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U.S. DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE
CENTER FOR DISEASE CONTROL
NATIONAL INSTITUTE FOR OCCUPATIONAL SAFETY AND HEALTH
CINCINNATI, OHIO 45226

HEALTH HAZARD EVALUATION DETERMINATION
REPORT NO. 77-48-462

JEFFERSON CHEMICAL COMPANY
PORT NECHES, TEXAS

FEBRUARY 1978

I. TOXICITY DETERMINATION

During the period of a Health Hazard Evaluation conducted by NIOSH, on July 1 and August 17-18, 1977, at Jefferson Chemical Company, Port Neches, Texas, the following determinations were made, based on environmental evidence, work practice observations, and review of available toxicological literature.

A. A hazard to the health of "laboratory" workers did not exist at the time of the surveys as indicated by air sampling results. Ventilation measurements revealed that all laboratory "fume" hoods were operating effectively. In addition, there were written operating procedures available for all laboratory personnel.

B. A potential health hazard existed for workers assigned to the A-2 unit, due to benzene vapor exposures as indicated by air sampling results. The concentrations measured for four personal samples ranged from 2.4 - 81 mg/M^3. A nine hour fifty minute general area sample indicated that in the area of the sample the average airborne concentration was approximately 1.2 ppm or 3.8 mg/M^3 benzene.

C. A health hazard was not indicated for employees of the E-1 unit based on the results of the type of air samples obtained on those dates.

D. A health hazard was not indicated for employees of the E-3 unit based on the results of the type air samples obtained.

E. A determination of potential health hazards was not possible for the Cell Renewal Area due to the operation not being on line at the time of the surveys. Review of employees' blood lead was within the NIOSH recommended criteria; less than 60 ug lead/100 ml whole blood.

F. A potential health hazard existed for employees of the E-9 (UP-22), unit based on work practice observations and spent catalyst dust analysis. The spent catalyst contained approximately 0.6 percent Aniline and 9 percent Diaminodiphenyl methane (DDM) isomers by weight. The worker(s) were not adequately protected for the catalyst dumping operation.

Recommendations are included in the text of this report to assist in ensuring worker safety and health.

II. DISTRIBUTION AND AVAILABILITY OF DETERMINATION REPORT

Copies of this Determination Report are currently available upon request from NIOSH, Division of Technical Services, Information and Dissemination Section, 4676 Columbia Parkway, Cincinnati, Ohio 45226. After 90 days, the report will be available through the National Technical Information Service, (NTIS), Springfield, Virginia. Information regarding its availability through NTIS can be obtained from NIOSH, Publication Office at the Cincinnati address.

Copies of this report have been sent to:

a) Jefferson Chemical Company, Port Neches, Texas
b) Authorized Representatives of Employees, Oil, Chemical and Atomic Workers, Local 4-228, Port Neches, Texas
c) Oil, Chemical and Atomic Workers, International Union, Washington, D.C.
d) U.S. Department of Labor - Region VI
e) NIOSH - Region VI

For the purpose of informing the approximately 80 "affected employees", the employer shall promptly "post" for a period of thirty calendar days, this Determination Report in a prominent place(s) near where exposed employees work.

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 an 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 employees regarding worker exposures to chemicals at the Port Neches facility. The primary areas of concern were the laboratory, cell renewal area and UP-22 unit.

Other areas of the plant were walked through, employees questioned and specific operations sampled. The workers interviewed indicated they were not experiencing any health problems but were concerned about the chemicals they may be exposed to and the potential health effects which could arise from the exposures. There were some complaints due to odors.

IV. HEALTH HAZARD EVALUATION

A. Facility Description

The Jefferson Chemical Company, a subsidiary of Texaco Incorporated, is located on approximately 1100 acres and employs approximately 619 people. The facility produces a variety of chemical substances, many of which serve as feedstock to produce the final products. The majority of the substances are produced and handled in closed reacter systems and distillation units. The final products are loaded into tank cars, trucks and drums.

B. Process Description

1. Laboratory

The laboratory analyzes most of the raw materials and final products to determine if the proper specifications for the materials are met. Some organic research is also conducted for new product development and system improvements.

2. A-2 Unit

The A-2 unit processes refinery gas feedstock through a series of caustic scrubbers, heaters, quenching towers, compressors and fractionation towers. These steps in proper sequence, time, and temperatures separate aromatics and aliphatics and further separates the aliphatics (C_2-C_5) for processing in other units.

