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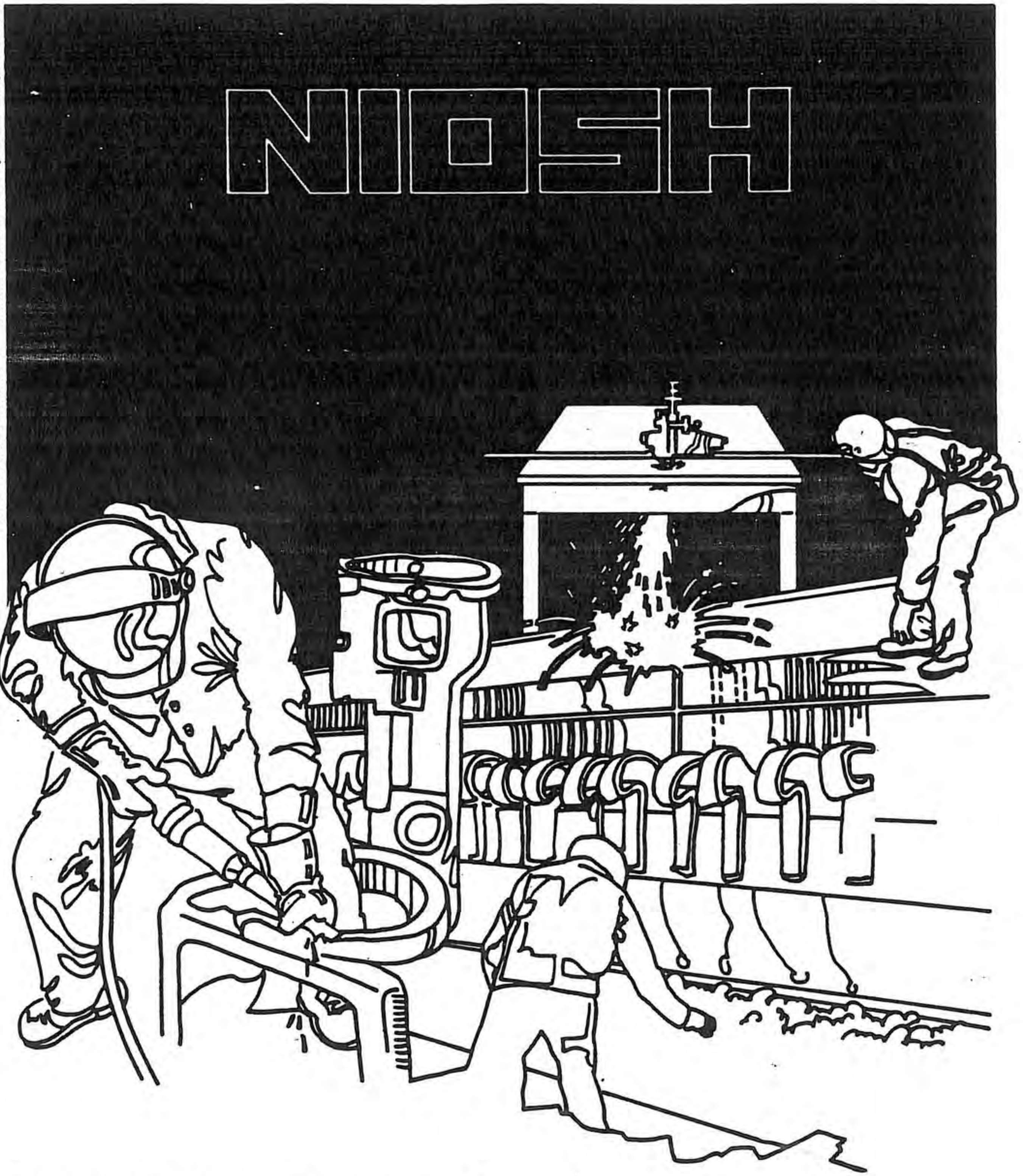

Health Hazard Evaluation Report

HETA 81-283-1224
SOUTHERN MINNESOTA BEET SUGAR CORPORATIVE
RENVILLE, MINNESOTA

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 81-283-1224
NOVEMBER 1982
SOUTHERN MINNESOTA BEET
SUGAR COOPERATIVE
RENVILLE, MINNESOTA

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I. SUMMARY

In April 1981, the National Institute for Occupational Safety and Health (NIOSH) received a request from the local union to evaluate exposures to bis-Chloromethyl ether (BCME), calcium oxide (lime dust), formaldehyde, hydrochloric acid, sulfur dioxide and welding fumes at the Southern Minnesota Beet Sugar Cooperative (SMSC), Renville, Minnesota. In addition to the above substances, NIOSH was asked to evaluate employee exposures to welding fumes generated during SMSC's summer maintenance operations.

On August 25-27, 1981, and on February 17-19, 1982, NIOSH conducted surveys at the plant. Long-term personal breathing-zone air sampling was performed to characterize employee exposure to total chromium, copper fume, fluoride, hexavalent chromium, hydrogen chloride, iron oxide fume, lime dust, manganese fume and nickel. Long-term area environmental air samples were obtained for BCME, hydrogen chloride and calcium oxide. Short-term, direct-reading, area air sampling measurements were made for carbon dioxide, formaldehyde and sulfur dioxide. Analysis of the air samples produced the following ranges of concentrations which are compared with their respective environmental criteria (EC): BCME, nondetectable (N.D.) - 0.5 ug/M^3; calcium oxide 4.0-83.4 mg/M^3 (EC-2.0 mg/M^3); carbon dioxide 900 mg/M^3 (EC - 9000 mg/M^3); chromium N.D. - 0.05 mg/M^3 (EC - 0.5 mg/M^3); fluoride N.D. - 0.73 mg/M^3 (EC - 2.5 mg/M^3); hexavalent chromium N.D. - 5.7 ug/M^3 (EC - 1.0 ug/M^3); iron oxide fume 0.08-1.0 mg/M^3 (EC - 5.0 mg/M^3); manganese fume 0.01 - 0.21 mg/M^3 (EC - 1.0 mg/M^3); and nickel N.D. - 0.02 mg/M^3 (EC-0.015 mg/M^3). No copper fumes, formaldehyde, hydrogen chloride and sulfur dioxide were found. Although the lime kiln employees did wear disposable half-face piece respirators, the protection afforded was inadequate due to excessive calcium oxide concentrations up to 40 times the exposure criteria.

A medical questionnaire was administered to eight employees (full-time welders during the off-season) and seven workers (three lime kiln employees, three employees in the carbonation-peterson filter area and one general laborer) on the initial and follow-up surveys, respectively. Review of the questionnaires revealed that four of the eight welders reported experiencing both conjunctivitis and skin burns while welding. All three of the lime kiln employees reported sustaining either skin burns or eye irritation due to calcium oxide exposures. Two of the three workers in the carbonation-peterson filter area reported having occasional skin irritation/dermatitis and a third employee in this area reported occasionally experiencing both skin and eye burns.

On the basis of the data obtained during this investigation NIOSH has determined that a health hazard existed at the SMSC plant due to overexposures to calcium oxide, hexavalent chromium and nickel. Area air sampling data suggest their employees also have potential exposures to bis-Chloromethyl ether. Also, employee interview results infer that occasional overexposures to ultraviolet radiation may occur during welding operations. To improve workers safety and health, recommendations to reduce exposures are included in Section VIII of this report.

KEYWORDS: SIC 2063 (Beet Sugar), bis-Chloromethyl ether, calcium oxide, hexavalent chromium, nickel, ultraviolet radiation

II. INTRODUCTION

On April 21, 1981, the National Institute for Occupational Safety and Health (NIOSH) received a request from the American Federation of Grain Millers, Local #369, to evaluate employee exposures to bis-Chloromethyl ether (BCME), formaldehyde, hydrochloric acid, lime dust and sulfur dioxide at the Southern Minnesota Beet Sugar Cooperative (SMSC), Renville, Minnesota, where sugar beets are processed into granulated refined sugar and other sugar products. In additional to the above substances, NIOSH was asked to evaluate employee exposures to welding fumes generated during SMSC's summer maintenance operations.

NIOSH investigators conducted an initial environmental survey at the SMSC plant on August 25-27, 1981. Interim Report #1 which discussed the preliminary findings of the initial survey was distributed in September 1981.

A follow-up environmental survey was performed on February 17-19, 1982. Interim Report #2 which contained the air sampling results of the initial survey and a description of the processes evaluated on the follow-up survey was distributed in March 1982.

III. BACKGROUND

The SMSC factory is located on one square mile of land near Renville, Minnesota. It processes nearly 1 million tons of sugar beets annually, which are produced on about 59,000 acres of land in 11 surrounding counties. The facility has been involved in processing sugar beets since 1975. The processed products and annual production rate are: granulated refined sugar (about 99.9% sucrose), 100,000 tons; beet molasses, 50,000 tons; and beet pulp pellets (by-products), 50,000 tons.

A. Process Description

A flow sheet diagram which graphically depicts the processes at the facility is included as Appendix #1. The main process building is 480 feet long, 175 feet wide, with heights ranging from 85-130 feet.

