DUSTRIAL HYGIENE SURVEY

CF Chemicals, Inc.
Bartow, Florida

SURVEY DATE

August 9-12, 1976

SURVEY CONDUCTED BY

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DATE OF REPORT

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INTRODUCTION

The Division of Surveillance, Hazard Evaluations, and Field Studies 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 developed lung cancer.

In August 1976, as a continuation to the study of variations of exposure in the phosphate industry, Frances Stephenson, Harry Donaldson, Terry Boyle, Mike Crandall, Tom Sandusky and Howard Cohen conducted a survey of C.F. Chemicals, Inc. in Bartow, Florida.

DESCRIPTION OF PHOSPHATE FERTILIZER MANUFACTURING

The first step in the mining phosphate rock is the removal of the overburden, which consists generally of sand and sandy clay. The overburden is removed using large dragline excavators. Once the overburden has been removed and dumped into adjacent mined out areas, the dragline excavates the matrix, which contains approximately one-third sand, clay and phosphate ore. The matrix is dumped into a shallow pit located adjacent to the mining cut then slurried with high pressure streams of water from hydraulically operated guns.

The 35% solids slurry is pumped to the beneficiation plant where it is washed, sized, crushed and floated to remove silica and other impurities, the resulting product is a pebble phosphate rock.

From the beneficiation plant the phosphate rock is shipped to a drying and storage plant where it is dried and then stored for subsequent shipment to a chemical plant.

Sulfuric acid is made using typical single or double absorption sulfuric acid production techniques. The sulfuric acid from the acid plant and the ground phosphate rock are combined in attack tanks to produce the 30% phosphoric acid. The 30% acid is concentrated by evaporation to form 54% acid. The 54% acid is combined with the anhydrous ammonia to form the diammonium phosphate. The diammonium phosphate is granulated, dried, screened and stored until needed for shipping. Diagrams 1 & 2 attached show the overall production process including the diammonium phosphate process. To produce dicalcium phosphate, limestone phosphoric acid are combined in a process which is similar to the diammonium phosphate process.

DESCRIPTION OF THE PLANT

CF Chemicals Inc. opened their Bartow facility in 1953. Significant additions were made in 1961, 1962, 1963, 1965, 1967 and 1975. The acreage of the plant site is 2796 acres on which rest 12 major buildings. The

buildings house the eight major operations, which follow:

1) Sulfuric Acid Plant
2) Phosphoric Acid Plant
3) Acidulation Plant
4) 3 Diammonium phosphate plants
5) 2 product storage areas
6) 2 shipping areas
7) Operations and Staff Office
8) Quality Control Laboratory

The total number of employees at the CF Chemicals Bartow Operation is 500 persons, 400 of whom are employed in the production area and 100 in the administrative area. The plant operates with 4 shifts in the production areas.

The major products are diammonium phosphate and dicalcium phosphate. The primary raw materials used are gound phosphate rock, liquid sulfur and anhydrous ammonia.

MEDICAL, SAFETY, AND INDUSTRIAL HYGIENE PROGRAM

The health care personnel include a full-time nurse, a part-time physician and a clinic in Bartow which provides emergency care. There are an additional 15-20 persons trained in first aid.

Pre-employment physicals are required for all new employees. These include a medical history, chest x-rays, hearing and visual test, lung function test, and blood and urine tests. Periodic exams are also given including the above tests. The nurse also makes recommendations for physicals if she suspects a need.

The safety program is directed by a full-time safety supervisor, who gives direction to area supervisors and union representatives for conducting the safety program.

The safety program provides personal protective equipment, safety showers, eye wash fountains and first aid and job training. First aid is taught to 100 employees yearly on a rotating basis, so that all employees have some training. There are regular safety meetings to educate personnel and discuss any problems. There is a safety incentive program which rewards the employees in a department who complete a million man hours without a lost time accident. The company is a member of the National Safety Council.

The director of safety is also responsible for the industrial hygiene program. Periodic sampling is done for SO_2, noise, ammonia and fluoride.

The ventilation systems are primarily geared for emission control and appear to be adequate.

ENVIRONMENTAL SURVEY

The operations evaluated by NIOSH were the cleaning of a large phosphoric acid reactor vessel. During the study 8-hour time weighted averages for arsenic, cadmium, chromium, vanadium, phosphoric acid and sulfuric acid for workers involved in cleaning out the reactor vessels. In addition to the personal samples, general area samples were collected for fluorides, radon 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 adsorption spectroscopy.

