

U. S. DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE
NATIONAL INSTITUTE FOR OCCUPATIONAL SAFETY AND HEALTH
CINCINNATI, OHIO 45202

HEALTH HAZARD EVALUATION DETERMINATION
REPORT NO. 72-60

TRANS-WORLD AIRLINES, INC.
OVERHAUL BASE
KANSAS CITY, MISSOURI
SEPTEMBER 1973

I. TOXICITY DETERMINATION

It has been determined that the level of substances (Sulfuric Acid, Chlorine, Sodium Hydroxide, Iron Salts, Calcium Hydroxide, Fuller's Earth, Respirable Dust, and Total Dust) covered by this request are not toxic at the concentrations found in the workers' environment during normal operations at the Waste Treatment Plant (WTP). This conclusion is based on the following pertinent information: (1) the environmental concentrations of the substances investigated at the time of the environmental survey were significantly less than those known to affect health and less than 55% of the health standards used for these substances; and (2) no history of symptoms or occupational disease was found during employee interviews.

It has been further determined that the level of substances (e.g., sulfuric acid, sodium hydroxide and chlorine) are potentially toxic and may result in acute exposures to employees during improper maintenance operations, and accidental leaks. This conclusion is based upon the following information: (1) past acid and caustic burns of skin reported by several employees; and acute eye, nose, and throat irritation of employees during chlorine leaks; and (2) a chlorine leak occurring during the initial observational survey which was very irritating to the eyes, nose, and throat of the NIOSH investigators.

It was recommended that consideration be given to: (1) the institution of certain operational engineering and maintenance improvements; (2) elaboration and improvement of current health and safety policies, procedures, and programs (e.g., respiratory protection program, chemical goggles, "buddy system", "lock and tag", acid-caustic gloves, etc.) for operations at the WTP; (3) a good program of general housekeeping; and (4) a few other general recommendations consistent with good health and safety practices for diminishing or obviating any potential hazards from the exposure of the 12 employees to the substances covered by this report.

II. DISTRIBUTION AND AVAILABILITY OF DETERMINATION REPORT

Copies of this Determination Report are available upon request from the Hazard Evaluation Services Branch, NIOSH, U. S. Post Office Building, Room 508, Fifth & Walnut Streets, Cincinnati, Ohio 45202. Copies have been sent to:

- a) Trans-World Airlines, Inc. - Overhaul Base

- b) Authorized Representative of Employees
- c) U. S. Department of Labor - Region VII
- d) NIOSH - Region VII

For the purposes of informing the approximately 12 exposed employees, the employer will promptly "post" the Determination Report in a prominent place(s) near where affected employees work for a period of 30 calendar days.

III. INTRODUCTION

Section 20(a)(6) of the Occupational Safety and Health Act of 1970, 29 U.S.C. 669(a)(6), authorizes the Secretary of Health, Education, and Welfare, following a written request by 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 National Institute for Occupational Safety and Health (NIOSH) received such a request from an authorized representative of the union at the Overhaul Base of Trans-World Airlines at the Kansas City International Airport, Kansas City, Missouri. The primary hazards evaluated concerned employees' exposure to various chemicals (e.g., sulfuric acid, chlorine, etc.) used in the treatment of dilute wastes in the Waste Treatment Plant (WTP) which is operated by a total of 12 employees on a 24-hour, 7-days-a-week basis. Occasionally, a few other employees from the Maintenance Department will provide for repair of equipment as appropriate. The request was precipitated by leaks in the system, certain operations which needed improvement, and the general health and safety conditions at the plant that apparently caused workers to question their own occupational safety and health.

IV. HEALTH HAZARD EVALUATION

A. Plant Process - Conditions of Use

The Overhaul Base is a large industrial complex providing for the overhaul of airframes and power plants of commercial and cargo airplanes. There are over 5,000 employees at the base which is operated on a 24-hour, 7-days-a-week basis. Operations at the WTP involve about 12 employees and operates on a 24-hour day, 7-days-a-week basis. The WTP is located on about 5 acres of land with a building containing 7,775 square feet of floor area on 3 levels (basement 20' high, first level 12' high, and second level of 9' high ceilings). The building is utilized primarily for make-up and storage of chemicals for the treatment process, chemical bulk storage, pumps, tanks, sampling devices, large vacuum drum rotating filter for sludge removal, and various hopper bins for dry chemicals. Outside of the building are equalization basins, pre-oil clarifiers, acid clarifiers, solids contact basins, 30-minute reduction basin, secondary clarifier, trickling filter (secondary treatment) Parshall flume and 2 large polishing or holding lagoons (3.5 million gallons) used prior to discharge into Todd Creek.

