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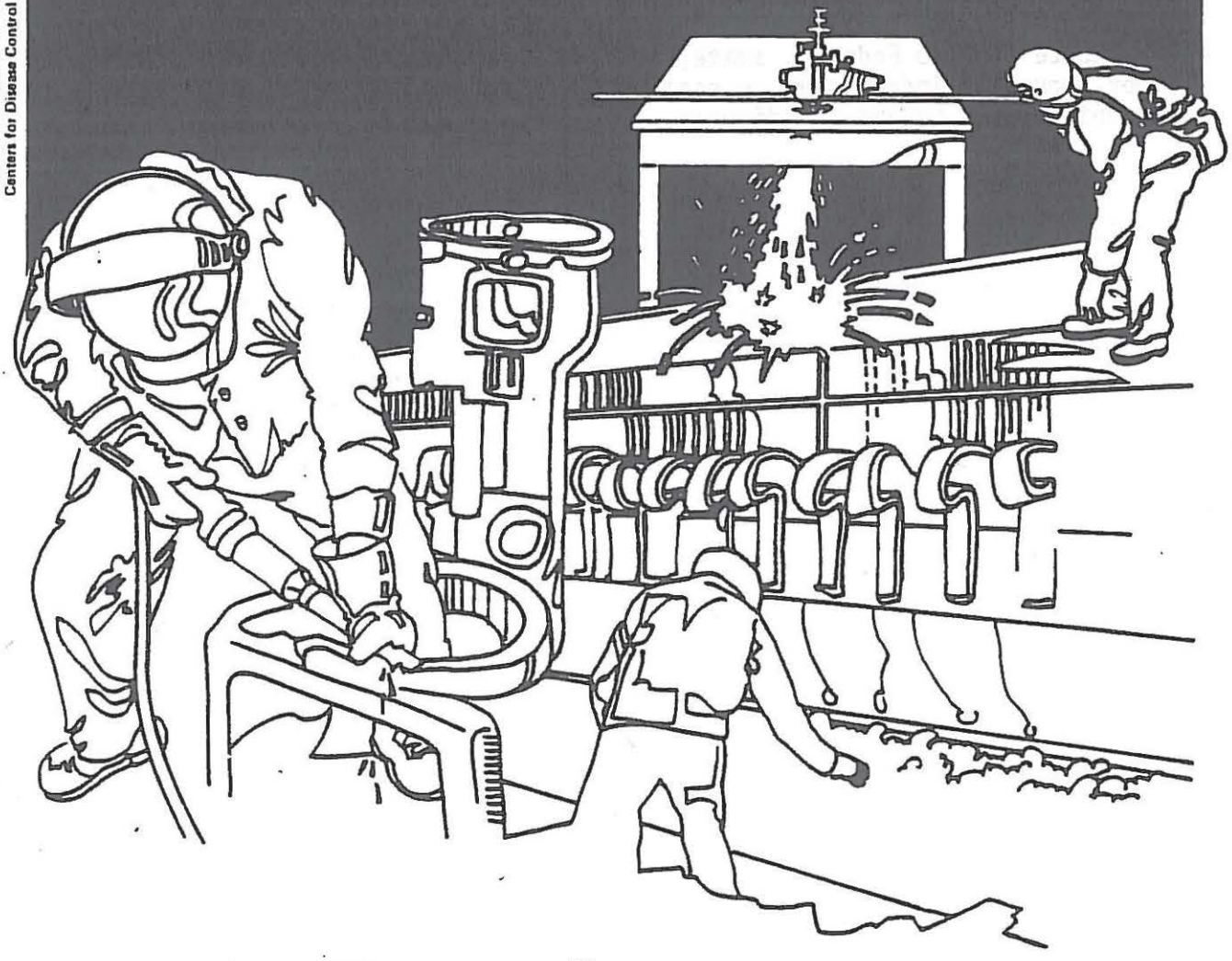

Health Hazard Evaluation Report

HETA 84-307-1581
BIG DRY CREEK PLANT
WESTMINISTER, COLORADO

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.

Mention of company names or products does not constitute endorsement by the National Institute for Occupational Safety and Health.