Briefly, sugar beets are delivered to the factory in trucks and are either piled on the ground or dumped directly from the trucks into wet hoppers. The beets float into the factory via a water flume and go through various debris removing processes.

After cleaning, the beets are cut into long noodle-like pieces called "cossettes". The cossettes are introduced into the diffuser at one end while water enters the diffuser at the opposite end. The diffuser, about 20' in diameter and 200' in length, is located in the north-west section of the main building. Approximately 300 tons of beets and a similar volume of water are processed through the diffuser each hour. Inside the diffuser sugar is extracted from the cossettes via osmosis. The cossettes, then free of most of their sugar, are dried and made into beet pulp pellets. The sugar solution leaves the diffuser in the form of "raw juice".

Once removed from the diffuser, the raw juice cycles through various stages of purification, precipitation, pH adjustments (using carbon dioxide gas from the lime kiln) and filtration to remove impurities and other non-sugars.

Excess water is removed in the evaporator and the juice becomes thicker. The remaining water is driven off by boiling and then crystallized to a high concentration of sugar called "white massecuite". This massecuite is then centrifuged to remove and separate the sugar crystals from the liquor containing sugar syrups and impurities. The finished sugar is then sifted, packaged and/or stored prior to shipment. There are other sideline processes not described herein which are used to recover even more of the sugar from the beet.

B. General

The sulfur dioxide (SO_2) bulk storage tank, installed new in August 1981, is located above ground, outside the plant on the south-west corner. This cylindrical shaped tank with a capacity of about 120,000 pounds of SO_2 gas is automatically controlled from metering devices located inside the plant. The SO_2 gas is pumped into the factory in an enclosed system and is used in the sulfonator tank located adjacent to the carbonation filtering system. About 4700 pounds of SO_2 gas is used daily with specific amounts varying with the pH level of the juice. SO_2 is also used to inhibit or prevent some browning reactions of the juice which would eventually appear in the sugar.

Liquid formaldehyde is stored in a 5,000 gallon tank located on the first floor of the factory underneath the diffuser. It is used inside the diffuser as a bactericide. The quantities of formaldehyde used daily vary with the lactic acid and nitrite levels found in the diffuser and usually range from 0-180 gallons. Like the sulfur dioxide system, formaldehyde is contained in an enclosed system. The controls for the holding tank are located away from the tank in the north-east part of the plant adjacent to the diffuser on the second floor of the slicer deck.

Peterson drum filters are used to filter settled solid wastes in the carbonation processes. Dilute hydrochloric acid is used on a as needed basis to manually clean the polypropylene peterson drum filters and to wash test tubes used for determining sediment settling rates in the carbonation - peterson filter area. About 110 gallons of acid are used each day for these purposes and is obtained from the 500 gallon acid storage tank located in the north-west corner of the plant above the peterson filters.

The lime kiln building, separate from the main process building, is located adjacent to the steam boiler house (see Appendix #2). The two identically sized kilns housed in the building are continuously fired at about 2800°F. The lime kilns supply burnt lime and carbon dioxide gas for the regular factory processes. Both products result from the burning of limestone with coke in controlled amounts in the kiln. About 400 tons of limestone and 40 tons of coke are used daily. The carbon dioxide gas is pumped off the top of the kilns and is washed before being injected into the first and second carbonation tanks. The burnt lime rock goes to the slacker to be mixed with sweetwater. This produces milk of lime for use in the first carbonation tank.

C. Environmental

The initial NIOSH survey (August 25-27, 1981) was conducted during the off-season when SMSC employs 135 workers for equipment maintenance repairs. During the preliminary survey, about 20 welders worked throughout the plant on a one shift, 6-day, 10 1/2 hour-per-day schedule. Of the total 20 welders, only 8-10 spent the majority of the shift actually welding. The type of welding techniques used were as follows: conventional shielded metal arc welding (consumable flux-coated electrode) on carbon steel and stainless steel; and gas metal arc welding (MIG), (using a consumable wire electrode and a mixture of helium, argon, and carbon dioxide as a shielding gas) on stainless steel. Other processes performed and evaluated were the cutting of carbon steel and stainless steel by the plasma-arc, arc-air, and oxy-acetylene methods.

The follow-up survey was performed during the sugar beet slicing campaign on February 17-19, 1982. Nearly 250 production employees work on three shifts, seven days a week throughout the campaign which lasts from about September 15, through the end of April.

IV. EVALUATION DESIGN AND METHODS

A. Environmental

During the initial survey on August 25-27, 1981, long-term personal breathing-zone air samples were collected for measurement of exposure to welding fumes of various metals including chromium, copper, hexavalent chromium, iron oxide, manganese and nickel, as well as for inorganic fluorides. The air sampling and analysis methodology for these chemicals including substance, collection device, flow rate and referenced analytical procedures are presented in Table I.

Long-term personal and area environmental air sampling was performed on the follow-up survey (February 17-19, 1982) to characterize employee exposure to bis-Chloromethyl ether (a potential for BCME formation exists from formaldehyde and hydrogen chloride combinations)[1], hydrogen chloride and calcium oxide (lime dust). See Table I for air sample collection and analysis methodology.

The NIOSH industrial hygienist had intended to collect full-shift personal and area environmental air samples for formaldehyde during the sugar beet processing season. However, near the time of the follow-up survey, there was some confusion regarding the appropriate NIOSH sampling/analysis method for collection of formaldehyde air samples. At that time, the most suitable NIOSH formaldehyde air sampling method was thought to be benzylethanolamine coated Chromosorb 102 sorbent tubes with the benzylethanolamine forming a derivative of formaldehyde (3-benzyloxazolidine) and later analysis by capillary gas chromatography using flame ionization detection.[2] Inadvertently, the Chromosorb 102 sorvent tubes used on the follow-up survey to collect formaldehyde air samples had not been previously treated with the amine agent and thus, could not be analyzed.

Short-term, direct-reading, colorimetric detector tube measurements were made on the follow-up survey for carbon dioxide, formaldehyde and sulfur dioxide.

B. Medical

To assess potential health effects a non-directed medical questionnaire covering symptoms, chemical exposure and medical and occupational history was administered to eight employees (full-time welders during the off-season) on the initial survey and to seven employees on the follow-up evaluation.

V. EVALUATION CRITERIA

A. Environmental Standards

A number of sources recommend airborne levels of substances below which it is believed that nearly all workers may be repeatedly exposed 8-10 hours per day, 40-hours per week, over a working lifetime, without suffering adverse health effects. Such airborne levels are referred to as permissible exposure limits or threshold limit values (TLV's®). However, due to variations in individual susceptability, a small percentage of workers may experience effects at levels at or below the TLV: a smaller percentage may be more seriously affected by aggravation of a pre-existing condition or by a hypersensitivity reaction.

The environmental evaluation criteria utilized in this study are presented in Table II. Listed for each substance are three primary sources of exposure criteria: (1) NIOSH recommended standards for occupational exposure to substances (Criteria Documents); (2) recommended TLV's® and their supporting documentation as set forth by the American Conference of Governmental Industrial Hygienists (ACGIH - 1981)[3]; and (3) occupational health standards as promulgated by the U.S. Department of Labor (29 CFR 1910.1000).[4]

B. Toxicological Effects

1. bis-Chloromethyl ether

Bis-Chloromethyl ether (BCME) is recognized as a carcinogenic agent for animals and humans. Epidemiologic studies of workers occupationally exposed to BCME have shown these persons to be at an increased risk of developing lung cancer. It has been reported that the formation of BCME can occur from the reaction of formaldehyde and ionic chloride compounds. Studies by NIOSH have found BCME to occur spontaneously in concentrations of parts per billion in the textile industry where both formaldehyde and the chloride ion are present.[5]

2. Calcium Oxide

Calcium oxide (lime dust) irritates the eyes and upper respiratory tract. The irritant effects are probably due primarily to its alkalinity, but dehydrating and thermal effects also may be contributing factors. Inflammation of the respiratory passages, ulceration, and perforation of the nasal septum, and pneumonia have been attributed to inhalation of calcium oxide dust; severe irritation of the upper respiratory tract ordinarily causes persons to avoid serious inhalation exposure. Particles of calcium oxide have caused severe burns of the eyes; prolonged or repeated contact with skin could cause dermatitis.[6]

3. Carbon Dioxide

Carbon dioxide (CO_2) gas is an asphyxiant, a potent respiratory stimulant, and both stimulant and depressant of the central nervous system. Respiratory volume is doubled at 4% CO_2 and redoubled at 5%. Increases in heart rate and blood pressure have been noted at 7.6% and dyspnea, headache, dizziness, and sweating occur if exposure at that level is prolonged. At 10% and above, prolonged exposure can result in unconsciousness. Above 11% unconsciousness occurs in one minute or less. Exposure to very high concentrations, 25 to 30%, may cause convulsions.[6]