3. E-1 Unit

The E-1 unit produces ethanolamines. This is accomplished, in a closed system, by reacting ammonia, water and ethylene oxide and then separating the mono, di, and tri ethanolamines via fractional distillation. The final products are then drummed.

4. E-3 Unit

The E-3 unit processes phenol, ethylene oxide and C_9 hydrocarbons to produce nonylphenol and special ethoxylation products used as surfactants.

5. Cell Renewal Area

This area was not operating, but is involved in rebuilding of the anode and cathode cells used in the chlorine production area.

6. E-9 Unit (UP-22)

The E-9 (UP-22) unit produces DDM via an aniline-formaldehyde catalyzed condensation reaction. The product is a mixture of DDM isomers and is batch produced intermittently, as required. The product batch is filtered, washed, and then drummed. The drum filling mechanism has local exhaust ventilation and a three sided splash guard. The filtrate is dried and dumped into a hopper for disposal.

In all these and most other areas of the facility the materials flow through closed systems for specific times and temperatures until the final specifications of the product are achieved. The materials are then stored or loaded for distribution to customers. The employees work routines are such that they continually monitor process controls in the control room and circulate through the process areas maintaining operations.

C. Evaluation Procedure

1. Environmental

General area and personal samples for organic vapors were obtained utilizing both 150 milligram silica gel and activated charcoal tubes with MSA* Model G and Sipin* personal sampling pumps operated at air flows of 1.0, 0.4 and 0.2 liters per minute (lpm). The silica gel samples taken in the E-9 unit area had 0.8 micron (u) AA Millipore* prefilters. The filters were held in a three piece plastic cassette. Personal samples were obtained by clipping the adsorption media tubes to the workers' collar to approximate their breathing zone.

Four general area samples were obtained with whole air monitors. The monitors are an evacuated steel container with a critical orifice for constant flow sampling over a given time period. The monitors are presently being field tested. One bulk sample of the DDM catalyst was obtained in a glass scintillation vial with a teflon lined cap. A bulk sample of the DDM was also obtained in that manner.

Temperature and relative humidity measurements were obtained with a Bendix*, battery powered psychrometer. Ventilation measurements were made with a Sierra* hot wire anemometer.

The charcoal tube samples were desorbed with carbon disulphide and analyzed by gas chromatography (GC)/mass spectrometry (MS). The monoethanolamine samples were analyzed by a method under development which involves acidic methanol extraction, neutralization, and derivatization with benzaldehyde. Silica gel samples were desorbed with ethanol and analyzed by GC/MS.

2. Medical

Private interviews with employees selected at random were conducted and non-directed medical questionnaires were compiled. The first aid facilities and medical programs were also reviewed along with selected blood lead data.

*Mention of Manufacturer's name does not constitute a NIOSH endorsement.

D. Evaluation Criteria

1. Environmental

The following occupational exposure criteria were used in evaluating the environmental contaminants found in this survey: (1) National Institute for Occupational Safety and Health (NIOSH), Recommended Criteria for Occupational Exposures, (2) American Conference of Gonvernmental Industrial Hygienists (ACGIH), Threshold Limit Values for Substances and Physical Agents in the Workroom Environment and supporting documentation, and (3) U.S. Department of Labor, Occupational Safety and Health Administration (OSHA) Standards (29 CFR 1910.1000, Tables Z-1 and Z-2).

Substance[3]	(1) NIOSH*	(2) ACGIH*	(3) OSHA*
Aniline	-	19[2]	19[2]
Benzene	3.2[1]	30[2]	3.2**[2]
Diaminodiphenylmethane	-	-	-

*milligrams of substance per cubic meter air
**OSHA Emergency Temporary Standard and Proposed Permanent Standard
[1]Ceiling Value not to be exceeded at any time
[2]8-Hour Time-Weighted Average (TWA) daily exposure
[3]The environmental criteria for all other contaminants identified are not presented because the airborne concentrations determined, by the sampling methods employed, were well below all present existing occupational exposure criteria.

These criteria are designed to protect the average worker for an eight or ten hour day, fourty hour week, during a normal working lifetime. However, there are numerous factors that may influence an individual's response to a particular agent such as age, sex, health status, smoking habits, etc. Also, effects from exposures to combinations of agents may be additive or synergistic when the agents elicit similar physiological responses.

2. Medical

a. Health Effects

The health effects of only those substances considered potentially toxic as used or found on the dates of the surveys will be discussed.