HETA 84-307-1581
APRIL 1985
BIG DRY CREEK PLANT
WESTMINISTER, COLORADO

NIOSH INVESTIGATORS:
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I. SUMMARY

In April 1984, the National Institute for Occupational Safety and Health (NIOSH) received a request for a Health Hazard Evaluation from Big Dry Creek Plant, a wastewater treatment facility in Westminister, Colorado, to evaluate occupational exposures to acrylamide, butyl acetate, glacial acetic acid, hydrogen sulfide and noise.

On July 30, 1984 and on November 6 and 7, 1984, a NIOSH investigator conducted an industrial hygiene survey to determine airborne concentrations of the contaminants listed above.

All air samples were below their respective standards or criteria. Levels for acrylamide (0.3 mg/M^3 NIOSH/OSHA); butyl acetate (710 mg/M^3 ACGIH/OSHA) and glacial acetic acid (25 mg/M^3 ACGIH/OSHA) were all below their analytical detection levels. Hydrogen sulfide levels ranged from non-detectable to 3 parts per million (ppm) which is below the exposure criteria of 10 ppm recommended by the American Conference of Governmental Industrial Hygienists (ACGIH) and 20 ppm required by the Occupational Safety and Health Administration (OSHA).

During the July and November survey, personal noise levels (range 87.4 to 90.9 dBA) exceeded the NIOSH recommended limit of 85 dBA 8-hour time weighted average (TWA). Noise level measurements taken in areas thought to contribute to the highest exposures in the sludge process building ranged from 85 to 100 dBA.

On the the basis of the environmental data collected, NIOSH determined that a potential health hazard to those chemicals evaluated did not exist during the study periods. However, it was determined that a potential health hazard did exist from overexposures to noise. Recommendations to further assist in preventing noise exposures are included in this report.

KEYWORDS: SIC 4959 (Sanitary Services - Sewerage Systems) wastewater treatment, sludge concentrator, air compressor; odor neutralizer, polymer flocculant systems; acrylamide, hydrogen sulfide, butyl acetate, glacial acetic acid and noise.

II. INTRODUCTION

The National Institute for Occupational Safety and Health (NIOSH) received a request in March 1984 from a representative of Big Dry Creek Plant, Westminister, Colorado. The request was to determine if there was a health hazard from various chemicals and noise created during particular phases of the waste treatment process. These chemicals included acrylamide, butyl acetate, glacial acetic acid, and hydrogen sulfide. The noise exposures were being generated during various operations and maintenance procedures in the different buildings located at the plant. Environmental surveys were conducted on July 30, 1984 and again on November 6 and 7, 1984. Results from these surveys were given verbally to the requestor and the employees as they became available and formally presented in December 1984.

III. BACKGROUND

Big Dry Creek Plant, located in Westminister, Colorado, is the largest wastewater treatment plant in the city of Westminister and has the capacity to treat over 5.0 million gallons per day. The wastewater to be treated at the plant consists of domestic and industrial wastewater from the Big Dry Creek basin. This treatment plant is referred to as a complete mix-activated sludge facility followed by aerated lagoons for effluent polishing.

There are 18 full-time employees at the plant, with the majority of these performing a variety of duties. There was only one building, the sludge processing building where two to three employees spend the majority of the day overseeing the activities of the treatment process. Other than the administration and lab building, the other buildings at the treatment facility require only occasional activities. Therefore, the concern for potential occupational health problems concentrated primarily in the sludge processing building. The following information is a brief description of the jobs and health concerns NIOSH evaluated:

The initial health problem that was thought to exist was from the addition of the acrylamide polymer (flocculant/coagulating material) which is used in the sludge processing building prior to sludge concentration. The acrylamide enters the treatment process in either a liquid or solid micro bead form. It was the later technique that was thought to be overexposing the operators. In this process, the operator is required to place a 50 pound bag of the flocculant material into a dry feeder hopper, cut the bag open, remove the contents, and dispose of the empty bag. This process was performed approximately 3 times per week and required only 10 to 15 minutes, including clean-up, to complete. The hopper was equipped with an internal exhaust system which was activated by opening the hopper lid. One hundred to 150 feet per minute (fpm) of air was pulled across the face of the hopper without a bag, which increased to 175 to 200 fpm when a bag was placed inside the hopper.