There are 3 separate treatment processes at the plant: (1) the Petroleum System treats around 650,000 gallons of wastes (e.g., floor drains, cleaning fluids, detergents, oil, solvents, etc.) per day; (2) the Acid System treats

about 1.5 million gallons of wastes (dilute acid solutions of rinse water from plating area) each month; and (3) the Alkaline System treats about 1.5 million gallons of waste (dilute basic rinse solutions from plating area) each month. The WTP facilities, equipment and process operations are typical for such plants for treatment of dilute solutions of low level wastes. One side of the building is used for the chemical treatment processes (acid and alkaline) and the other for the treatment of the petroleum waste. There is a chemistry laboratory for analysis of samples obtained during treatment and prior to discharge. The handling of dry chemicals involves transfer of ferrous sulfate, polyelectrolyte (acrylamide polymer-flocculating agent), and Fuller's Earth, and lime (calcium hydroxide) to metal storage hopper bins. Sulfuric acid, sodium hydroxide and ferric chloride solutions are also used in the treatment process. Chlorine gas is used in the treatment of alkaline wastes.

B. Evaluation Design

Following the preliminary observational survey (August 10, 1972) which facilitated recognition of the most probable health hazards, it was necessary to return to the facility to conduct a more in-depth analysis of employee exposure to the hazards covered by this report. The procedures used to assess the validity of the alleged hazards included on-site worker interviews, discussions with management and union personnel, walk-through inspection of the workplace, collection of bulk samples for analysis and identification of primary health hazards; and the collection of general area and personal air samples for laboratory analysis were obtained during the final survey conducted on November 7 and 9, 1972. During both surveys, workers at the WTP were individually questioned about their occupational history and medical well-being. Pointed questions were asked about the presence of symptomatology.

C. Evaluation Methods

Due to the small number of people involved in this hazard evaluation, all worker responses to the medical interviews were assessed empirically. Samples for Respirable and Total Dust, Ferrous Sulfate, calcium Hydroxide, and Sulfuric Acid Mists were collected on preweighted 37 mm diameter esters of cellulose membrane filters (HA), glass fiber (GF), or polyvinylchloride (PVC) filters using appropriate standard sampling techniques and equipment. The air was drawn through the collection filters by an MSA Model G Battery-Powered Vacuum Pump operating at a rate of 1.7 or 2 liters per minute for several hours to simulate an 8-hour time-weighted average exposure. Samples for organic solvents were collected in MSA charcoal sampling tubes by an MSA Model G Vacuum Pump at 1 liter per minute for 10-60 minutes. Samples for chlorine were collected in a midget impinger containing 0.01 N solution of sodium hydroxide by a Bendix Vacuum Pump at 1.5 liters per minute for 1-4 hours. Flow rates were maintained during sampling by periodically adjusting each pump's calibrated flow meter. Personal air samples were obtained by attaching the Monitor to an employee's collar or lapel which was connected via Tygon Tubing to the pump which was attached to a belt at the waist. The general area samples were collected in specific locations in the working environment.

All of the 28 air samples were analyzed by the Division of Laboratories and Criteria Development, NIOSH, Cincinnati, Ohio and 40 analytical determinations were made to evaluate the working environment. Sixteen samples (all filter samples) were analyzed by gravimetric methods for total weight of the dust with a minimum detection level of 0.1 milligrams per sample. Five of the filters (PVC) were also analyzed for calcium by atomic absorption methods with a minimum detection of 0.003 milligrams per sample. Six of the filters (HA) were analyzed for ferrous sulfate by atomic absorption methods with a minimum detection limit of 0.004 milligrams per sample. Two filters (glass fiber) were analyzed by the sulfate method from the Thirteenth Edition of Standard Methods (pages 334-335) with a minimum detection level of 0.002 milligrams of sulfuric acid. The analysis of 12 impinger sample solutions was accomplished according to the Methyl Orange Method from Health Laboratory Science, Volume 8, No. 1, of January 1972 with a minimum detection level of 0.002 milligrams per sample. Also 13 air samples (charcoal tubes) were collected and analyzed by gas chromatographic procedures for organic solvents with a minimum detection level for these compounds of 1/20th of the appropriate health standard.

D. Evaluation Criteria

1. Environmental Standards

The Occupational Health Standards as promulgated by the U. S. Department of Labor (Federal Register, Volume 37, 1970.93, October 18, 1972) are given below for those potentially toxic substances identified in this hazard evaluation. Where no Federal or specific health standard exists, we used the recommended Threshold Limit Value (TLV) as established by the American Conference of Governmental Industrial Hygienists (ACGIH-1972 for substances) at least as toxic as those covered by this report.