(1) Aniline[1-6]

Aniline is a liquid aromatic amine. It can be absorbed into the body via inhalation, ingestion and most frequently through the skin. The primary body response is the formation of methemoglobin. This results from the

interaction of the iron containing heme group in red blood cells with the amino compound. The reaction results in a decreased oxygen carrying capacity of the blood, creating systemic poisoning characterized by a blueish-gray discoloration of the skin. The discoloration effect is generally called cyanosis. Acute exposures exhibit cyanosis, shortness of breath, feeble rapid pulse, excitement, mental confusion, convulsions and occasionally death.

Chronic exposures may not exhibit cyanosis, but anemia, loss of energy, digestive disburbances and headaches are frequently prevalent. The occurrence of bladder tumors, benign and malignant, have been associated with aniline workers, however, it has not been shown to date if the tumors result from only aniline or if it is due to multiple chemical exposures of aniline and its derivatives. Aniline and its metabolites are eliminated in urine.

(2) Benzene[7-9]

Benzene is a flammable, colorless, odorous, aromatic liquid. It is relatively insoluble in body fluids and tissues, thus only small amounts are retained by the body. Benzene can enter the body by inhalation, ingestion and, to a small degree, by direct skin contact. It is toxic to every organ, tissue and cellular system of the body and is an enzymatic poison.

The primary toxic action of acute benzene exposure is exerted on the central nervous system. Symptoms of acute exposure include; dizziness, excitation, euphoria, pallar followed by flushing, headaches, breathlessness, coma, and death. Visual disturbances, tremors and convulsions frequently occur. The chronic effects of benzene intoxication are primarily associated with the blood cells and hemapoietic tissues. Numerous effects have been documented, the most insedious being aplastic anemia. Symptoms from chronic exposure are varied and vague but include headaches, dizziness, fatigue, anoxeria, and dyspnea. NIOSH considers the accumulated evidence from clinical and epidemiologic data to be conclusive, at this time, that benzene is leukemogenic.

Pregnant women may be more susceptible to benzene poisoning and may have a higher risk of sterility.

Benzene is eliminated from the body by expiration and urine. The body can also transform some benzene into phenol, pyrocatechol, and hydroquinone which are then excreted in the urine.

(3) Diaminodiphenyl methane (DDM)[10-16]

DDM is a viscous brownish liquid. It can enter the body by inhalation, ingestion and through the skin. The compound is a hepato and renal toxin and has been implicated, in animal studies, to be carcinogenic. There is little available literature which describes its metabolism or fate once absorption has taken place, but is probably similar to that of other aniline derivatives. Some animal tests have also indicated there may be testicular damage due to parenchymatous degeneration. As with other aromatic amines it may also be a skin sensitizer.

E. Evaluation Results and Discussion

1. Environmental

a. Laboratory

As indicated by the results of the type environmental samples obtained, (Table I), the laboratory personnel were not exposed to toxic concentrations of airborne contaminants. Ventilation measurements revealed that all laboratory "fume" hoods were operating effectively for control of contaminant generation within the hoods. (One hood was found to have a broken fan motor belt but upon replacement, that hood operated effectively.) The laboratory also had written operating procedures available for all personnel and the personnel appeared to have good work practices and personal hygiene.

b. A-2 Unit

A hazard to the health of employees of the A-2 unit was indicated (Tables I, III), by the environmental samples obtained on both site visits. The personal exposures to airborne benzene vapors exceeded all occupational exposure criteria. The concentrations found indicate that there is a significant contamination generation site around the unit and that the heaterman has the greatest potential for exposure to toxic agents. The tower operator's work routine also has potential for exceeding the exposure criteria. The general area (Table IV), which appears to be the source of contamination is around the caustic scrubbers and heater units, which were worked on by the heaterman during the sampling period. The company is encouraged to continue its efforts in identifying contamination generation sites and this area should be re-evaluated. If the source(s) can not be controlled by engineering techniques, then the suspect area(s) should be posted as respirator protection area(s).

c. Cell Renewal

The cell renewal area was not on-line at the time of the surveys, thus, it was not evaluated. Local exhaust ventilation systems were observed in the process area. The substances used in this area include asbestos, lead, and tar.

d. E-1 Unit

The environmental samples obtained in the E-1 unit (Tables II and IV), indicate that employees were not exposed to toxic concentrations of airborne contaminants. The results of ethanolamine analysis are not entirely certain, however, because the present analytical techniques for ethanolamines are under development and the sampling techniques

not certain to date. The detection limit of the mono ethanolamines was only 50 ug/ml and no desorption data was available for charcoal samples. Also, desorption data for di and tri ethanolamines on silica gel tubes has not been studied to date for the method used.