Other health concerns included overexposures to hydrogen sulfide, butyl acetate, and glacial acetic acid. The concern for hydrogen sulfide occurred primarily during the initial stages of the start-up of any one of the four sludge concentrators in the sludge processing building. These units stand idle over the weekend and create an anoerobic condition in the sludge remaining in the lines.

The concern for butyl acetate and glacial acetic acid resulted from an odor eliminating agent which is used in the primary sludge pump station. This material is mixed in a large tank by one person. It takes approximately 10 minutes to mix and is very irritating during the pouring and mixing process.

The last exposure evaluated was noise, which is a potential problem in most of the buildings reviewed. As previously discussed the only building which is occupied for the majority of the day, other than the administration building is the sludge process building. There are numerous sources of noise in this building (e.g. concentrators, air compressors, flocculators, generators, pumps, etc.). The major source of noise in this building was three air compressors located at various locations in the building.

In most operations evaluated, the employees were provided and did wear the appropriate personal protective clothing. This included noise protectors (ear muffs), goggles, aprons, gloves and boots. NIOSH/MSHA approved respirators were available; however, their use was optional.

IV. ENVIRONMENTAL DESIGN AND METHODS

A variety of sampling techniques were used to evaluate the suspected contaminants in the buildings. Personal samples were taken on the employees in each of the processes evaluated. The following is a description of the sampling techniques used:

A. Acrylamide

Acrylamide samples were collected by drawing air through a silica gel tube at approximately 200 cubic centimeters (cc) per minute. These were analyzed following the American Cyanamid Company method for acrylamide in air. The limit of detection was 0.5 milligrams (mg) per sample for acrylamide on silica gel tubes.

B. Acetic Acid

Acetic acid samples were collected by drawing air through ORBO-53 tubes at approximately 200 cc per minute and these were analyzed by NIOSH Method S-169. The limit of detection was 0.01 mg per sample for acetic acid.

C. Butyl Acetate

Butyl acetate air samples were collected by drawing air through charcoal tubes at approximately 200 cc per minute. These samples were analyzed by NIOSH Method S-47 with modifications. The limit of detection was 0.01 mg per sample for butyl acetate.

D. Hydrogen Sulfide

Hydrogen sulfide was evaluated using a colorimetric gas detection device. These tubes have an accuracy of ± 35 percent at one-half the exposure limit and an accuracy of ± 25 percent at one to five times the exposure limit.

E. NOISE

Two personal noise level measurements were taken using Metrosonic noise dosemeters which register on a memory cell the dose or noise level received during the exposure period. The data can then be displayed as a read-out (hard copy) for each minute at the end of the exposure period. The read-out also describes, at the end of the sampling period the accumulated exposure for each hour and is described as the average noise exposure for each hour evaluated.

Noise levels and sound pressure levels were also evaluated around the various buildings using a Bruel & Kjoer @ (B&K) Precision Sound Level Meter equipped with an octave band analyzer.

V. EVALUATION CRITERIA AND TOXICOLOGY

A. Environmental

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. However, it is 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 become 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), and 3) the U.S. Department of Labor (OSHA) occupational health standards. 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 standards, by contrast, are based solely 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 only 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.

Except for noise, which is discussed below, the environmental and medical (toxicology) evaluation criteria used for those chemicals investigated in this study are presented in Table 1. Recommended environmental limits and/or general information concerning each substance are listed, i.e., the source of the recommended limits, the present OSHA standard, and a brief description of the primary health effects known to date.

Noise

Exposure to high levels of noise may cause temporary and/or permanent hearing loss. The extent of damage depends primarily upon the intensity of the noise and the duration of the exposure. There is abundant epidemiological and laboratory evidence that protracted noise exposure above 90 decibels (dBA) causes hearing loss in a portion of the exposed population.