Free Silica

Free silica samples were taken on a respirable mass basis as outlined in the NIOSH Criteria Document. These samples were analyzed for free silica using x-ray diffraction.

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 from 4 to 8 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.

Uranium

Uranium particulate was collected by means of a hi-volume sampler (45 lpm) onto a glass fiber filter for no less than four (4) hours. Samples were analyzed by the Dibenzoylmethane method.

Arsenic

Arsenic was 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 method of analysis was by hydride generation.

Radon Daughters

An air sample collected at the rate of 10.8 lpm for 5 minutes onto a glass fiber filter. After waiting 40-90 minutes the alpha-radiation present was measured using an alpha-scintillation detector and counter.

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 sulfuric acid mist was analyzed by titration method for the sulfate ion.

Phosphoric Acid Mists

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, 0.8 micron pore size, as a collection media. The sampling duration varied from 4 to 8 hours. The phosphoric acid was analyzed using a heteropolyblue colorimetric method.

DISCUSSION OF RESULTS

The results fall within the Occupational Safety and Health Administration (OSHA) legal limits, except for two fluorides (F^-) samples. These results indicate an usually high concentration of fluoride (F^-) in the material in the attack tank and cannot be discredited as sampling or analytical error, since two other samples are approaching the legal limit.

Three results for chromium (Cr) are at or above the level recommended by The National Institute for Occupational Safety and Health (NIOSH). NIOSH has proposed this level because the agency feels there is significant evidence to implicate chromium (Cr) as a pulmonary carcinogen.

The sampling results are attached.

RECOMMENDATIONS

Tank entry procedures are recommended which include the following: safety lines, constant communication with personnel outside the tank; and assurance that the tank atmosphere is not immediately hazardous to health, nor deficient in oxygen (less than 19.5% O_2). The tank should be purged with copious amounts of air prior to and during tank entry; both to decrease the concentration of airborne contaminants and to help cool personnel as they work.

Protection from the irritating effects of acid mists is necessary and can be provided by approved respirators, splash goggles and protective clothing. Further protection would be provided by placing portable eyebaths and showers in the immediate area.

The proper use of respiratory protection should provide adequate protection for the major health hazard of chromium.

Table 1

CF Chemicals, Inc.

Personal Sample Results

Job Description	Cd mg/m^3	Cr mg/m^3	V mg/m^3	As mg/m^3	U mg/m^3	H_2SO_4 mg/m^3	H_3PO_5 mg/m^3	F- mg/m^3
Phos Acid Filter Main.	<0.001	0.02[x]	<0.01	<0.001		0.013		
Attack Tank Cleaning	<0.001	<0.001	<0.01				0.03	
Flash Cooler Cleaning	<0.001	<0.001	<0.01	<0.001		0.03	0.22	
Flash Cooler Cleaning	<0.001	<0.001	<0.01			0.16	0.25	
Flash Cooler Cleaning							0.23	
OSHA Standard	0.2(dust) 0.1(fume)	0.5	0.5	0.5	0.25 (insoluble) 0.05 (soluble)	1.0	1.0	2.5
NIOSH Proposed Std.	0.040	0.001	0.05	0.002		1.0		2.5
ACGIH-TLV	0.5	0.5	0.5	0.5	0.2	1.0	1.0	2.5

[x] Exceeds the NIOSH Recommended Level

Table 2

CF Chemicals, Inc.

General Area Sample Results

Description of Sampling Area	Cd mg/m^3	Cr mg/m^3	V mg/m^3	As mg/m^3	U mg/m^3	H_2SO_4 mg/m^3	H_3PO_5 mg/m^3	F- mg/m^3
DAP #2 Storage	<0.001	<0.001	<0.01					
DAP Storage	<0.001	<0.001	<0.01	<0.01				
DAP Cooler	<0.001	<0.001	<0.01					
DAP Cooler	<0.002	<0.002	<0.01					
Attack Tank Cleaning	<0.002	<0.002	<0.01			0.18		13.24
#2 Phos-Acid Filter	<0.001	<0.001	<0.01			0.03	0.17	
Flash Cooler Cleaning	<0.001	<0.001	<0.01	<0.001			0.23	1.91
Attack Tank #2 compartment						0.06		
Sulfur Burner #7						0.19		
S. side absorbant tower						0.22		
Flash Cooler #3 Train							0.52	
#2 Phos-Acid Filter					0.005		0.32	
DAP Control Rm. (1&3)								0.02
Attack Tank Cleaning								0.27
Attack Tank Cleaning								0.41
Attack Tank Cleaning								5.85
Flash Cooler Cleaning								2.06
Acid Plant (Mixing Area)					0.014			

Table 3

C.F. Chemicals, Inc.