4. Chromium

Chromium compounds can act as allergens in some workers to cause dermatitis to exposed skin. Acute exposure to chromium dust and mist may cause irritation of the eyes, nose and throat. Chromium exists in chromates in one of three valence states 2+, 3+, and 6+. Chromium compounds in the 3+ state are of a low order of toxicity. In the 6+ state, chromium compounds are irritants and corrosive. This hexavalent form may be carcinogenic or non-carcinogenic depending on solubility. The less-soluble forms are carcinogenic. Workers in the chromate-producing industry have been reported to have an increased risk of lung cancer.[7] The known health hazards from excessive exposure to chromium welding fumes are dermatitis, ulceration and perforation of the nasal septum, irritation of the mucous membranes of the larynx, pharynx, conjuctiva and chronic asthmatic bronchitis.[8]

5. Copper Fume

Inhalation of dusts, fumes, and mists of copper salts may cause congestion of the nasal mucous membranes, and on occasions, ulceration with perforation of the nasal septum. Inhalation of copper fume results in irritation of the upper respiratory tract and an influenza-like illness termed metal fume fever. Signs and symptoms of metal fume fever include chills, muscle aches, nausea, fever, dry throat, cough, weakness, and lassitude. Recovery is usually rapid. Most workers develop a tolerance to these attacks, but it is quickly lost; attacks tend to be more severe on the first day of the work-week. Other effects from copper fume are metallic or sweet taste, and in some instances, discoloration of the skin and hair or dermatitis. Exposure of workers to concentrations of 1 to 3 mg/M^3 for short periods resulted in altered taste response but no nausea; levels of from 0.02 to 0.4 mg/M^3 produced no complaints. Transient irritation of the eyes has followed exposure to a fine dust of oxidation products of copper produced in an electric arc.[7,9]

6. Fluoride

The inhalation of fluoride fumes or gases may produce respiratory tract irritation manifested by chills, fever, dyspnea, and cough. Exposure to excessive airborne fluoride concentrations may cause eye irritation and repeated or prolonged exposure of the skin to fluoride-bearing dusts and fumes may cause dermatitis. Fluoride particles are readily absorbed, and promptly produce an increase in the urinary fluoride excretion. When excessive amounts are inhaled, this excretion lags behind the daily intake resulting in a buildup of fluoride in the bones. If storage of fluorides continues over a sufficiently long period, the bones may show an increased radiographic density and structural abnormalities may eventually develop.[9,10]

7. Formaldehyde

Formaldehyde gas may cause severe irritation to the mucous membranes of the respiratory tract and eyes. The aqueous solution splashed in the eyes may cause eye burns. Urticaria has been reported following inhalation of gas. Repeated exposure to formaldehyde may cause dermatitis either from irritation or allergy. Systemic intoxication is unlikely to occur since intense irritation of upper respiratory passages compels workers to leave areas of exposure. If workers do inhale high concentrations of formaldehyde, coughing, difficulty in breathing, and pulmonary edema may occur. Formaldehyde has induced a rare form of nasal cancer in two test animals as reported in an ongoing study by the Chemical Industry Institute of Toxicology. Formaldehyde has also been shown to be a mutagen in several test systems. Based on this information, NIOSH recommends that formaldehyde be handled in the workplace as a potential occupational carcinogen.[7,11]

8. Hydrogen Chloride

Hydrogen chloride is a strong irritant, of the eyes, mucous membranes, and skin. The major effects of acute exposure are usually limited to the upper respiratory tract and are sufficiently severe to encourage prompt withdrawl from a contaminated atmosphere. Exposure to the gas immediately causes cough, burning of the throat, and a choking sensation. Effects are usually limited to inflammation and occasionally ulceration of the nose, throat, and larynx. Acute exposures causing significant trauma are usually limited to people who are prevented from escaping; in such cases, laryngeal spasm or pulmonary edema may occur. High concentrations of the gas caused eye irritation and may cause prolonged or permanent visual impairment, including total loss of vision. Exposure of the skin to a high concentration of the gas or to a concentrated solution of the gas (hydrochloric acid) will cause burns; repeated or prolonged exposure to dilute solutions may cause dermatitis. Erosion of the exposed teeth may occur from repeated or prolonged exposure.[6,10]

9. Iron Oxide Fume

Inhalation of iron oxide fume or dust causes an apparently benign pneumoconiosis termed siderosis. Iron oxide alone does not cause fibrosis in the lungs of animals, and the same probably applies to humans. Exposures of 6 to 10 years are usually considered necessary before changes recognizable by x-ray can occur; the retained dust gives x-ray shadows that may be indistinguishable from fibrotic pneumoconiosis. Eight of 25 welders exposed chiefly to iron oxide for an average of 18.7 (range 3 to 32) years had reticulonodular shadows on chest x-rays consistent with siderosis but no reduction in pulmonary function; exposure levels ranged from 0.65 to 47 mg/M^3. In another study, 16 welders with an average exposure of 17.1 (range 7 to 30) years also had x-rays suggesting siderosis and spirograms which were normal; however, the static and functional compliance of the lungs was reduced; some of the welders were smokers. The welders with the lowest compliance complained of dyspnea.[6]

10. Manganese

Manganese affects the central nervous system, and intoxication occurs mostly in chronic form (manganism); inhalation of high concentrations of nascent manganese oxide causes an influenza-like illness (metal fume fever).

Manganism is quite similar to Parkinsonism and usually occurs after exposure to manganese oxides for one to two years or more; however, it may develop after only a few months. The onset of symptoms is usually insidious. Initially there is headache, asthenia, restless sleep or somnolence, change in personality with psychomotor instability associated with restlessness, irritability, and pathologic laughter. This is followed by an intermediate phase with visual hallucinations, double vision, impaired hearing, uncontrollable impulses, mental confusion, and euphoria.

In the advanced phase, the subject exhibits excessive salivation and disorders of the basal ganglia of Parkinsonian type, such as masklike facies, muscle weakness, muscle rigidity, tremor of the upper extremities and head, and impaired gait.

In manganism with neurologic symptoms, the course is frequently progressive, although some patients' cases are stationary and others recover. Prognosis is more favorable in the young and in those with only a few years of exposure.[10]

11. Nickel

Metallic nickel and certain soluble nickel compounds as dust or fume cause sensitization dermatitis and probably produce cancer of the paranasal sinuses and the lung; nickel fume in high concentrations is a respiratory irritant. Severe but transient pneumonitis in two workers resulted from exposure to nickel fume; in one cause, exposure was for six hours, and post-incident sampling suggested a nickel concentration of 0.26 mg/M^3. "Nickel itch" is a dermatitis resulting from sensitization to nickel; the first symptom is usually itching, which occurs up to seven days before skin eruption appears. The primary skin eruption is erythematous, or follicular; it may be followed by superficial discrete ulcers, which discharge and become crusted, or by eczema; in the chronic stages, pigmented or depigmented plaques may be formed. Nickel sensitivity, once acquired, is apparently not lost; recovery from the dermatitis usually occurs within seven days of cessation of exposure, but may take several weeks. A worker who had developed cutaneous sensitization also developed apparent asthma from inhalation of nickel sulfate; immunologic studies showed circulating antibodies to the salt, and controlled exposure to a solution of nickel sulfate resulted in decreased pulmonary function and progressive dyspnea; the possibility of developing hypersensitivity pneumonitis cound not be excluded. In animals, finely divided metallic nickel was carcinogenic when introduced into the pleural cavity, muscle tissue, and subcutaneous tissues; rate and guinea pigs exposed to a concentration of 15 mg/M^3 of powdered metallic nickel developed malignant neoplasms. Several epidemiologic studies have shown an increased incidence of cancer of the paranasal sinuses and lungs among workers in nickel refineries and factories; suspicion of carcinogenicity has been focused primarily on respirable particles of nickel, nickel subsulfide, nickel oxide, and on nickel carbonyl vapor.[6]

12. Sulfur Dioxide

Sulfur dioxide (SO_2) is a colorless gas at ambient temperature and pressure with a strong pungent odor. SO_2 is a severe irritant of the eyes, mucous membranes, and skin. Chronic exposure can cause rhinitis (runny nose), dryness of the throat, fatigue, nasopharyngitis (inflammation of the nasopharynx), cough, and shortness of breath. SO_2 rapidly forms sulfurous acid on contact with mucous membranes. This accounts for its severe irritant effects. It is estimated that 10 to 20% of the young healthy adult population are especially susceptible to SO_2 effects. NIOSH recommends that occupational SO_2 exposures should not exceed 1.3 mg/M^3, time-weighted average, up to a 10-hour work-day, 40-hour work-week.[6,7]

