioxide samples, the NIOSH and Simplot exposure data appear comparable.

The medical survey found work-related eye and upper respiratory tract irritation to be commonly reported by employees. There were no X ray-defined cases of silicosis. After controlling for age and cigarette smoking, there was no association between length of employment at the company and chronic cough, chronic bronchitis, or shortness of breath. The participation rate in the medical survey was low, so participants, and thus the survey results, may not have been representative of the entire workforce.

VIII. RECOMMENDATIONS

1. The NIOSH recommended exposure limits for ammonia, nitrogen dioxide and sulfur dioxide are more restrictive than the OSHA standards, and we recommend that worker exposures be maintained below these concentrations. We recommend that each job description and task be re-evaluated, and that those exposures that exceed the most stringent criterion for the respective substance be reduced through the use of engineering controls and, where necessary, respiratory protection. Although respirators are used in many areas of the plant, reducing the workers' exposures through the use of engineering controls should be a primary objective.

2. Local exhaust ventilation could be installed in the ammonia compressor room. By utilizing flexible ducting and multiple outlets, escaping ammonia gas could be captured until the leaks are repaired. Until the leaking ammonia sources can be controlled at the source, workers in the compressor building should wear respirators for use with ammonia.

3. To reduce the operators' exposures to respirable free silica, filtered conditioned air should be supplied to the cabs of the heavy equipment.

4. Except when they are in the control room, personnel in the mill area should wear respirators approved for use with exposure to free silica.

5. To prevent free silica from being carried home, workers in the calciner, rock, and mill areas should have work clothing that is not worn home. The company should provide lockers and showers and should be responsible for laundering work clothes.

6. The sampling method previously used for nitrogen dioxide should not be re-instituted unless it is evaluated, by taking side-by-side samples with a method that is known to have no interference from other nitrogen-containing compounds present, and found to be accurate.

7. Sulfur dioxide concentrations in the sulfuric acid plant control rooms should be measured. If sulfur dioxide is present and it contributes significantly to the 8-hour TWA operator's exposure, the sulfur dioxide should be removed from the control room supply air.

8. The company should continue to provide the workers with the sample results for their job descriptions, information on the potential health effects of the exposures, and information and training regarding the various methods to reduce their exposures.

9. Since a respirator can increase the pulmonary, cardiac, and other physiologic stresses associated with work, workers should have periodic medical evaluations to determine their ability to wear respirators. Guidelines regarding the content and frequency of the medical evaluations, and the medical reasons for recommending restrictions on respirator use, have been published.[3,4]

10. Employees exposed to silica should have pre-placement and periodic medical evaluations. These should include a medical and occupational history, physical examination, pulmonary function tests, and a chest X ray. The X rays can be taken infrequently at first (at 5-year intervals, for example), unless other medical findings suggest a need for a diagnostic X ray sooner. After 10 or 15 years of exposure, more frequent X rays are appropriate. X rays should be read according to the ILO 1980 system.[2] Pulmonary function testing should be performed using equipment and procedures conforming to the American Thoracic Society's criteria for screening spirometry.[5] An employee with significant respiratory symptoms, physical findings, pulmonary function test abnormalities, or X ray signs of pneumoconiosis should be evaluated by a physician

(preferably a pulmonary or occupational medicine specialist) to determine whether it is advisable for the employee to be removed from further exposure to silica.

IX. REFERENCES

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XI. DISTRIBUTION AND AVAILABILITY OR REPORT

Copies of this report are currently available upon request from NIOSH, Division of Standards Development and Technology Transfer, Information Resources and Dissemination Section, 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. J. R. Simplot Company
2. Oil, Chemical, and Atomic Workers Union Local 2-632
3. U.S. Department of Labor/OSHA - Region X

For the purpose of informing affected employees, a copy 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.

Substances measured, collection and analytical methods

J. R. Simplot Company
Pocatello, Idaho
HETA 84-488
July 23-26, 1985

Substance	Collection Method	Flow Rate	NIOSH Analytical Method
Acid Mists (hydrogen fluoride, phosphoric acid, sulfuric acid)	silica gel tubes	200 cc/min	7903
Ammonia	sulfuric acid treated silica gel tubes	200 cc/min	P&CAM S-347
	detector tubes	-	direct reading
Fluorides gaseous and particulate	0.8 u cellulose ester filters followed by Na_2CO_3 treated back up pads	1-2 lpm	7902
Nitrogen dioxide	Palms tubes with 3 triethanolamine treated screens	-	6700
Respirable dust	PVC Filter	1.7 lpm	Filters weighed on an electro-balance
Respirable free silica	PVC filter	1.7 lpm	Free silica determined by X-ray defraction method 7500
Sulfur dioxide	Cellulose membrane filters followed by KOH treated filters	1 lpm	P&CAM 268

Table 2.