Radon Daughter Sample Results

Description of Sampling Area	Cpm	Working Level
N. Car Unloading	25	0.02
Attack Tank Feed	25	0.02
Attack Tank between #3 and 4 Compartment	0	0.0
Flash Cooler	0	0.0
Attack Tank #4 Compartment	0	0.0
Storage Bin DAP Truck Unloading #1 Shipyard	0	0.0
Control Room - Rock Unloading	0	0.0

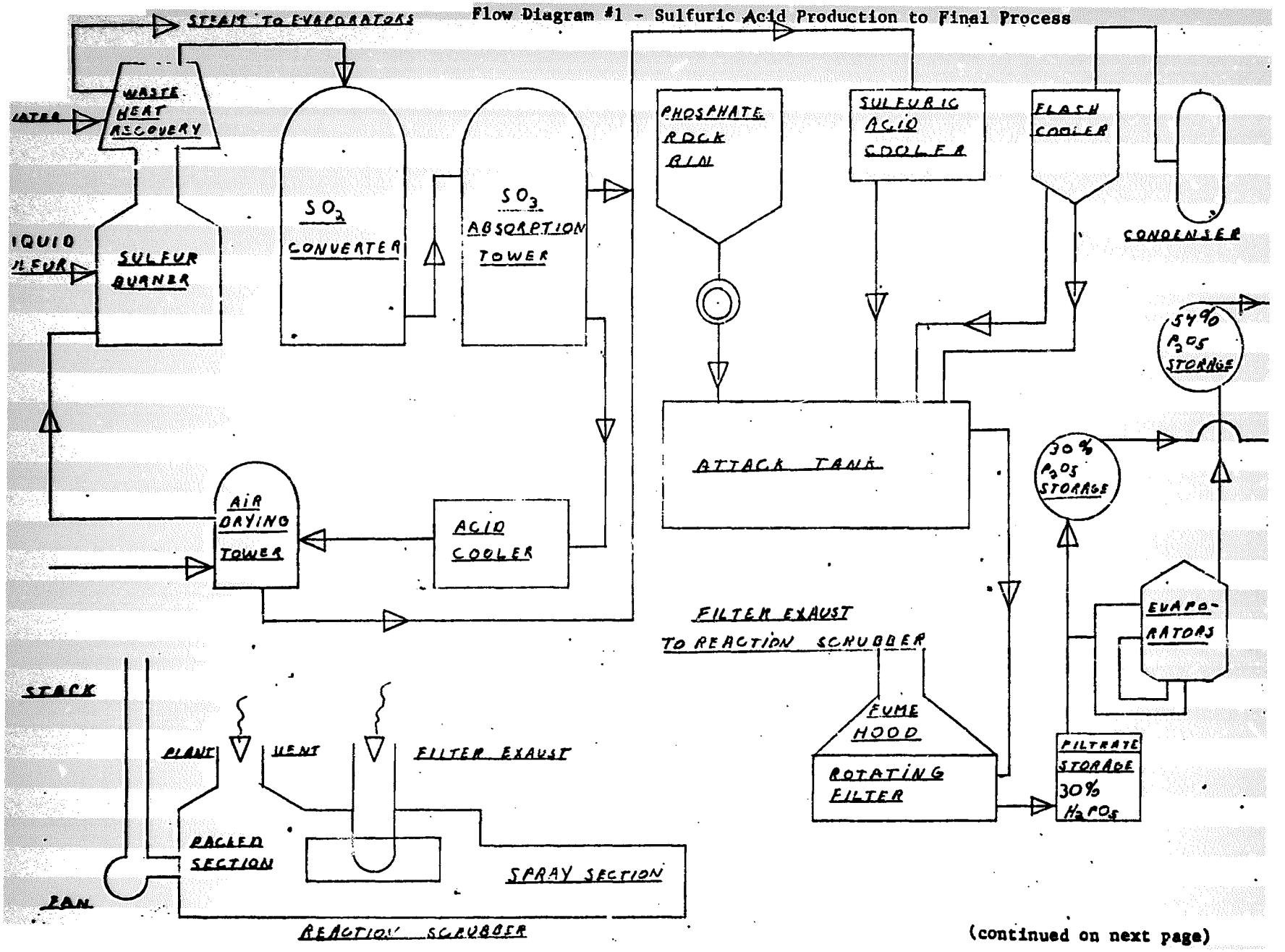
Table 4

C.F. Chemicals, Inc.

