INDUSTRIAL HYGIENE SURVEY

Stauffer Chemical Company
Salt Lake City, Utah

SURVEY DATE

July 16 - 25, 1975

SURVEY CONDUCTED BY

Melvin E. Cassady
Frances Wolf
Bruce Etchison

REPORT PREPARED BY

Frances Wolf
Melvin E. Cassady

DATE OF REPORT

Industrial Hygiene Section
Division of Surveillance, Hazard Evaluations, and Field Studies
National Institute for Occupational Safety and Health
Cincinnati, Ohio

INTRODUCTION

The Division of Surveillance, Hazard Evaluations, and Field Studies (DSHEFS) of the National Institute for Occupational Safety and Health was requested to investigate the environmental conditions at a wet chemical fertilizer plant in Central Florida where three persons working on the same job, and alledged non-smokers, were diagnosed as having lung cancer. This was brought to the attention of NIOSH by Mr. Guy Smith, Attorney at Law, representing the surviving lung cancer victim.

During October, 1974, a team of investigators for DSHEFS toured the plant located in Polk County, Florida, where the three lung cancer cases were reported. In July, 1975, as a continuation of the study of variations in worker exposures in different wet chemical operations, Frances Wolf, Bruce Etchison, and Mel Cassady conducted a survey of Stauffer Chemical Company's wet chemical processing plant in Salt Lake City.

DESCRIPTION OF PHOSPHATE FERTILIZER MANUFACTURING

During the chemical processing, phosphate rock is ground and mixed with sulfuric acid to produce phosphoric acid. Hydrofluorosilicic acid is recovered as a by-product in some operations. The reaction is $Ca_{10}F_2 (PO_4) 6 + 10 H_2SO_4 + 20 H_2O \rightarrow CaSO_4 2H_2O + 2 HF + 6 H_3PO_4$. Phosphoric acid is mixed with phosphate rock to manufacture granular superphosphate fertilizer.

Diammonium phosphate is produced by introducing controlled amounts of anhydrous ammonia (NH_3), through the bottom of a saturator tank containing 44% phosphoric acid to form a slurry which is mixed in a blender. The mixture is granulated, dried, screened, and the desired product size is transported to bulk storage.

Monoammonium phosphate is produced by bubbling anhydrous ammonia through 30% phosphoric acid solution to form a slurry. The reaction is $H_3PO_4 + NH_3 \rightarrow (NH_4) H_2PO_4$. The mixture is granulated, dried, screened and the product transported to bulk storage.

DESCRIPTION OF PLANT

The plant built in 1954 is located 20 miles west of Salt Lake City on about 1000 acres of land. The chemical complex consists of five main operating units: crushing and grinding; phosphoric acid plant; triple superphosphate; diammonium and monoammonium phosphate; and storage.

The total work force of the Stauffer plant consists of approximately 117 of which 80 are production workers and 37 are salaried employees.

The plant operates three shifts per day seven days per week with the major products being phosphoric acid (52% P_2O_5), superphosphoric acid (68% P_2O_5),

hydrofluorosilicis acid, diammonium phosphate, monoammonium phosphate and triple superphosphate. The raw materials are phosphate ore, 90% of which comes from Leefe, Wyoming and 10% of which comes from Vernal, Utah and sulphuric acid piped from Kennecott Copper Corporation plant located next to this facility.

MEDICAL, SAFETY, AND INDUSTRIAL HYGIENE PROGRAM

This facility does not presently have inplant medical facilities. The Gallant Clinic in Salt Lake City is retained to perform the pre-employment physical examinations and emergency care. There is no full time nurse; however, several persons have been trained in first aid. The pre-employment physical examination consists of a medical history, hearing test, and x-rays for chest and lower back.

The safety program seems to be a standard program consisting of accident prevention with an incentive award program. Stauffer has a full time Director of Safety and Loss Prevention and one full time safety engineer. Production supervisors are responsible for safety in their respective areas. A safety committee consisting of from 8 to 12 people, with approximately 50 percent representation from salaried employees and 50 percent from the union, meets twice a month to discuss safety violations and status of abatement. The safety inspections are performed by union and salaried employees in areas where they do not normally work. In addition to the safety committee meeting these committee members investigate accidents and if the accident was determined to be a result of poorly designed equipment or method of operating, or for reasons other than negligence on the part of the injured person, then an effort is made by the committee to recommend a solution to prevent accidents of that nature in the future. The employees are provided with safety glasses and hard hats. They are not required to wear safety shoes; however, the company will pay 60% toward the purchase of safety shoes. Respiratory protective equipment consists of self contain breathing apparatus (SCBA), gas mask, and dust and chemical cartridge half mask. Respirators with appropriate cartridges were being used while working inside the digester tank.

The plant's industrial hygiene functions are performed by an environmental control engineer and environmental chemist. The exhaust systems are primarily process units or air pollution control devices; however, they appear to be effective in controlling dust at major areas where considerable dust may be generated. The cyclones and baghouses are used as classifiers or process units; wet scrubbers for control of fluorides.

POTENTIAL HEALTH HAZARDS

The major potential contaminants that can exist and were tested for during this survey are the following:

Phosphoric Acid Mist

Considerable phosphoric acid mist and droplets could be generated in the production of phosphoric acid from phosphate rock and sulfuric acid or through material handling.

Sulfuric Acid Mist

Sulfuric acid is used as a reactant therefore a mist could be generated in the digester tank.

Fluorides

Because of the amount of fluoride in the ore, conditions are such as to generate hydrofluorosilicic acid as a by-product in phosphoric acid production.

Urnaium

Urnaium and its decay products are found in the phosphate deposits in the United States. However, the ore deposits in Utah and Wyoming appear to have less uranium; therefore, it was anticipated that the occupational exposures would be less in the case of the Stauffer Chemical Plant in Salt Lake City, then those found in Florida.