OSHA's existing standard for occupational exposure to noise (29 CFR 1910.95) specifies a maximum permissible noise exposure level of 90 dBA for a duration of 8 hours, with higher levels allowed for shorter durations. NIOSH, in its Criteria for a Recommended Standard, proposed a limit of 5 dB less than the OSHA standard.

Time-weighted average noise limits as a function of exposure duration are shown below:

Duration of Exposure (hours/day)	Sound Level, dBA NIOSH	OSHA
16	80	---
8	85	90
4	90	95
2	95	100
1	100	105
1/2	105	110
1/4	110	115*
1/8	115*	---
	---	140 dB**

* No exposure to continuous noise above 115 dBA.

** No exposure to impact or impulse noise above 140 dB peak sound pressure level (SPL).

When workers are exposed to sound levels exceeding the OSHA standard, feasible engineering or administrative controls must be implemented to reduce levels to permissible limits. OSHA has recently issued a hearing conservation amendment to its noise standard, however, it should be noted that as of this writing it is currently being contested. The amendment states, however, that for workers exposed at or above a TWA of 85 dB, noise exposure monitoring, employee education, and audiometric testing will be required. Review of audiograms have to be made by an audiologist, otolaryngologist or a qualified physician. Employees also must be notified of monitoring results within 21 days. Employee records must be kept by the employer for up to five years after termination of employment. Finally, for those employees exposed to noise levels exceeding 90 dBA for eight hours and/or where audiometric testing results indicate a hearing loss, ear protection must be worn.

Noise, commonly defined as unwanted sound, covers the frequency range of sound which is implicated in harmful effects (4000-6000 Hz). Noise can be classified into many different types, including wide-band noise, narrowband noise, and impulse noise. To describe the spectrum of a noise, the audible frequency range is usually divided into eight frequency bands, each one-octave wide, and sound pressure level (SPL) measurements are made in each band using a special sound level meter. A wide-band noise is one where the acoustical energy is distributed over a large range of frequencies. Examples of wide-band noise can be found in the weaving room of a textile mill and in jet aircraft operations.

Exposure to intense noise causes hearing losses which may be temporary, permanent, or a combination of the two. These impairments are reflected by elevated thresholds of audibility for discrete frequency sounds, with the increase in dB required to hear such sounds being used as a measure of the loss. Temporary hearing losses, also called auditory fatigue, represent threshold losses which are recoverable after a period of time away from the noise. Such losses may occur after only a few minutes of exposure to intense noise. With prolonged and repeated exposures (months or years) to the same noise level, there may be only partial recovery of the threshold losses, the residual loss being indicative of a developing permanent hearing impairment.

Temporary hearing impairment has been extensively studied in relation to various conditions of noise exposure. Typical industrial noise exposures produce the largest temporary hearing losses at test frequencies of 4,000 and 6,000 Hertz (Hz).

The actual pattern of loss depends upon the spectrum of the noise itself. The greatest portion of the loss occurs within the first two hours of exposure. Recovery from such losses is greatest within one or two hours after exposure.

The amount of temporary hearing loss from a given amount of noise varies considerably from individual to individual. For example losses at a given frequency due to noise intensities of 100 dBA may range from 0 to more than 30 dB.

Low frequency noise, below 300 Hz, must be considerably more intense than middle or high frequency noise to produce significant threshold losses.

Considerably fewer temporary hearing losses result from intermittent than from continuous noise exposure, even though the total amount of noise exposure is the same in both instances.

Physiologic reactions to a noise of sudden onset represent a typical startle pattern. There is a rise in blood pressure, an increase in sweating, an increase in heart rate, changes in breathing, and sharp contractions of the muscles over the whole body. These changes are often regarded as an emergency reaction of the body, increasing the effectiveness of any muscular exertion which may be required. However desirable in emergencies, these changes are not desirable for long periods since they could interfere with other necessary activities. Fortunately, these physiologic reactions subside with repeated presentations of the noise.

For performance on a task to remain unimpaired by noise, man must exert greater effort than would be necessary under quiet conditions. When measures of energy expenditure--for example, oxygen consumption and heart rate--are made during the early stages of work under noisy conditions, they show variations which are indicative of increased effort. Measurements in later stages under continued exposure, however, show responses return to their normal level.