Noise Measurement Results

Description of Sampling Area	DBA (averages)
General	85-95
Top of Loading Platform	98

Flow Diagram #1 - Sulfuric Acid Production to Final Process



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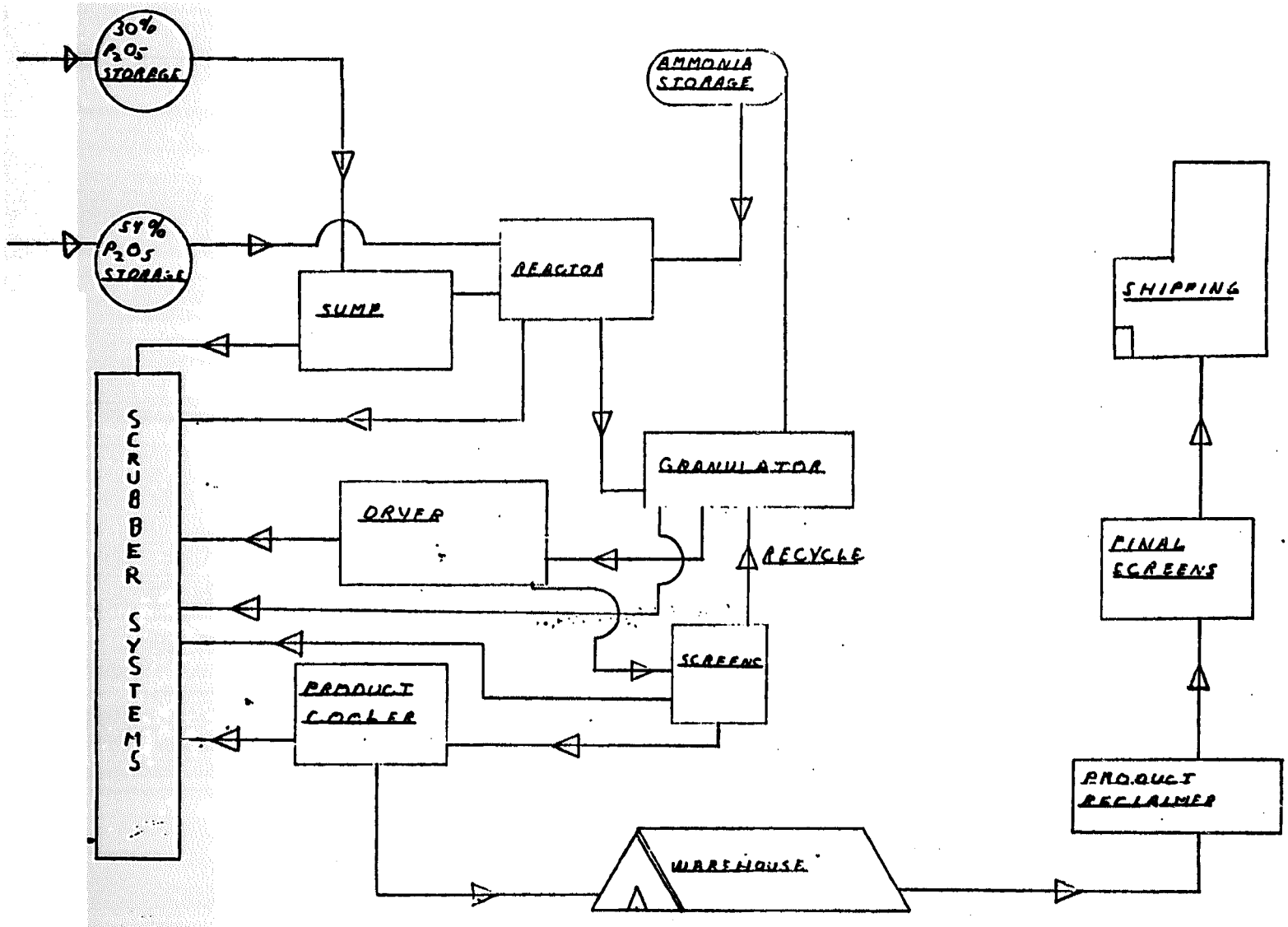
30% P_2O_5 STORAGE
54% P_2O_5 STORAGE
AMMONIA STORAGE
REACTOR
SUMP
SCRUBBER SYSTEMS
GRANULATOR
DRYER
RECYCLE
SCREENS
PRODUCT COOLER
SHIPPING
FINAL SCREENS
PRODUCT RECLAIMER
WAREHOUSE

Diagram 2

Diammonium Phosphate Production