VI. RESULTS

A. Environmental

Results of the environmental air samples obtained on the initial NIOSH survey August 26-27, 1981, for assessment of employee exposures during welding operations are presented in Tables III-V. Environmental air samples obtained during welding operations were taken at breathing-zone locations inside the welding helmet. Hexavalent chromium levels ranged from nondetectable (N.D.) to 5.7 micrograms per cubic meter of air (ug/m^3), with a mean of the time-weighted averages (TWA), of 2.1 ug/m^3. This is in excess of the NIOSH recommended standard of 1.0 ug/m^3. Total fluoride air samples collected ranged from N.D. - 0.73 milligrams per cubic meter of air (mg/m^3), and were within the NIOSH recommended standard of 2.5 mg/m^3. Iron oxide samples ranged from 0.08 - 1.0 mg/m^3, well below the American Conference of Governmental Industrial Hygienists (ACGIH) recommended standard of 5.0 mg/m^3. Environmental air sample results for total chromium ranged from N.D. - 0.05 mg/m^3 with the highest value found (0.05 mg) at 10% of the ACGIH recommended standard of 0.5 mg/m^3. Manganese samples ranged from 0.01 - 0.21, and were within the ACGIH recommended criteria of 1.0 mg/m^3. Air sample values for nickel ranged from N.D. - 0.02 mg/m^3. Of the 17 air samples for nickel 12 were nondetectable, 3 were at 0.01 mg/m^3 or 70% of the NIOSH recommended standard of 0.015 mg/m^3, and 2 were in excess of the NIOSH standard at 0.02 mg/m^3. No detectable concentrations were found on any air sample collected for copper fumes.[3,12]

The findings of the long-term air samples collected on the follow-up NIOSH survey February 17-19, 1982, for evaluation of worker exposures during sugar beet processing operations are presented in Tables VI-VIII. The area air sample values for BCME ranged from N.D. - 0.5 mg/m^3. Seven of the ten area air samples for BCME were nondetectable and three BCME air samples were above the laboratory analytical limit of detection of 0.02 ug/m^3 at 0.1 ug/m^3, 0.2 ug/m^3, and 0.5 ug/m^3. Calcium oxide sample values ranged from 4.0 - 83.4 mg/m^3, all well in excess of the ACGIH recommended criteria of 2.0 mg/m^3.[3] No detectable concentrations were found on any air sample collected for hydrogen chloride.

The results of the short-term colorimetric detector tube measurements taken during the follow-up survey are shown in Table IX. Carbon dioxide (CO_2) was the only substances detected at 900 mg/m^3, well below the ACGIH recommended criteria 8-hour TWA of 9,000 mg/m^3.[3] Formaldehyde and sulfur dioxide indicator tube measurements revealed non-detectable concentrations.

B. Medical

On the initial NIOSH survey, a non-directed medical questionnaire was administered to eight employees (welders) all of which also participated in the environmental evaluation by wearing personal air-sampling devices. Review of the questionnaires revealed that the ages and length of employment of the employees ranged from 25-60 years (mean 34) and six years, respectively. Five of eight employees reported experiencing burns from skin contact with hot metal slag while welding. Four of eight welders reported occasionally experiencing exposure to arc flash and later, conjunctivitis. At least one of the eight welders reported one or more of the following symptoms: sunburn; partial loss of vision; respiratory problems; nosebleeds; headache; and sinus congestion.

The same nondirected medical questionnaire was administered on the follow-up survey to seven employees: three workers in the lime kiln building; three employees on the second floor carbonation-peterson filter area; and one general laborer responsible for transfers of liquid formaldehyde into the diffuser. Two of three lime kiln employees reported experiencing burns (skin) due to contact with lime dust (calcium oxide). At the time of the NIOSH interview, both of these workers had unhealed burns on their feet and/or hands and scaring which they stated was due to previous calcium oxide exposures. One of these two lime kiln employees suffered a skin burn on the hand due to calcium oxide during the course of the NIOSH follow-up survey. The third lime kiln operator reported experiencing occasional eye irritation. Review of the questionnaires administered to the three employees in the carbonation - peterson filter area revealed that two of the three reported occasionally experiencing skin irritation/dermatitis. The third employee interviewed gave accounts of occasionally sustaining skin and eye burns from contact with either hydrochloric acid and/or calcium oxide. The general laborer questioned did not report any symptoms thought to be work - related.

VII. DISCUSSION

The ultimate reduction of the employee overexposures must be accomplished by the implementation of improved engineering control of workplace contaminants such as substitution of less hazardous process materials, automation, redesign or replacement of existing mechanical ventilation systems or a combination of these measures.

Overexposures to calcium oxide (CaO) was confirmed as evidenced by the personal and area air sample results. Improved respiratory protection is necessary to initially control the employee overexposures. The respirators currently in use by the workforce in the lime kiln building (half-face piece disposable dust respirators) are not appropriate for CaO levels of the magnitude measured. Since all the personal and area CaO air samples obtained were well in excess of the recommended 2.0 mg/m^3 evaluation criteria, the use of high-efficiency particulate respirators with full-facepiece is recommended.

Employee exposures to excessive hexavalent chromium and nickel concentrations during welding operations was demonstrated by air sampling. Worker exposure to these two substances would primarily occur during welding processes on stainless steel. Due to the nature of the welding operations (numerous locations including confined spaces) local exhaust ventilation is not always feasible. Therefore, NIOSH recommends that employees engaged in welding operations on stainless steel be provided with respiratory protective equipment similar in nature to that described in Appendixes III and IV of this report: (spark resistant) hood-type, supplied-air, positive pressure respirators with the welding lens incorporated into the facepiece of the respirator.

Although no personal BCME samples were collected on the NIOSH surveys, BCME was quantitated on 3 of 10 area air samples obtained on the follow-up survey. The probability of any routine employee exposures to BCME seems somewhat remote due to the fact that all the personal and area air samples for hydorgen chloride were non detectable and formaldehyde is stored and used in an enclosed system. However whenever formaldehyde and chlorides are present in quantity, the formation of BCME cannot be discounted, either in the bulk of solutions, in moisture droplets, in adsorbed film on airborne particulates, or in condensed covering of solid surfaces on the ground. Long-term recommendations are that efforts be made to avoid the coexistence of formaldehyde and chlorides in the same confinement. For industrial processes wherein both of these components are utilized, substitutes for either of the two is suggested.[1] In the interim, if a large scale leak of either formaldehyde or hydrogen chloride were to accidentally occur at SMSC, it is suggested that environmental air samples for BCME be procurred. It is also advised that periodic air monitoring environmental for BMCE be conducted during the sugar beet processing compaign to ascertain that no worker exposures to BCME ensue. See Recommendation Section VIII, no. 16.

Although no environmental measurements were made for evaluation of employee exposure to ultraviolet radiation (UV) during welding operations on the initial survey, four of eight welders interviewed by the NIOSH industrial hygienist reported occasionally experiencing conjunctivitis, a characteristic visual symptom of overexposure to UV radiation. One of the eight welders also reported experiencing erythema (sunburn), another common effect of excessive UV exposure. All employees exposed to UV radiation created by welding operations should be protected by the appropriate protective equipment as described in the General Industry Occupational Safety and Health Standards (29 CFR 1910.252), (see Section VIII, no. 7).

As mentioned previously in this report, the formaldehyde and sulfur dioxide systems of storage and use at SMSC are in an enclosed system. Thus, routine use of these chemicals would not present an exposure hazard of either substance to the workers. It was revealed though that infrequent leaks in the SO_2 supply system have occurred and employee exposures to SO_2 did exist. In order to adequately address such an emergency situation, the development of a audible and visual warning systems and overall emergency procedures is encouraged. See Recommendation Section VIII, no. 13.

During NIOSH's initial and follow-up surveys, deficiencies in the use and availability of personal protective equipment and work process controls were recognized. Several of the welders had experienced burns from contact with stray hot metal slag while welding. Some of the welders wore polyester clothing which presented an additional burn hazard. An inadequate respiratory protection program existed as evidenced by the lack of standard operating procedures including respirator use, training and fit testing. Recommendations, some of which address these shortcomings, are included in the following Section VIII of this report.

VIII. RECOMMENDATIONS

In view of the findings of the environmental investigations, the following recommendations are made to ameliorate existing or potential hazards, and to provide a better work environment for the employees covered by this determination.

1. Employee exposure to excessive lime dust levels within the lime kiln building should be immediately reduced to the lowest level possible through effective engineering controls. NIOSH recommends that private engineering consultants be retained by SMSC to specifically address the calcium oxide emissions in the lime kiln building.

2. Respirators (described previously) as a means of control should be used in the interim period when effective engineering controls are being implemented in the lime kiln building.

3. Make available immediate and periodic medical attention for those employees working in the lime kiln area who have suffered burns (skin) due to exposure to calcium oxide.

4. Ascertain that workers in the lime kiln area are provided with a means by which to prevent lime dust (calcium oxide) from falling inside their boots and/or gloves and causing skin burns.

5. Respirators (described previously and in Appendix III & IV) should be worn by employees engaged in welding on stainless steel.

6. Wearing of polyester clothing by welders should be prohibited.

7. All welding operations should comply with the regulations set forth in the General Industry Occupational Safety and Health Standards, OSHA (29 CFR 1910.252).

8. The recommendations found in DHEW (NIOSH) Publication No. 80-106, "Working in Confined Spaces," Criteria for a Recommended Standard, should be followed when employees are required to enter, work in, and exit from confined spaces. (Copies have been provided to plant management and union representatives.)

9. Develop and enforce a respiratory program pursuant to those guidelines found in DHEW (NIOSH) Publication No. 76-189, " A Guide to Industrial Respiratory Protection," and to the General Industry Occupational Safety and Health Standards, OSHA (29 CFR 1910.134). In addition, ascertain that the compressors used for supplying air are equipped with the necessary safety and standby devices and meet minimum air quality specifications.