In light of these facts, it is very important that good work practices and personal hygiene be strictly observed in this area.

e. E-3 Unit

Based on the results of the type air samples obtained (Table II), in the E-3 unit area, the employees were not exposed to toxic concentrations of airborne contaminants. The E-3 unit handles surfactants which are high molecular weight compounds with a low volatility. The primary route of potential exposures to employees of this area would be from contact, which can be avoided by proper use of gloves, goggles, and protective clothing. Good work practices and personal hygiene are a must to help ensure each worker's health and safety.

f. E-9 Unit

Although the E-9 unit "proper" was not operating during the evaluation, the catalyst dumping and product drumming operations were evaluated, (Table III).

The drumming operation appeared to have adequate local exhaust ventilation, (i.e. 200+ feet per minute capture velocity) splash shielding and the operator's main controls were approximately ten feet from the drumming apparatus. The operator wore impervious clothing, gloves, and a face shield. The results of the air samples indicate that the operator was not exposed to toxic concentrations of airborne contaminants. However, the results are questionable due to field and analytical problems with these samples. The pre filters used created numerous interferances when extracted with ethanol. Also, the sensitivity of the method used was only approximately 0.25 mg DDM/tube. In addition, the drumming process had some problems and only a limited number of drums were filled on any given shift, thus, a majority of the sample time was not during the actual process. This in effect, diluted the samples and decreased the sensitivity. Also, a spill of DDM was cleaned up by personnel who were not being monitored, thus, their potential exposures for clean-up type operations were not determined. The cleanup was accomplished by covering the spill with sand and then shoveling the mixture into containers.

The catalyst dumping operation, although intermittent and of short duration, exposed the operator to toxic materials. This is not evident in the environmental results because of sampling and analytical problems mentioned. However, the catalyst dust contains both aniline and DDM isomers contamination which

were not properly protected against, particularly since both substances are absorbed through the skin and are suspected carcinogens. The operator wore a dust respirator which is ineffective in controlling organic vapors. Also, the position of the dumping controls are such that the operator is contaminated with the dust. Contact with the dust would be the greatest source of exposure to the contaminants.

2. Medical

Private interviews with employees, selected at random, indicated that the individuals were not experiencing health problems. They were concerned however, of potential chronic health problems if exposed to chemicals. There were also some odor complaints.

The investigators reviewed selected blood lead data of employees from the cell renewal area and the data indicated that exposures were not excessive. The data reviewed was within the NIOSH recommended criteria, less than 60 ug lead/100 ml whole blood.

The medical facilities appeared to be well equipped and the medical program had provisions for pre-employment, annual and termination physicals. The physical examinations included a variety of biomedical tests.

There were also change rooms and showers available to employees.

V. RECOMMENDATIONS

The following recommendations are made to help improve the health and safety at this facility:

1. The laboratory hoods should be inspected monthly, in-house, to assure their continued adequate performance. In addition, pedestal fans should not be used in the laboratory, for comfort control, because the air turbulence generated by the fans will disrupt the "fume" hood's effectiveness. Also, the hood's sashes should be closed as far as possible when tasks are performed in the hoods, to help increase the hood's performance in controlling contaminants and protecting the operator.

2. To help ensure a continued safe laboratory working environment, a supervisor and/or committeeman of the lab should attend the NIOSH Laboratory Safety Course, or an equivalent course, in order to be refamiliarized with laboratory safety developments, new laboratory guidelines, laws, disposal techniques, etc.

3. If the cell revewal area is brought back on-line and the employees are concerned about the health and safety of the operation, a new request for an evaluation of that area should be submitted. However, the workers are encouraged to review the company's environmental and medical data prior to deciding if an evaluation is indicated.

4. The E-1 unit drumming mechanism should be fitted with local exhaust ventilation controls similar to those in the E-9 area to help reduce possible exposures. The area should be re-evaluated in the future when the sampling and analytical methods are refined.

5. The operator's controls for the E-9 spent catalyst dumping operation should be relocated to decrease the dust exposure. Also, larger and thicker dust collecting bags should be considered for the operation, to more adequately control the dust collection process and reduce spillage.

To ensure minimal exposure to the dust and reduce the potential skin absorption of the toxic contaminants, it may be best to require the operator to shower after dumping the catalyst. Since the compounds are suspected carcinogens, exposures should be kept as low as possible and extra precautions should be used in disposing of the spent catalyst to help reduce potential contamination of the environment.