Environmental evaluation criteria and health effects of substances measured as part of the investigation

J. R. Simplot Company
Pocatello, Idaho
HETA 84-488
July 23-26, 1985

Substance	NIOSH (or ACGIH) Recommended Exposure Limit 10-Hr TWA	OSHA Standard 8-Hour TWA	Health Effects
Ammonia	50 ppm, 5-min ceiling	50 ppm	Irritation of eyes, nose, throat, and lungs; shortness of breath, chest pain, and pulmonary edema (fluid in the lungs) from high exposures; eye injury and skin burns from contact with liquid anhydrous ammonia.
Fluorides, gaseous and particulate	2.5 mg/cu m	2.5 mg/cu m	Irritation of eyes and respiratory tract, nausea, dermatitis; increased X ray density of bones, calcification of ligaments, and stiffness of spine from prolonged high exposure.
Nitrogen dioxide	1 ppm ceiling	5 ppm	Cough, shortness of breath, and pulmonary edema; relapse can occur; imparied lung function can occur.
Hydrogen fluoride	2.5 mg/cu m; 5 mg/ cu m, 15-min ceiling	2 mg/cu m	Irritation of eyes, nose, throat, and lungs; delayed pulmonary edema; eye injury and severe, persistent skin burn from contact with liquid.

Table 2. (Continued)

Environmental evaluation criteria and health effects of substances measured as part of the investigation

J. R. Simplot Company
Pocatello, Idaho
HETA 84-488
July 23-26, 1985

Substance	NIOSH (or ACGIH) Recommended Exposure Limit 10-Hr TWA	OSHA Standard 8-Hour TWA	Health Effects
Phosphoric acid	-	1 mg/cu m	Irritation of eyes, nose, throat, and skin; skin and eye burns from contact with liquid.
Respirable quartz dust (free silica)	0.05 mg/cu m	10 mg/cu m % SiO_2+2	Pulmonary fibrosis with impairment of lung function, shortness of breath, and cough; X ray signs appear before symptoms.
Sulfur dioxide	0.5 ppm	5 ppm	Irritation of eyes, nose, throat, and skin; choking and coughing; pulmonary edema; eye and skin burns from liquid.
Sulfuric acid	1 mg/cu m	1 mg/cu m	Irritation of eyes, nose and throat; pulmonary edema; bronchitis; erosion of teeth; skin and eye burns from liquid.

Table 3

Ammonia Air Concentrations

J. R. Simplot Company
Pocatello, Idaho
HETA 84-488
July 23-25, 1985

Job Description in Ammonia Plant	Date	Sample Number	Sample Time Min	Sample Volume Liters	Ammonia ppm
Control Man	7-23-85	1	439	87	7
Asst Control Compressor	7-23-85	2	436	82	33
Asst Control Compressor	7-24-85	9	406	75	27
Asst Control Compressor	7-25-85	5	424	84	34
Utility Operator	7-24-85	3	417	78	5
Asst Control Outside	7-24-85	4	409	64	7
Nitrate Solution Opr	7-25-85	7	418	76	3
Detector Tube Samples					
General Area Ammonia Compressor Rm	7-25-85	10	5 10:30am	1	65
General Area Ammonia Compressor Rm	7-25-85	11	5 1:00pm	1	55
General Area at "A" Compressor Lubricating Station	7-25-85	12	5 1:00pm	1	75
Control Room	7-25-85	13	5 1:30pm	1	5

Evaluation Criteria - 50 ppm, 5 min ceiling

Table 4

Fluoride Air Concentrations
J. R. Simplot Company
Pocatello, Idaho

HETA 84-488
July 23-25 and August 7-8, 1985

Job Description	Date	Sample Number	Sample Time Minutes	Sample Volume Liters	Gaseous Fluoride mg/cu m	Particulate Fluoride mg/cu m	Total Fluoride mg/cu m
Evaporator - A Opr Tank Farm	7-23-85	2	420	420	0.22	0.06	0.28
Evaporator - A Opr Tank Farm	7-24-85	9	426	426	0.23	0.05	0.28
Evaporator - A Opr	7-24-85	7	387	387	0.39	0.31	0.70
Evaporator - A Opr	7-25-85	12	431	431	0.97	0.11	1.08
Evaporator - Maint	7-23-85	1	420	420	0.22	0.06	0.28
Phos-Acid - Senior Operator Agitator	7-23-85	3	408	408	0.21	0.04	0.25
Phos-Acid - B Opr	7-24-85	8	400	400	0.21	0.26	0.47
Phos Acid - B Opr	7-25-85	6	424	424	0.61	0.05	0.66
Phos Acid - Maint	7-25-85	15	420	420	0.73	0.11	0.84
Liquid Plant Opr	8-7-85	5	420	727	0.39	0.01	0.40
Liquid Plant Opr	8-8-85	14	450	783	0.20	0.01	0.21
Liquid Plant Filter Operator	8-7-85	4	420	727	0.16	0.01	0.17
Liquid Plant Filter Operator	8-8-85	10	450	783	0.19	0.01	0.20