VI. RESULTS AND DISCUSSION

Employee exposures to acrylamide, butyl acetate, glacial acetic acid, hydrogen sulfide and noise were evaluated. The following are the results of NIOSH's study.

1. Acrylamide

Acrylamide samples were all below the limit of detection and therefore, were considered within the acceptable exposure level of 0.03 mg/M^3 (refer to Table 1). This is not surprising since the amount of time spent performing the process was short, as well as the overall face velocity of the exhaust system used in the receiving hopper can be considered excellent (150 to 200 fpm).

It was noted, however, that some spillage occurred during the transfer of the flocculant material from the storage bend to the hopper, approximately twenty feet. This was due to insufficient sealing of the bags which should be resolved to eliminate unnecessary exposures to the employee.

2. Butyl Acetate and Glacial Acetic Acid

Two personal samples and one area sample were collected for both butyl acetate and glacial acetic acid. Each of the sample results were below their limit of detection, that is 0.01 mg per sample for each of the chemicals tested. This is primarily because of the short amount of time the operator spends preforming this activity.

3. Hydrogen Sulfide

Ten samples were taken at locations along the dewatering platform during system start-up. The results ranged from non-detectable to 3 ppm, which is well below the criteria of 10 ppm, and therefore, not a health hazard.

4. NOISE

Two personal noise samples were taken on the equipment operators working in the sludge processing building. An additional ten noise measurements were taken in various locations in the shop using a hand held dosemeter. Both of the personal samples exceeded the current NIOSH noise criteria of 85 dBA 8-hour TWA (refer to Table 2).

The area noise level measurements ranged from 65 to 100 dBA. The locations with the highest noise levels (87 to 100 dBA) were the work bench and air compressor areas. During the NIOSH investigation, recommendations for reducing the noise levels were made. This included adding rubber tubing to the pressure relief valve, and once in place, this reduced the noise levels at each of these locations to less than 83 dBA. The background noise levels in the shop were then lowered to less than 82 dBA, which can be considered a significant overall noise reduction.

VII. CONCLUSIONS

It was concluded that a health hazard did not exist from exposures to hydrogen sulfide, butyl acetate, glacial acetic acid, and acrylamide. It should be noted that an improved method or technique should be devised to eliminate spillage when transferring the flocculant material.

A potential health hazard did exist to the employees from excessive noise levels found in the sludge processing building. This situation was reduced significantly during the survey period by modifying the pressure relief valve on the air compressors. Modification consisted of placing a hose over the valve and venting it to the outside.

VIII. RECOMMENDATIONS

In view of the findings of NIOSH's environmental study, as well as personal communications with individuals at the Big Dry Creek Plant, Westminister, Colorado, the following recommendations are made to assist in providing a better work environment for the concerned employees:

A. Hearing Protection

Based on the alterations made on the compressors in the sludge processing building, a hearing protection program is not required. However, there was enough information presented to the NIOSH investigator regarding other potential noise problems in the various buildings surveyed at the plant to warrant the following recommendations:

1. All air compressors should be evaluated to determine if a noise reducing device, similar to that devised for those in the sludge processing building, can be incorporated into other compressors in order to reduce the noise levels in these areas.

2. Noise monitoring should be performed periodically in all buildings. This is especially necessary during maintenance operations where high noise levels are thought to exist. This will identify areas which even for short periods require hearing protection. All areas determined to be high noise areas should be posted accordingly.

3. To insure that full personal protection is being provided during those periods of high noise exposures, the Environmental Protection Agency's Noise Reduction Ratings (NRR) should be applied when selecting hearing protection. Each protective device (ear plugs or muffs) has a NRR rating which, for that particular type and model, describes what percent of noise attenuation may be obtained.

   It should be noted that these ratings can be misunderstood, that is, suppose muff (X) had good attenuation at all frequencies and excellent attenuation at 4000 Hertz, however, its overall NRR rating is only 25. Another muff (Y) has its overall NRR rating as 30 with great attenuation at all frequencies except at 4000 Hertz where its attenuation is poor. If the greatest intensity noise in the workplace was at 4000 Hertz and the company was using muff Y (NRR = 30) thinking the higher the rating the better the protection, this would be misleading. The hearing protector of choice, in this case, should be muff X (NRR = 25) which had excellent protection at 4000 Hertz.