6. The industrial hygiene personnel should attend the NIOSH Industrial Hygiene Respiratory Protection Course to help update and improve their knowledge of new developments in respiratory protection. The written respirator program should be improved and more specific. In that some unapproved respirators were observed in the E-9 unit, and the operator dumping the contaminated spent catalyst wore only a dust respirator, the following type of respiratory protection is recommended; an approved type full face respirator with organic vapor cartridges and dust pre filters.

7. Management is encouraged to continue development of its industrial hygiene program and the written program should be detailed and continually updated. Continued efforts in identifying contaminant generation sources are imperative, particularly for new process/product institution.

8. Management should continue development of a health and safety educational/awareness program. This is particularly important for new employees and maintenance personnel. Small group seminars may be a method to utilize.

9. All employees should adhere to strict personal hygiene and good work practices to help reduce potential exposures. The employees are encouraged to use the change room and shower facilities provided. This will help prevent contaminating their homes and families if work clothes, boots, etc. are contaminated.

10. The company is encouraged to develop a reproductive medical surveillance program.

The company is commended for its fire/accident programs which are very thorough and are supported by the low accident record of the facility.

The NIOSH investigator would like to thank both management and labor for their cooperation and assistance, with particular thanks to Mr. Leslie Williams, Jefferson Chemical Company and Mr. Norris Bobbitt, OCAW Local 4-228.

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TABLE I

RESULTS OF AIR SAMPLING FOR ORGANIC VAPORS

JEFFERSON CHEMICAL COMPANY
Port Neches, Texas
July 1, 1977
HE 77-48

A. Laboratory - air conditioning off

Sample Number	Time	Description	Results (mg/M^3)* Benzene	Ethanolamine	Propylene oxide	1,1,1, trichloroethane
J-1	0823 - 1047	Personal Sample (P.S.) Lab Technician	0.29	-	N.D.[1]	2.6
J-2	1117 - 1450	P.S. Lab Technician	0.20	-	0.07	2.6
J-3	0834 - 1450	P.S. Technician Distillation Lab	0.58	-	0.32	2.9
J-4	0820 - 1450	P.S. Day Technician	N.D.[2]	-	0.46	2.2
J-5	0848 - 1453	P.S. Quality Control Tester	-	N.D.[3]	-	-

B. A2-Ethylene Unit - - - sunny, variable winds from WSW, =85-92° F.

Sample Number	Time	Description	Results (mg/M^3)* Benzene	Dicyclopentadiene	Toluene	Trimethylbenzene	Xylene
CT-4	1030 - 1330	P.S. Tower Operator	16.0	0.67	1.2	0.28	1.2
CT-5	1036 - 1327	P.S. Controlman (Heaterman)	11.0	0.23	1.6	0.23	1.7

* Approximate milligrams per cubic meter air - Not Time Weighted Averages (TWA)

1. Less than 3 micrograms per sample
2. Less than 0.01 milligrams per sample
3. Less than 0.1 milligrams per sample - very poor desorption efficiency due to sample media (charcoal)

The NIOSH Recommended Standard for Occupational Exposure to Benzene is 3.2 mg/M^3 and is not to be exceeded.

TABLE II

RESULTS OF AIR SAMPLING FOR ORGANIC VAPORS

JEFFERSON CHEMICAL COMPANY
Port Neches, Texas
July 1, 1977
HE 77-48

A. E-1-Ethanolamine Unit - sunny, variable winds from WSW, ≈85-92° F.

Sample Number	Time	Description	Results (mg/M^3)* Benzene	Dicyclopentadiene	Ethanolamine	Toluene	Trimethylbenzene	Xylene
CT-3	0940 - 1409	Personal Sample(P.S.) Tank Car Loader	N.D.[1]	N.D.[1]	N.D.[2]	N.D.[1]	N.D.[1]	N.D.[1]
CT-6	1357 - 1457	General Area(G.A.) Pump Row	0.17	N.D.[1]	N.D.[2]	N.D.	N.D.	N.D.
SG-1	1357 - 1457	" " " " "	-	-	N.D.[3]	-	-	-

B. E-3-Surfactant Unit - same ambient conditions

Sample Number	Time	Description	Results (mg/M^3)* Benzene	Dicyclopentadiene	Toluene	Trimethylbenzene	Xylene
CT-1	0846 - 1013	P.S. Utility Controller	N.D.[1]	N.D.[1]	N.D.[1]	N.D.[1]	N.D.[1]
CT-2	0840 - 1009	P.S. Outside Control Man	N.D.[1]	N.D.[1]	N.D.[1]	N.D.[1]	N.D.[1]