Evaluation Criteria - Gaseous fluoride - 2.5 mg/m^3
Particulate Fluoride - 2.5 mg/m^3
Total Fluoride - 2.5 mg/m^3

Table 5

Hydrogen Fluoride, Phosphoric Acid and Sulfuric Acid
Air Concentrations
J. R. Simplot Company
Pocatello, Idaho

HETA 84-488
July 23-25, 1985

Job Description	Date	Sample Number	Sample Time Minutes	Sample Volume Liters	Hydrogen Fluoride mg/cu m	Phosphoric Acid mg/cu m	Sulfuric Acid mg/cu m	Total Acid mg/cu m
Evaporator "A" Opr	7-23-85	4	425	88	0.07	<0.05	<0.05	0.07
Evaporator Sr Opr	7-25-85	13	428	82	0.19	<0.05	<0.05	0.19
Evaporator "A" Opr Tank Farm	7-24-85	8	400	79	0.13	0.06	<0.06	0.19
Evaporator Tank Farm Helper "B" Opr	7-24-85	7	383	70	3.29	3.43	1.26	7.98
"	7-25-85	11	390	51	<0.02	<0.08	<0.08	<0.08
Phos Acid "A" Opr Belt Filter	7-23-85	3	405	76	0.11	<0.06	0.05	0.16
Phos Acid "A" Opr Belt Filter	7-24-85	6	405	82	0.18	<0.05	<0.05	0.18
"	7-25-85	15	423	81	4.69	0.22	0.14	5.05
"B" Opr Filter Opr	7-23-85	1	399	80	0.20	<0.05	<0.05	0.20
Phos-Acid Sr Opr Agitator	7-24-85	2	405	79	0.13	<0.05	0.06	0.19
Phos-Acid Sr Opr Agitator	7-25-85	14	287	54	0.21	<0.07	<0.07	0.21

Evaluation Criteria - Hydrogen Fluoride - 2.5
Phosphoric acid - 1.0
Sulfuric acid - 1.0

Table 6

Nitrogen Dioxide Air Concentrations

J. R. Simplot Company
Pocatello, Idaho
HETA 84-488
July 23-25, 1985

Job Description	Date	Sample Number	Sample Time Minutes	Nitrogen Dioxide ppm
Asst Control Outside	7-23-85	2	403	<0.15
Asst Control Outside	7-24-85	5	298	<0.15
Asst Control Outside	7-25-85	13	410	<0.15
Nitrate Solution Opr	7-23-85	4	360	<0.15
Nitrate Solution Opr	7-24-85	6	399	<0.15
Nitrate Solution Opr	7-25-85	14	416	<0.15
Utility Operator	7-23-85	3	402	<0.15
Utility Operator	7-24-85	7	305	<0.15
Utility Operator	7-25-85	11	418	<0.15
Asst Control Compressor	7-24-85	8	287	<0.15

Evaluation Criteria - 1 ppm ceiling

Table 7

Respirable Dust & Free SiO_2 Air Concentrations
J. R. Simplot Company
Pocatello, Idaho

HETA 84-488
July 23-25, 1985

Location & Job	Date	Sample No.	Sample Time Minutes	Sample Volume Liters	Respirable Dust mg/cu m	Wt Free SiO_2 mg/cu m	% Free SiO_2	OSHA PEL mg/cu m	NIOSH Criteria mg/cu m
Calciner									
A Operator	7-23-85	5015	434	738	0.27	<0.02	-	-	0.05
A Operator	7-24-85	5236	420	714	1.68	0.04	2.4	2.27	0.05
A Operator	7-25-85	5036	425	722	1.26	0.03	2.4	2.27	0.05
Utility Helper	7-23-85	4822	434	738	6.02*	0.53*	8.8	0.93	0.05
Utility Helper	7-24-85	5020	424	721	4.13*	0.11*	2.7	2.13	0.05
Utility Helper	7-25-85	5035	425	722	2.77*	0.12*	4.3	1.59	0.05
Laborer	7-23-85	5014	371	631	1.72	0.03	1.7	2.70	0.05
Control Room	7-24-85	5019	420	714	0.06	<0.02	-	-	0.05
Maint	7-25-85	5034	355	603	6.98*	0.25*	3.6	1.79	0.05
Rock									
Smokey Open	7-23-85	5018	414	704	0.89	0.06*	6.7	1.15	0.05
Laborer	7-23-85	4820	424	721	0.48	0.03	6.3	1.20	0.05
Hvy Equip Scoop	7-24-85	4970	414	704	3.48*	0.06*	1.7	2.70	0.05
Gay Laborer	7-24-85	5237	416	707	0.98	0.06*	6.1	1.23	0.05
A Operator	7-25-85	5027	418	710	1.49	0.06*	4.0	1.67	0.05
Maint	7-25-85	5028	254	432	0.93	<0.04	4.3	1.59	0.05
Mills									
A Operator	7-23-85	4818	388	660	1.12	<0.03	2.7	2.13	0.05
A Operator	7-24-85	5235	429	729	5.43*	0.03	0.6	3.92	0.05
Maint	7-25-85	5032	355	603	1.44	<0.04	2.8	2.08	0.05