<u>Substance</u>	<u>Standard Level or Concentration</u>
Sulfuric Acid	1 mg/M ³ (TWA)
Chlorine	3 mg/M ³ (TWA)
Sodium Hydroxide	2 mg/M ³ (TWA)
Iron Salts (Soluble) as Fe (TLV) (Ferrous Sulfate)	1 mg/M ³ (TWA)
Calcium Oxide (Calcium Hydroxide)	5 mg/M ³ (TWA)
Total Dust (Inert or Nuisance Dust)	15 mg/M ³ (TWA)
Respirable Dust (Inert or Nuisance Dust)	5 mg/M ³ (TWA)

mg/M³ - milligrams of substance per cubic meter of air
TWA - 8-hour time-weighted average

Occupational Health Standards are established at levels designed to protect workers occupationally exposed to a substance on an 8-hour per day, 40-hour per week basis over a normal working lifetime.

2. Biological Norms

The following is a brief resume of the pathologic effects of substances considered in this evaluation:

Sulfuric Acid (H₂SO₄): Sulfuric acid is considered highly toxic and a dangerous irritant to all body tissue. Burns of the skin, irritation of the mucous membranes (severe exposure to mists may result in chemical pneumonitis) and erosion of the teeth may occur. Concentrations below 1 mg/M³ are not detected by odor, taste, or irritation. Concentrations of 3 mg/M³ are not noticed by most persons and a level of 5 mg/M³ is very objectionable. The Federal Health Standard of 1 mg/M³ is recommended to prevent irritation of respiratory passages and dental erosion.

Chlorine (Cl₂- gas): Chlorine gas is highly toxic as an irritant and by inhalation it is extremely irritating to the mucous membranes of the eyes and respiratory tract. Studies indicate concentrations of 15 mg/M³ cause respiratory complaints, erosion of teeth, and inflammation of the mucous membranes. Concentrations too low to affect the lungs may irritate the eyes, nose, and throat. The Federal Standard of 3 mg/M³ is recommended to minimize chronic changes in lungs, accelerated aging, and erosion of the teeth.

Sodium Hydroxide (NaOH-Caustic): Sodium hydroxide is considered highly toxic by ingesting and inhalation and is extremely irritating to the mucous membranes at high concentrations. Subjective symptoms are often relied upon as an indication for the need for control. The Federal Health Standard of 2 mg/M³ may be noticeable to humans but is not an excessive irritant at this concentration.

Ferrous Sulfate (FeSO₄): Ferrous sulfate is not considered highly toxic. Acute exposures cause reversible slight effects on skin or mucous membranes. It is slightly soluble in water and is not considered as toxic as Soluble Iron Salts (e.g., as Fe in ferric sulfate or ferric chloride-health standard of 1 mg/M³). Ferrous sulfate is used in water treatment, fertilizer, feed additive, and a dietary supplement. No Federal Standard has been established for ferrous sulfate. Ferric chloride is also used at the WTP and in evaluating exposures, we used the more conservative limit of 1 mg/M³.

Calcium Hydroxide (Ca(OH)₂- Slacked Lime, Hydrated Lime): Calcium hydroxide is a moderately caustic irritant to the skin, and as a dust by inhalation. Its uses are varied and include plasters, cements, medicine, water softening, food additive, dietary supplement, and paints. It can cause dermatitis and irritation of eyes and mucous membranes. It can be considered similar to calcium oxide with a Federal Standard of 5 mg/M³. Ca(OH)₂ is a strong base and reacts rapidly with carbon dioxide to form the insoluble and relatively innocuous calcium carbonate.

Acrylic Acid Resin or Acrylamide Polymer: The polyelectrolyte used in the process is an acrylamide polymer which may produce minor transient effects on the skin and mucous membranes. It is widely used in water treatment plants, occasionally as a food additive permitted in food for human consumption, and as thickeners in paints, fabric, coatings, and adhesives. Such polymers are considered slightly toxic similar to respirable inert dusts.

Fuller's Earth: Is a porous aluminum silicate which normally contains no free silica and is considered non-toxic. It is used in waste treatment plants as a flocculant; in cosmetics; and as a filtering medium. It is considered as a nuisance dust from a toxicity standpoint.

Total and Respirable Dusts (Inert or Nuisance Dust): Nuisance dusts have little adverse effects on the lungs and do not produce significant disease or toxicity.