* Total approximate milligrams per cubic meter air - (Not TWA)
1. Less than 0.01 milligrams per sample
2. Less than 0.1 milligrams per sample - poor desorption efficiency due to media (charcoal)
3. Less than 0.25 milligrams per sample - derivitization method utilized under development (silica gel)

TABLE III

RESULTS OF AIR SAMPLING FOR ORGANIC VAPORS

JEFFERSON CHEMICAL COMPANY
Port Neches, Texas
August 17-18, 1977
HE 77-48

A. E-9-UP-22 Unit (Diaminodiphenyl methane) - Unit not running, R.H. ≈72-80%, 84°-90°F, Variable WSW winds

Sample Number	Time	Description	Results (mg/M^3)* Aniline[1]	DDM[2]
SG-1	1030 - 1434	General Area (G.A.) Drumming Room	0.02	-
SG-2	1045 - 1420	Personal Sample (P.S.) Outside Operator (one drum filled)	0.93	-
SG-3	1520 - 1555	P.S. Outside Operator - Dumped Catalyst	5.63	-
SG-4	1040 - 1436	P.S. Outside Operator	0.31	-
SG-5	1519 - 2010	P.S. Drummer - ≈40 drums filled	0.25	-
SG-6	2015 - 2130	P.S. Drummer - Small Spill, drumming stopped	0.03	-
SG-7	2320 - 0644	P.S. Drummer - ≈40 drums, pump failed, stopped 0200	0.16	-
SG-8	2320 - 0640	G.A. Drumming Room " " " " "	0.01	0.57

B. A2 Unit, same environmental conditions

Sample Number	Time	Description	Results (mg/M^3)*[3] Benzene	Napthalene	Styrene	Methyl Styrenes	Toluene	Xylene
CT-1	0958 - 1413	P.S. Tower Operator	2.4	-	-	-	0.55[4]	-
CT-2	0955 - 1412	P.S. Outside Heaterman	81[4]	2.1	71	4.8	83[4]	15

* Approximate milligrams per cubic meter air
1. The blank silica gel had <1 microgram per tube.
2. The analytical sensitivity for these samples was only 0.25 mg/tube.
3. Blank charcoal tubes had <0.01 milligrams per tube.
4. The tubes were loaded and break-thru of the contaminant was indicated-values represent minimum airborne concentration present.

The NIOSH Recommended Standard for Occupational Exposure to Benzene is 3.2 mg/M^3 and is not to be exceeded.

TABLE IV

RESULTS OF AIR SAMPLING FOR ORGANIC VAPORS - WHOLE AIR SAMPLERS

JEFFERSON CHEMICAL COMPANY
Port Neches, Texas
August 17-18, 1977
HE 77-48

A. E-1 - Ethanolamine Unit, Sunny , R.H. 72-80%, 84-90°F, Variable WSW winds

Sample Number	Time	Description	Results (ppm)* Benzene	Carbon Monoxide	Methane	Cyclopentane	Propane	Toluene	Trichlorethylene	Total Hydrocarbons**
#33	0944 - 1402	Personal Sample Drummer (TEA)[1]	0.1	-	-	-	-	0.2	-	12.7

B. A-2 Unit - same Environmental Conditions

Sample Number	Time	Description	Results (ppm)* Benzene	Carbon Monoxide	Methane	Cyclopentane	Propane	Toluene	Trichlorethylene	Total Hydrocarbons**
#01	1002 - 2000	General Area, Control Room	0.1[2]	2.1[2]	2.1[2]	-	-	0.6[2]	0.4[2]	38.2[2]
#32	1010 - 2000	General Area, Caustic Scrubber, Distillation Stream	1.2	1.4	11.8	0.3	0.2	1.8	0.6	30.4
#34	1020 - 2001	General Area, Compressor Station	0.2	-	-	-	41.7	-	-	9.2[3]

* Parts per million.
** Milligrams per cubic meter air.
1. Some Triethenolamine drummed during sample period, however, operator was also in areas outside the drumming area.
2. Sampler had excess pressure, thus results are questionable.
3. Total hydrocarbons present not including propane.

The NIOSH Recommended Standard for Occupational Exposure to Benzene is 1 ppm (3.2 mg/M^3) and is not to be exceeded.