10. Periodically ascertain that all emergency eyewash stations are functional with clean and tempered water and that they are used for such purposes.

11. Provide eye protection for all employees in the carbonation - peterson filter area who are responsible for handling hydrochloric acid.

12. Guidelines covering general personal protective equipment should be implemented. Procedures regarding protective equipment maintenance, use and limitations should be established and enforced.

13. Develop a visual and audible emergency warning system (including appropriate emergency procedures) that would give notice to all employees in case of an extensive leak of formaldehyde, sulfur dioxide and/or hydrochloric acid.

14. Provide functional shower facilities with hot and cold water in the change rooms.

15. A continuing education program conducted by a person or persons qualified by experience or special training, should be instituted to ensure that all employees have current knowledge and understanding of job safety and health hazards, proper work practices and maintenance procedures, and that they know how to use respirators correctly.

16. Greater involvement from both management and union representatives at SMSC is needed in establishing an occupational safety and health program. Furthermore, NIOSH suggests that SMSC conduct periodic environmental evaluations of employee exposures to BCME, calcium oxide, hexavalent chromium and nickel to assure that the extent of implementation of the above recommendations are adequate to protect the affected employees.

IX. REFERENCES

1. National Institute for Occupational Safety and Health (NIOSH) Research Report, BCME Formation and Detection in Selected Work Environments, (U.S. Department of HEW, (NIOSH) Publication No. 79-118).

2. National Institute for Occupational Safety and Health (NIOSH) manual of analytical methods. Vol 7, 2nd ed. Analytical Method P&CAM 354 Formaldehyde, Cincinati, OH: NIOSH, 1981 (DHHS (NIOSH) publication no. 82-100).

3. American Conference of Governmental Industrial Hygienists. Threshold limit values for chemical substances and physical agents in the workroom environment with intended changes for 1981. Cincinnati, Ohio: ACGIH, 1981.

4. Occupational Safety and Health Administration. OSHA safety and health standards, 29 CFR 1910. Occupational Safety and Health Administration, revised 1980.

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11. National Institute for Occupational Safety and Health. Current Intelligence Bulletin 34: Formaldehyde; Evidence of Carcinogenicity. April 1981. (DHHS (NIOSH) Publication No. 81-111).

12. National Institute for Occupational Safety and Health. Summary Booklet of NIOSH Recommendations for Occupational Health Standards, March 1980.

13. National Institute for Occupational Safety and Health. NIOSH manual of analytical methods; Vol 1, Publication no. 77-157A, 1977; Vol 3, Publication no. 77-157-C, 1977; Vol 4, Publication no. 78-175, 1978; Vol 5, Publication no. 79-141, 1979.

X. AUTHORSHIP AND ACKNOWLEDGEMENTS

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X. 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. Southern Minnesota Beet Sugar Cooperative
2. American Federation of Grain Millers, Local 369
3. NIOSH, Region V
4. OSHA, Region V

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 I

AIR SAMPLING AND ANALYSIS METHODOLOGY
SOUTHERN MINNESOTA BEET SUGAR COOPERATIVE

RENVILLE, MINNESOTA
HETA 81-283

Substance	Collection Device	Flow Rate (liters per minute)	Analysis	References[13]
Bis-Chloromethyl ether	Midget Impinger (methanolic solation of the sodium salt of 2,4,6-trichlorophenol)	1.0	Electron Capture Gas Chromatography	NIOSH P&CAM 220 with modifications
Calcium Oxide	AA-MCEF Filter	1.5	Atomic Absorption	NIOSH No. S-205
Chromium VI	Tared PVC Filter	1.5	Colorimetric	NIOSH P&CAM 169
Chromium	AA-MCEF Filter	1.5	Atomic Absorption	NIOSH P&CAM 173
Copper Fume	AA-MCEF Filter	1.5	Atomic Absorption	NIOSH P&CAM 173
Total Fluoride	Particulate Fluoride: AA-MCEF Filter Gaseous Fluoride: Alkali-Impregnated Cellulose Pad	2.0	Fluoride Ion Selective Electrode	NIOSH P&CAM 212
Hydrogen Chloride	Silica Gel Tube	0.005	Ion Chromatography	NIOSH P&CAM 310
Iron Oxide Fume	AA-MCEF Filter	1.5	Atomic Absorption	NIOSH P&CAM 173
Manganese Fume	AA-MCEF Filter	1.5	Atomic Absorption	NIOSH P&CAM 173
Nickel	AA-MCEF Filter	1.5	Atomic Absorption	NIOSH P&CAM 173

TABLE II

ENVIRONMENTAL EVALUATION CRITERIA
SOUTHERN MINNESOTA BEET SUGAR COOPERATIVE

RENVILLE, MINNESOTA
HETA 81-283

Substance	NIOSH Recommended Standard (mg/m^3)	ACGIH TLV (mg/m^3)	OSHA Standard (mg/m^3)
bis-Chloromethyl ether	-(1)	0.0047	-(2)
Calcium Oxide	-	2.0	5.0
Carbon Dioxide	18,000	9000	9000
Chromium	-	0.5	1.0
Chromium VI	0.001(3)	0.05	0.1
Copper Fume	-	0.2	0.1
Fluoride	2.5	2.5	2.5
Formaldehyde	-(4)	-(5)	3.7
Hydrogen Chloride	-	7.0 (ceiling)	7.0 (ceiling)
Iron Oxide Fume	-	5.0 (10.0-STEL)	10.0
Manganese Fume	-	1.0 (3.0-STEL)	5.0 (ceiling)
Nickel	0.015	1.0	1.0
Sulfur Dioxide	1.3	5	13.0

(1) BCME has been repeatedly identified as a potent carcinogen. Because it is not possible to establish a safe exposure level for a carcinogen, NIOSH recommends restricting exposure to below levels that can still be reliably measured in the workplace.[1]

(2) OSHA does not have a specific airborne exposure limit for BCME. The OSHA standard for BCME requires that employee exposures be controlled by engineering controls, proper work practices and personal protective devices.[4]

(3) Value given is for carcinogenic Chromium VI.[8]

(4) NIOSH recommends that formaldehyde be handled in the workplace as a potential occupational carcinogen. An estimate of the extent of the cancer risk to workers exposed to various levels of formaldehyde at or below the current OSHA 3.7 mg/m^3 standard has not yet been determined. In the interim NIOSH recommends that as a prudent public health measure, engineering controls and stringent work practices be employed to reduce occupational exposure to the lowest feasible limit.[11]

(5) ACGIH - 1981 (Notice of Intended Changes)[3]

TABLE III

RESULTS OF ENVIRONMENTAL AIR SAMPLES FOR CHROMIUM VI
PERSONAL SAMPLES - WELDING OPERATIONS

SOUTHERN MINNESOTA BEET SUGAR COOPERATIVE
RENVILLE, MINNESOTA

HETA 81-283

Sample Location	Date/Time	Sample Volume (liters)	Chromium VI (ug/M^3)	Time-Weighted Average Concentration (ug/M^3)
Outside-Screen House	8/26/81 7:45-10:00am	203	3.5	4.8
Outside-Screen House	8/26/81 10:00-2:02	212	5.7	
3rd Floor Inside Evaporator	8/26/81 1:45-5:19	321	3.4	3.4
2nd Floor Under Evaporator	8/26/81 7:00-12:00pm	450	N.D.	-
Inside Diffuser	8/26/81 7:04-12:00pm	446	1.0	1.0
Inside Diffuser	8/26/81 12:30-4:49	389	1.0	
Inside Evaporator	8/27/81 7:06-11:50	426	3.1	3.1
Inside Diffuser	8/27/81 6:59-11:50	437	N.D.	-
Evaluation Criteria (time-weighted average, normal workday, 40 hour/week)			1.0	1.0

1. N.D. = nondetectable
2. Laboratory analytical limit of detection in ug/sample = 0.2
3. ug/M^3 = micrograms per cubic meter of air

TABLE IV

RESULTS OF ENVIRONMENTAL AIR SAMPLES FOR FLUORIDES
PERSONAL SAMPLES - WELDING OPERATIONS

SOUTHERN MINNESOTA BEET SUGAR COOPERATIVE
RENVILLE, MINNESOTA

HETA 81-283

Sample Location	Date/Time	Sample Volume (liters)	Gaseous Fluorides mg/M^3	Particulate Fluorides mg/M^3	Total Fluorides mg/M^3
2nd Floor Under Evaporator	8/26/81 7:00-12:00pm	600	N.D.	0.01	0.01
Inside Diffuser	8/26/81 7:03-12:00	594	N.D.	N.D.	N.D.
3rd Floor Inside Evaporator	8/26/81 7:06-12:00	588	N.D.	0.20	0.20
2nd Floor Near Evaporator	8/27/81 6:54-11:56	604	0.03	.10	0.13
3rd Floor Inside Crystallization Tank	8/27/81 7:00-11:54	588	0.03	0.70	0.73
Evaluation Criteria (time-weighted average, normal workday, 40 hour/week)					2.5

1. N.D. = nondetectable
2. Laboratory analytical limit of detection in mg/sample = 0.005
3. mg/M^3 = milligrams per cubic meter of air