E. Evaluation Results and Discussions

1. Environmental Survey Results - November 7 and 9, 1972

Operations which may have presented airborne problems concerning Sulfuric Acid, Ferric Chloride, and Sodium Hydroxide were not evident at the time of the environmental survey due to operational changes. For instance, ferric chloride was not used in dry form but in solution; and there was only one minor leak or drip of sodium hydroxide which was immediately fixed before any airborne problem could occur, and did not result in any caustic burn of an employee's skin. The original request placed particular emphasis on employees having to manhandle 55-gallon barrels of concentrated sulfuric acid to add to the process resulting in exposures to the mists. Sulfuric acid is now purchased and stored in a large tank and added to the process via pump which should not present an airborne problem unless there is a leak. However, due to the emphasis on sulfuric acid in the original request, 2 general area samples were obtained for sulfuric acid and both sample results were less than 0.015 mg/M³ which is less than 2% of the Federal Standard of 1 mg/M³. Thirteen air samples (personal and general area) were obtained due to the possibility of chlorine leaks in the system and the potential of overloading the waste stream with excess chlorine. Sample results for chlorine were all less than .002 mg/M³ which is less than 1% of the Federal Standard of 3 mg/M³. There does not appear to be a hazard from these chemicals during normal operations.

Analysis of appropriate bulk samples shows less than 0.5% of free silica present and hence, it is not necessary to consider silica as a potential problem. It is noted that we used the concentration of Total Dust and Respirable Dust in considering the Acrylamide polymer and Fuller's Earth; and the results show that Total Dust and Respirable Dusts were even more limiting than the results for ferrous sulfate and calcium hydroxide. There were a total of 14 personal and general area samples obtained during the survey, of which 4 samples were for Respirable Dusts and 10 samples for Total Dusts. The maximum airborne dust loading was 2.7 mg/M³ which is less than 20% of the Federal Standard for Total Dust of 15 mg/M³. The maximum sample result for Respirable Dust was 1.1 mg/M³ which is less than 25% of the Federal Standard for Respirable Dust of 5.0 mg/M³. Even if one considered that all of the airborne dust loading were of respirable size, the results would be less than 55% of the Federal Standard for Respirable Dusts. Six of the 14 samples were also analyzed for iron, and 4 of the 14 samples were analyzed for Ca(OH)₂, and all sample results were less than 5% of their respective TLV's or health standards as contained in Section IV D 1 of this report. There does not appear to be a hazard from these chemicals during normal operations. It was noted that operators were wearing approved respirators for dusts while loading the hopper bins which should be continued as a matter of good practice.

The only potential exposure from organic solvents at the time of the survey was from the vacuum filter drum operation in the dryer room. Thirteen short

and long-term (10-60 min.) charcoal tube samples were obtained and analyzed for organic vapors and solvents. Sample results showed that concentrations of the organic vapors and solvents to be less than 1/20th of the Federal Standards and do not present a problem during normal operations.

2. Medical Survey Results

There are a total of 12 employees operating the WTP on a 24-hour, 7-days-a-week basis. On weekends and at certain other times there may be only 1 man in the building. Several indicated a lack of knowledge of company safety policies, procedures, and an apparent interest in their physical well-being was expressed.

Four workers were interviewed on August 10, 1972. Three of the 4 complained of chemical drips and minor splash burns to their extremities and heads. One man complains of nausea and vomiting about every 6 months which he relates to changes in the chlorine room. The workers essentially denied any other illness or physical problems related to their physical environment at work. All talked at length about the safety hazards of their work situation. One employee was recently in a chemical accident and is currently under medical care for eye burns. The only physical health hazard that could be elicited was the drip and splash burns of which all the men complained. All of the men appeared agitated and anxious concerning their safety and conversely, management's apparent lack of concern with their safety.

Six workers were interviewed by the NIOSH investigators during the environmental survey with essentially the same results as the preceding paragraph. However, all of the employees appeared more relaxed than during the previous survey and felt that management was taking positive action to improve the working conditions. Employees did not complain of any irritation of eyes, nose, throat, skin, or other symptoms due to conditions which existed at the time of the environmental survey.

It was concluded by the NIOSH staff that the greatest hazard to these workers in dealing with these materials (e.g., chlorine, acids, caustics, etc.) would be accidental spills and leaks of the chemicals used in the treatment process. No indication of a chronic occupational disease was elicited for normal operations.

3. Discussion of Evaluation

It is our conclusion, based on the medical and environmental evaluations, that levels of exposure are below those known to affect the health of the workers during normal operations at the WTP. Since environmental samples were taken during 2 different day shifts and no significant exposure was documented, and no symptoms were elicited during these operations, it is concluded that a health hazard does not exist under the work situations that were evaluated. However, there has been and still remains the possibility of acute exposures of employees to concentrated solutions or gases (e.g., H₂SO₄, Cl₂, etc.) from accidental leaks during various operations if proper precautions and procedures are not followed.

An exit interview was held with both representatives from management and union to discuss the initial results and observations of the survey. Recommendations were made at that time to obviate the potential hazards and to provide for a more desirable working environment for all personnel. The joint meeting was indicative of the increased emphasis and cooperation by management and union concerning health and safety matters since the initial observational survey.

V. REFERENCES

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