4. An educational program to instruct new employees on the hazards of chemical and noise exposures should be implemented. Special attention should be placed on short term maintenance operations where high noise levels are know to be found.

B. Other Concerns

1. The problem of spillage of the acrylamide flocculant material during transferring should be eliminated. This could best be achieved by contacting the manufacture and requesting a more secure bag. An alternative would be placing the bags in a wheel barrel and transferring them to the hopper. This would reduce and/or eliminate spillage and therefore the need for extensive clean-up.

2. When spillage occurs, the most preferred method of clean-up is vacuuming, which will reduce the potential for airborne exposures, as well as confine the material for easy disposal.

3. During clean-up, the appropriate personal protective clothing should be worn, including respirators, face shields, or goggles and gloves.

4. If any of those chemicals evaluated by NIOSH (e.g., acrylamide, butyl acetate, glacial acetic acid or hydrogen sulfide) come in contact with the skin, the material should be washed off immediately, or in the case of eye contact, flushed repeatedly for at least fifteen minutes.

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X. AUTHORSHIP AND ACKNOWLEDGMENTS

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NIOSH is thankful to the employees at Big Dry Creek treatment plant for their cooperation and assistance with this Health Hazard Evaluation. The information gathered from this study will not only assist in maintaining the health and safety of those persons working here, but also other facilities that perform similar operations.

XI. DISTRIBUTION AND AVAILABILITY

Copies of this report are currently available upon request from NIOSH, Division of Standard 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), 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:

1. Big Dry Creek Plant, Westminister, Colorado
2. U.S. Department of Labor/OSHA - Region VIII.
3. NIOSH - Region VIII.
4. Colorado Department of Health.
5. State Designated Agency.

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

TABLE 1

EVALUATION CRITERIA AND TOXICOLOGY

Big Dry Creek Plant
Westminister, Colorado

Substance	Recommended Environmental Limit[A]	Reference Criteria[B]	Primary Health Effects	OSHA Standard
Acrylamide	0.3 mg/M^3 10 hour TWA	NIOSH	Irritation eyes and skin; ataxia; numbness in limbs and weak muscles; sweating hands; fatigue; and lethargy.	0.03 mg/M^3
Butyl Acetate	710 mg/M^3	ACGIH	Irritation of eyes and skin; headaches; drowsiness; and upper respiratory irritation.	710 mg/M^3
Acetic Acid	25 mg/M^3	ACGIH	Eye, nose and throat irritation; edema; chronic bronchitis; skin sensitive; dental erosion; and hyper keratosis	25 mg/M^3
Hydrogen Sulfide	10 ppm	ACGIH	Irritation of the eyes and respiratory system; headaches, fatigue, dizziness and insomnia; apnea, convulsions and coma.	20 ppm

[A] All air concentrations are expressed as time-weighted average (TWA) exposures for up to a 10 hour workday unless designated (C) for Ceiling which should not be exceeded even instantaneously.

[B] Criteria are levels which are recommended by NIOSH or ACGIH = American Conference of Governmental Industrial Hygienists. These are only recommendations and not standards as designated by OSHA.

ppm = Parts per million parts of air

mg/M^3 = Approximate milligrams of substance per cubic meter of air.

TABLE 2

Personal Noise Dosimeter Levels

Big Dry Creek Plant
Westminister, Colorado

November 1984

Job/Task Description	Sampling Time (hours)	8-Hour TWA Noise (dBA)
Equipment Operator	6	90 9
Equipment Operator	6	87.4
EVALUATION CRITERIA	NIOSH 8-hour TWA	85 dBA
	OSHA 8-hour TWA	90 dBA
	OSHA 8-hour TWA*	85 dBA

* OSHA Revised Hearing Conservation Regulation, if mandated, will require employers to institute a hearing protection program if TWA noise levels exceed 85 dBA.

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