RESULTS OF ENVIRONMENTAL AIR SAMPLES FOR METAL FUMES
PERSONAL SAMPLES - WELDING OPERATIONS

SOUTHERN MINNESOTA BEET SUGAR COOPERATIVE
RENVILLE, MINNESOTA

HETA 81-283

Sample Location	Date/Time	Sample Volume (liters)	Iron Oxide mg/m³	Total Chromium mg/m³	Copper mg/m³	Manganese mg/m³	Nickel mg/m³
Outside Plant Welding on Screen House	8/26/81 07:45-12:00 12:30-17:20	758	0.73	N.D.[1]	N.D.	0.17	N.D.
Welding Inside the Evaporator	8/26/81 07:08-12:00 13:40-17:21	770	0.50	0.04	N.D.	0.21	0.01
Carbonation Tank Area 1st Floor	8/26/81 07:11-12:00 12:30-17:30	884	0.53	N.D.	N.D.	0.05	N.D.
2nd Floor Adjacent to Evaporator Line	8/26/81 07:13-12:00 12:30-17:27	877	0.30	N.D.	N.D.	0.03	N.D.
Inside Diffuser	8/26/81 07:14-12:00 12:30-16:49	818	0.21	N.D.	N.D.	0.01	N.D.
Inside and Outside of Crystallization Tank 3rd Floor	8/26/81 07:18-12:00 12:30-17:09	842	1.0	N.D.	N.D.	.09	N.D.
2nd Floor Boilerhouse	8/26/81 08:08-12:00 12:30-17:15	776	0.44	N.D.	N.D.	0.04	N.D.
2nd Floor Adjacent to Pulp Press	8/26/81 08:23-11:26	275	0.30	0.01	N.D.	0.03	N.D.
Inside Diffuser	8/26/81 13:10-16:49	329	0.28	0.03	N.D.	0.03	0.01
Evaluation Criteria (time-weighted average, normal workday, 40 hour/week)			5.0	0.5	0.2	1.0	0.015
Laboratory analytical limit of detection in mg/sample			0.003	0.003	0.003	0.001	0.003

1. N.D. = nondetectable
2. mg/m^3 = milligrams per cubic meter of air

TABLE V (continued)

RESULTS OF ENVIRONMENTAL AIR SAMPLES FOR METAL FUMES
PERSONAL SAMPLES - WELDING OPERATIONS

SOUTHERN MINNESOTA BEET SUGAR COOPERATIVE
RENVILLE, MINNESOTA

HETA 81-283

Sample Location	Date/Time	Sample Volume (liters)	Iron Oxide mg/m^3	Total Chromium mg/m^3	Copper mg/m^3	Manganese mg/m^3	Nickel mg/m^3
Inside Diffuser	8/27/81 06:58-11:50 12:30-16:00	747	0.11	N.D.	N.D.	0.01	N.D.
Inside Diffuser	8/27/81 07:00-11:50 12:30-16:00	750	0.08	0.05	N.D.	.06	0.02
1st Floor Carbonation Tanks	8/27/81 07:01-12:10 12:30-16:50	754	0.60	N.D.	N.D.	0.08	N.D.
2nd Floor Boilerhouse	8/27/81 07:21-12:01 12:30-16:30	780	0.24	N.D.	N.D.	0.01	N.D.
Outside Working on Screenhouse	8/27/81 07:02-12:00 12:30-16:23	797	0.55	N.D.	N.D.	0.03	N.D.
Inside Evaporator	8/27/81 06:57-12:13 12:30-16:30	795	0.27	0.03	N.D.	0.04	0.01
Under Evaporator	8/27/81 07:11-12:10 12:30-16:44	830	0.26	N.D.	N.D.	0.02	N.D.
2nd Floor Evaporator Low Raw Centrifuge	8/27/81 07:13-11:00	341	0.24	0.04	N.D.	0.04	0.02
Evaluation Criteria (time-weighted average, normal workday, 40 hour/week)			5.0	0.5	0.2	1.0	0.015
Laboratory analytical limit of detection in mg/sample			0.003	0.003	0.003	0.001	0.003

1. N.D. = nondetectable
2. mg/m^3 = milligrams per cubic meter of air

TABLE VI

RESULTS OF ENVIRONMENTAL AIR SAMPLES FOR bis-CHLOROMETHYL ETHER
AREA SAMPLES - BEET PROCESSING OPERATIONS

SOUTHERN MINNESOTA BEET SUGAR COOPERATIVE

RENVILLE, MINNESOTA
HETA 81-283

Sample Location	Date/Time	Sample Volume (liters)	bis-Chloromethyl Ether (ug/m^3)
Peterson Filter Area	2/18/82 09:37-14:49	312	0.2
Walkway between diffuser and 1st Carbonation tank	2/18/82 09:45-14:53	308	N.D.[2]
Walkway adjacent to diffuser and above the formaldehyde tank	2/18/82 09:56-14:56	300	N.D.
Under diffuser 10' from formaldehyde tank	2/18/82 10:07-15:04	297	0.5
Above Peterson Filter Area adjacent to HCL storage tank	2/18/82 10:20-14:45	265	0.1
Peterson Filter Area	2/19/82 08:40-13:17	277	N.D.
Walkway between diffuser and 1st Carbonation Tank	2/19/82 08:45-13:04	259	N.D.
Walkway adjacent to diffuser approximately 60' off floor level	2/19/82 08:50-13:10	269	N.D.
Adjacent to HCL storage tank	2/19/82 09:01-13:23	262	N.D.
Under diffuser 10' from formaldehyde tank	2/19/82 09:11-12:51	220	N.D.

1. BCME has been repeatedly identified as a potent carcinogen. Because it is not possible to establish a safe exposure level for a carcinogen, NIOSH recommends restricting exposure to below levels that can still be reliably measured in the workplace.[1]
2. N.D. = nondetectable concentrations
3. Laboratory analytical limit of detection in ug/sample 0.02

TABLE VII

RESULTS OF ENVIRONMENTAL AIR SAMPLES FOR CALCIUM OXIDE
PERSONAL AND AREA SAMPLES - LIME KILN OPERATIONS

SOUTHERN MINNESOTA BEET SUGAR COOPERATIVE

RENVILLE, MINNESOTA
HETA 81-283

Sample Location	Date/Time	Sample Volume (liters)	Calcium Oxide (ug/m^3)
Personal Sample Limerock Operator	2/18/82 08:22-16:00	688	83.4
Personal Sample Limerock Operator	2/18/82 08:24-15:58	682	13.5
Personal Sample Foreman - Lime Kiln Area	2/18/82 08:27-16:00	680	7.6
Area Sample West of slacker conveyor on ladder	2/18/82 08:34-16:12	685	19.2
Area Sample Underneath Conveyor	2/18/82 08:41-16:14	674	46.9
Personal Sample Foreman - Lime Kiln Area	2/19/82 07:54-15:35	692	4.0
Personal Sample Limerock Operator	2/19/82 07:57-15:35	686	14.7
Area Sample Attached to pillar west of conveyor	2/19/82 08:22-16:12	704	22.9
Personal Sample Limerock Operator	2/19/82 08:11-15:37	669	62.7
Evaluation Criteria (time-weighted average, normal workday, 40 hour/week)			2.0

1. Laboratory analytical limit of detection in mg/sample = 0.0028

TABLE VIII

RESULTS OF ENVIRONMENTAL AIR SAMPLES FOR HYDROGEN CHLORIDE
PERSONAL AND AREA SAMPLES - BEET PROCESSING OPERATIONS

SOUTHERN MINNESOTA BEET SUGAR COOPERATIVE

RENVILLE, MINNESOTA
HETA 81-283

Sample Location	Date/Time	Sample Volume (liters)	Hydrogen Chloride (ug/m³)
Personal Sample Foreman - Carbonation Filter Area	2/18/82 09:18-15:55	19.9	N.D.[1]
Area Sample Southeast corner of Peterson Filter #4	2/18/82 09:25-16:25	19.8	N.D.
Area Sample Below diffuser at beet end	2/18/82 10:12-16:18	18.4	N.D.
Personal Sample Foreman - Carbonation Filter Area	2/19/82 08:35-15:45	21.5	N.D.
Area Sample Between Peterson Filters #4 and #5	2/19/82 08:41-16:23	20.9	N.D.
Personal Sample Miscellaneous Laborer Beet end	2/19/82 08:00-15:49	24.4	N.D.