*Exceeded OSHA PEL or NIOSH criteria.

Table 8

Sulfur Dioxide Air Concentrations
J. R. Simplot Company
Pocatello, Idaho

HETA 84-488
July 23-25, 1985

Job Description	Date	Sample Number	Sample Time Minutes	Sample Volume Liters	Sulfur Dioxide ppm
Sulfuric Acid Plant #100 Operator	7-23-85	2	423	423	0.75
Sulfuric Acid Plant #100 Operator	7-24-85	7	424	424	<0.01
Sulfuric Acid Plant #200 Operator	7-23-85	1	413	413	0.03
Sulfuric Acid Plant #200 Operator	7-24-85	5	425	425	0.09
Sulfuric Acid Plant #200 Operator	7-25-85	11	411	411	0.10
Sulfuric Acid Plant #300 Operator	7-23-85	3	370	370	0.01
Sulfuric Acid Plant #300 Operator	7-24-85	4	368	368	0.08
Sulfuric Acid Plant #300 Operator	7-25-85	13	410	410	<0.01
Sulfur Unloader	7-23-85	9	371	371	<0.01
Sulfur Unloader	7-25-85	12	413	413	0.03
Liquid Plant A Operator	7-25-85	15	328	328	0.04

Evaluation Criteria - 0.5 ppm

Table 9

Work-related symptoms among 74 medical survey participants
J. R. Simplot Company
Pocatello, Idaho

HETA 84-488
July 23-26, 1985

Symptom	Number of respondents	Symptom present: At least 1-2 days per week	Symptom present: Most days
Sandy or gritty felling in eyes	73	28 (38)*	19 (26)
Itchy, watery eyes	74	25 (34)	15 (20)
Stuffy nose	72	24 (33)	12 (17)
Sinus pain or congestion	72	22 (31)	14 (19)
Burning eyes	73	21 (29)	9 (12)
Scratchy eyes	73	21 (29)	8 (11)
Frequent sneezing	73	18 (25)	10 (14)
Skin itching	72	16 (22)	8 (11)
Cough	72	15 (21)	9 (13)
Runny nose	73	15 (21)	6 (8)
Headache	72	15 (21)	3 (4)
Shortness of breath	73	14 (19)	9 (12)
Wheezy or whistling breathing	73	12 (16)	5 (7)
Itchy nose	73	12 (16)	3 (4)
Scratchy throat	73	11 (15)	3 (4)
Chest tightness	72	7 (10)	3 (4)
Hoarseness	72	6 (8)	1 (1)
Nausea	71	4 (6)	2 (3)
Itching in roof of mouth and throat	72	4 (6)	1 (1)
Bloody mucus when blowing nose	73	4 (5)	1 (1)
Burning throat	72	3 (4)	0 (0)

* Number and (% or respondents)

Table 10

Health outcomes (see text for definitions) and
potential risk factors among survey participants
J. R. Simplot Company
Pocatello, Idaho

HETA 84-488
July 23-26, 1985

	All participants	Chronic cough		Chronic bronchitis		Shortness of breath		
		No	Yes	No	Yes	No	Grade 1	Grade >1
Number*	74	60	9	62	7	51	11	5
Age (years) to nearest year								
Range	20-65	20-65	28-57	20-65	28-51	20-65	28-51	23-56
Median	36	35	48	35	48	33	43	44
Mean	38	36	42	37	42	36	40	42
Cigarette pack-years								
Range	0-129	0-129	6-70	0-129	6-70	0-43	0-70	0-129
Median	8	0	19	0	42	0	23	42
Mean	15	13	32	13	38	9	30	50
Years at company								
Range	<1-33	<1-32	3-33	<1-33	3-26	<1-33	3-28	4-26
Median	9	9	8	9	8	9	10	16
Mean	12	11	15	11	14	11	14	16

* - Because of missing or conflicting questionnaire answers, the chronic cough and chronic bronchitis status could not be determined for 5 participants, and the shortness of breath status could not be determined for 7.