ENVIRONMENTAL SURVEY

The operation evaluated by NIOSH was the cleaning of a large phosphoric acid reactor vessel. During the study 8-hour time weighted average exposures for cadmium, chromium, vanadium, phosphoric acid, and sulfuric acid on workers involved in cleaning out the reactor vessel. In addition to the personal samples, general area samples were collected for fluorides, radon, particle size distribution and uranium.

Heavy Metals

Heavy metals were collected at a flow rate of 2.0 lpm by a dampened MSA Model G sampling pump using 37 mm AA millipore filter, 0.8 micron pore size, as a collection media. The sampling duration varied from 4 to 8 hours. The analysis was done using atomic absorption spectroscopy.

Sulfuric Acid Mists

Sulfuric acid mist samples were collected at a flow rate of 2.0 lpm by a dampened MSA Model G sampling pump using 37 mm, 0.8 micron pore size, AA millipore filter, as a collection media. The sampling duration varied from 4 to 8 hours. The phosphoric acid was analyzed using a heteropolyblue colorimetric method.

Phosphoric

Phosphoric acid mist samples were collected at a flow rate of 2.0 lpm by a dampened MSA Model G sampling pump using 37 mm AA millipore filters, varied from 4 to 8 hours. The phosphoric acid was analyzed using a heteropolyblue colorimetric method.

Fluoride

Fluoride samples were collected at a flow rate of 2.0 lpm using a dampened MSA Model G sampling pump and midget impinger containing 10 milliliters (ml) of 0.1 m sodium acetate. The sampling duration was approximately 3 hours. Analyses for total fluorides was done using a specific ion electrode with a 1:1 solution of fluoride and total ionic strength activity buffer.

Radon

Radon samples were collected in a 1 liter evacuated flask. Air was drawn through the flask for 5 minutes to make certain no residual air remained in the flask. The samples were sent to the EPA Radiological Health Unit, Las Vegas, Nevada for analysis.

Uranium

Uranium particulate was collected by means of an Andersen particle fractionating device. The analysis was done by infrared spectrometry.

RESULTS AND DISCUSSIONS

Table I gives the range of concentration as well as the standard for the contaminants. The individual sample results are tabulated in Table II

Table I
Environmental Data

CONTAMINANT	HIGH	LOW	STANDARD
Fluoride	0.07 mg/m^3	0.03 mg/m^3	2.5 mg/m^3
Sulfuric Acid	0.13 mg/m^3	0.08 mg/m^3	1.0 mg/m^3
Phosphoric Acid	0.08 mg/m^3	0.02 mg/m^3	1.0 mg/m^3
Cadmium	0.003. mg/m^3	----------	0.2 mg/m^3
Chromium	0.002 mg/m^3	0.0007 mg/m^3	1.0 mg/m^3
Vanadium	0.01 mg/m^3	0.006 mg/m^3	0.5 mg/m^3
Radon	0.56 pCi/l	0.27 pCi/l	30 pCi/l

The beta radiation levels were 75 mr/hr above the tank at initial opening; 100-125 mr/hr during the cleaning operation; and below 75 mr/hr after the reaction vessel had been cleaned.

As can be noted in Table II, all contaminants were below the current legal standard. Although the environmental levels for the contaminants sampled were below the current legal standard there was an irritating material present in the tank environment.

RECOMMENDATIONS

It is recommended that Stauffer continue to follow the good work practices currently employed for tank entry.

Although the environmental levels for sulfuric acid, phosphoric acid, cadmium, chromium, fluorides (gaseous and particulate), vanadium, and radon were within acceptable level, there is an irritating material present in the tank environment. It is recommened that Stauffer staff conduct additional sampling during the cleaning operation to ascertain what the contaminant is and also the levels of the contaminant.

Utilization of an evaporative cooler to provide general ventilation will problably be adequate if the air supply tube is placed lower in the tank. The configuration utilized during our survey did not give adequate air movement in the lower portion of the tank.

It is further recommended that approved respiratory protection for acid mist continue to be worn while working in the reactor to protect the worker against the irritation effect of the acid mist. Also it is recommended that the use of splash goggles and protective clothing be encouraged to provide adequate protection to skin and eyes. Portable eye wash baths should be placed in the immediate area where work is being performed.

The radiation levels were very low which would have made this facility ideal for determining if exposure to phosphoric acid results in an increased incidence of cancer. However, the medical and personnel records were not adequate to perform a retrospective mortality study. The reason for the inadequate records was that all but the last 5 years were destroyed in February, 1975. Current regulations do not require keeping records more than 5 years.

CURRENT WORK PRACTICES

The following work practices are followed by Stauffer Chemical for tank entry:

1. Lock - Out - All electrical equipment servicing the tank being maintained is shut down and locked - out;

2. All material entry points are blocked off;

3. All valves are chained out;

4. The tank is emptied of all phosphoric acid then flushed with water several times over a period of 24-48 hours;

5. The tank is then purged with air for several hours;

6. Prior to tank entry, the oxygen content is checked and also a check is made to determine if a potential explosive atmosphere is present;

7. Personnel are provided with high top rubber boots, rubber gloves, approved respiratory protection, safety glasses, and rain or acid resistant rubberize suits;

8. Several people work in the digester with several observers stationed on the outside;

The cleaning procedure consists of chipping away at the gypsum deposited on the agitator and side walls of the reactor. Manual and pneumatic equipment is used in the procedure. The gypsum is loaded into a bucket and deposited outside. This entire project takes anywhere from 3 to 5 days to complete.

REFERENCES

1. Environmental Protection Agency: December, 1973, "Reconnaissance Study of Radiochemical Pollution from Phosphate Rock Mining and Milling". Internal Report.