Evaluation Criteria	
(A.C.G.I.H. 1981 ceiling limit in (milligrams) mg/m^3)	7.0
Laboratory analytical limit of detection in ug/sample (estimated)	4.0

1. N.D. = nondetectable

TABLE IX

RESULTS OF DETECTOR TUBE MEASUREMENTS
BEET PROCESSING OPERATIONS

SOUTHERN MINNESOTA BEET SUGAR COOPERATIVE

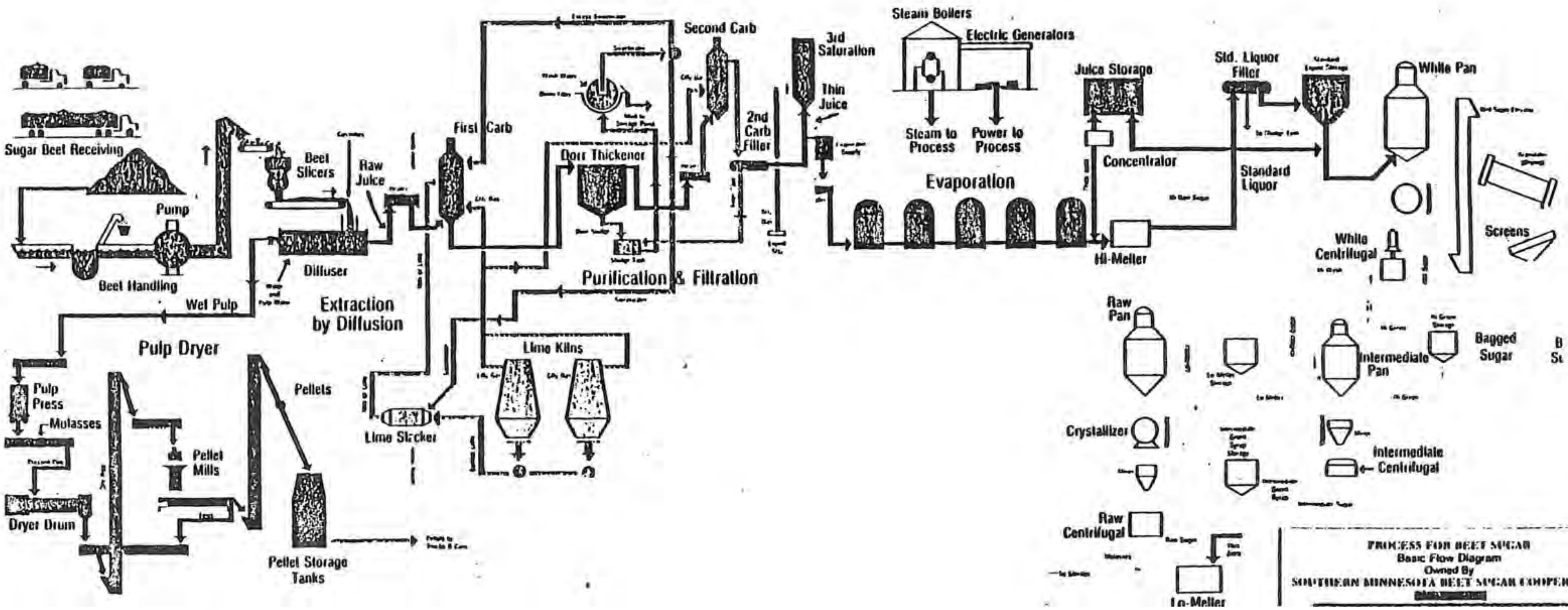
RENVILLE, MINNESOTA
HETA 81-283

February 18-19, 1982

Location/Date/Time	Substance	Concentration (mg/m^3)	Evaluation Criteria (mg/m^3)
Ground Level - Lime Kiln Building 2/18/82 - 11:00	Carbon Dioxide	900	TWA:9,000 STEL:15,000
Lime Kiln Building 35' Above Ground Level Adjacent To Leading Bin 2/18/82 - 11:05	Carbon Dioxide	900	TWA:9,000 STEL:15,000
Carbonation Area Adjacent to Sulfonator 2/18/82 - 14:00	Sulfur Dioxide	N.D.	TWA:1.3
Under Diffuser 10' from Formaldehyde Tank 2/19/82 - 09:30	Formaldehyde	N.D.	-5

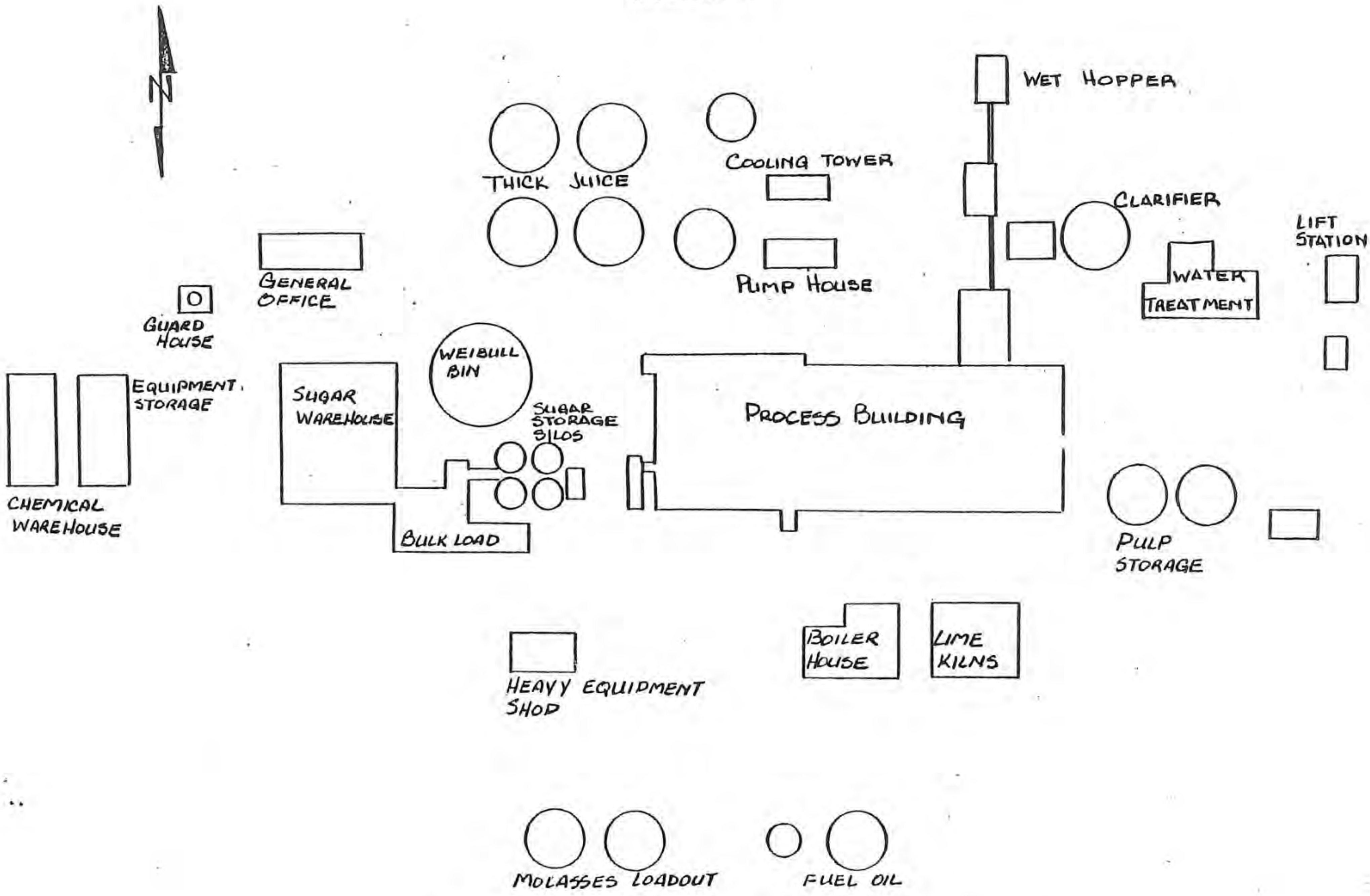
(1) TWA: time-weighted average (8-10 hour)
(2) STEL: Short Term Exposure Level (ACGIH - 1981)
(3) N.D.: nondetectable
(4) mg/m^3: milligrams per cubic meter of air
(5) NIOSH recommends that formaldehyde be handled in the workplace as a potential occupational carcinogen. An estimate of the extent of the cancer risk to to workers exposed to various levels of formaldehyde at or below the current OSHA 3.7 mg/m^3 standard has not yet been determined. In the interim, NIOSH recommends that as a prudent public health measure, engineering controls and stringent work practices be employed to reduce occupational exposure to the lowest feasible limit.[11]

APPENDIX I

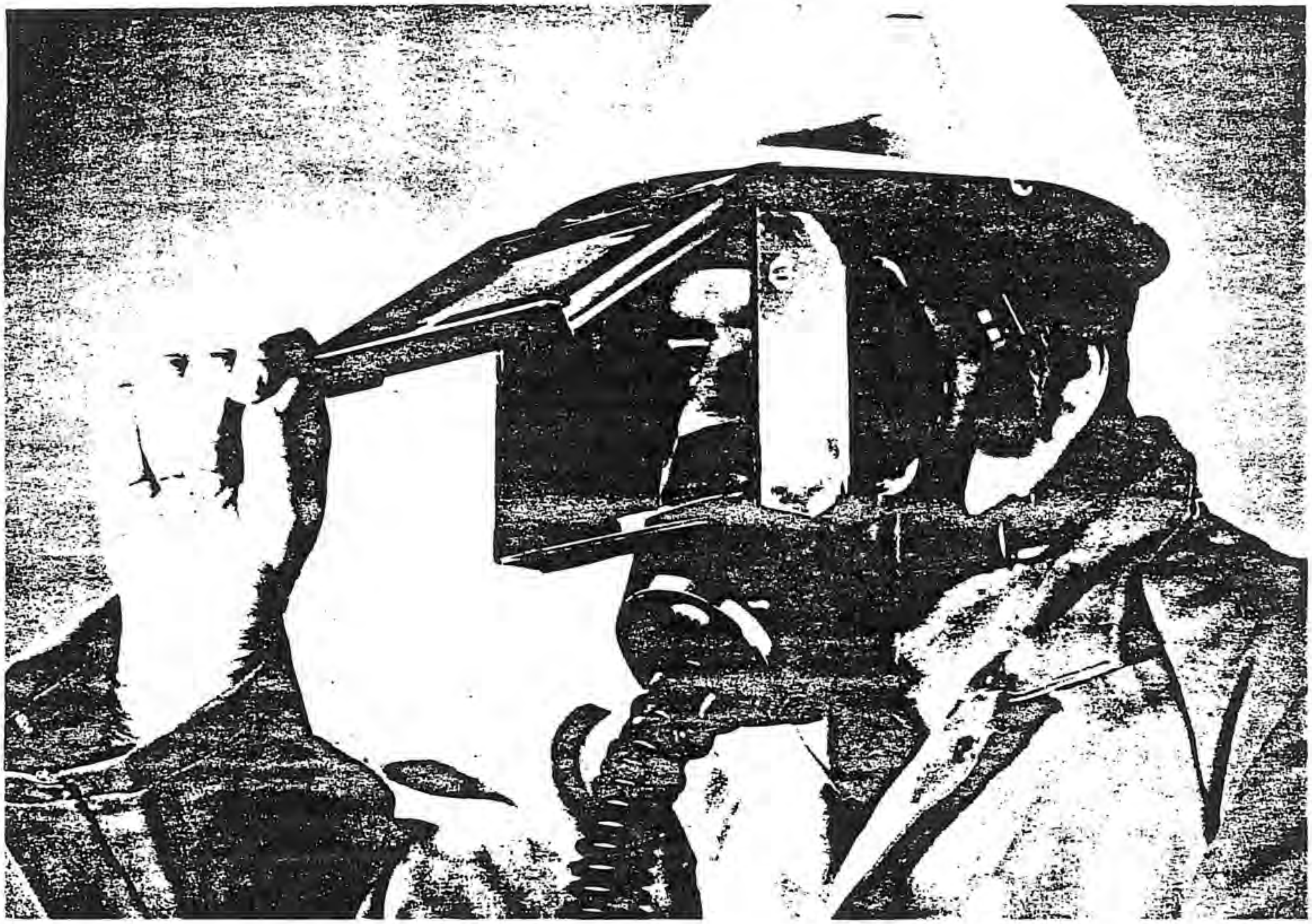


Sugar Beet Receiving
Beet Handling
Pump
Beet Slicers
Raw Juice
Diffuser
Wet Pulp
Extraction by Diffusion
Pulp Dryer
Pulp Press
Molasses
Pellet Mills
Pellets
Dryer Drum
Pellet Storage Tanks
First Carb
Second Carb
Dorr Thickener
Purification & Filtration
Lime Kilns
Lime Slacker
2nd Carb Filter
3rd Saturation
Thin Juice
Steam Boilers
Electric Generators
Steam to Process
Power to Process
Evaporation
Juice Storage
Concentrator
Hi-Melter
Std. Liquor Filter
Standard Liquor
White Pan
White Centrifugal
Screens
Raw Pan
Intermediate Pan
Bagged Sugar
Crystallizer
Intermediate Centrifugal
Raw Centrifugal
Lo-Melter
PROCESS FOR BEET SUGAR
Basic Flow Diagram
Owned By
SOUTHERN MINNESOTA BEET SUGAR COOPER

APPENDIX II



SOUTHERN MINNESOTA SUGAR BEET CO-OP



Application

MSA® Welders Adapter affords a means of combining vision protection with a wide choice of respiratory protection for welders subject to toxic hazards. Models are available to adapt both Ultravue® and Clearvue® Facepieces, making the whole line of MSA full-facepiece respiratory protection devices suitable for welding operations.

Description

The Welders Adapter is molded of polycarbonate plastic, which has high resistance to impact, heat, and welding splatter, and retains its strength at temperatures from −100° to 270°F. Adapter is attached to Ultravue or Clearvue Facepiece by spring retainers, and has a light-tight, fire-retardant polyurethane foam gasket. A large vision area—4½ x 5¼ in.—provides an unobstructed view of work.

The Welders Adapter is supplied with an impact-resistant cover lens; desired filter plate is ordered separately. Rayfoe™ Filter Plates are available in four standard shades—6,10,12, and 14. Intermediate shades are also available on request.

Operation

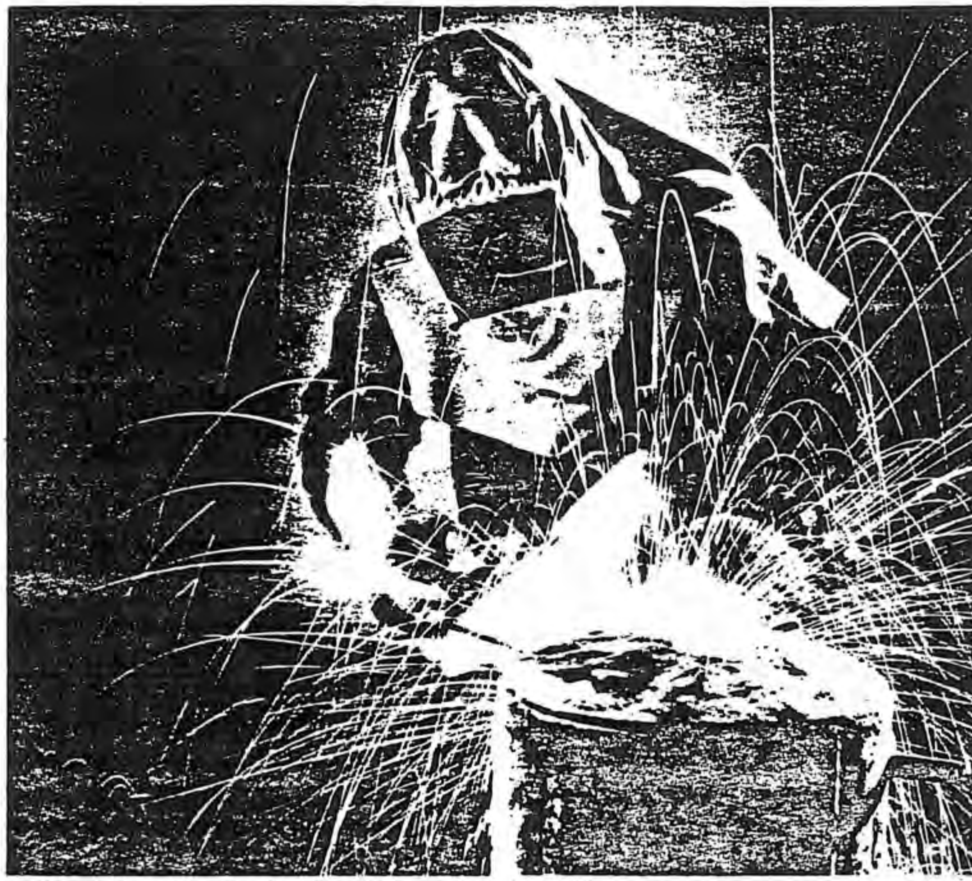
With Welders Adapter attached, the Ultravue or Clearvue Facepiece is worn normally. Filter plate and cover lens slide easily into place and are held securely by retaining springs. The lift-front, which contains the lenses, swings up easily to allow a clear view for preparatory work. It is returned to welding position with a downward snap of the head, leaving the welder's hands free for work.

High-impact-resistant cover lens is inserted in the outer position.

Rayfoe Filter Plate is inserted in the inner position.

Optional accessory

A heat-resistant chrome leather hood that connects to snap-type fasteners on the sides of the Welders Adapter protects the welder's neck and shoulders from welding splatter, sparks, and intense heat.



Optional chrome leather hood protects neck and shoulders.

Ordering information

Catalog numbers

449646	Ultravue Welders Adapter, complete with cover lens, less filter plate
471180	Clearvue Welders Adapter, complete with cover lens, less filter plate
38346	Rayfoe Filter Plate, shade 6, heat-treated
38347	Rayfoe Filter Plate, shade 10, heat-treated
38277	Rayfoe Filter Plate, shade 12, heat-treated
38348	Rayfoe Filter Plate, shade 14, heat-treated
88379	Cover Lens
87408	Welders Hood, chrome leather
34337	Cleaner-Sanitizer, 25 1-oz pkgs

Note: This Data Sheet contains only a general description of the MSA Welders Adapter. While uses and performance capabilities are described, under no circumstances should the product be used except by qualified, trained personnel and not until the instructions, labels, or other literature accompanying it have been carefully read and understood and the precautions therein set forth followed. Only they contain the complete and detailed information concerning this product.