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REGION-6

PB82-162231

Industrial Hygiene Walk-Through Survey

at

Shell Oil Company Refinery
P.O. Box 2352
Odessa, Texas 79760

SURVEY CONDUCTED BY:
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Sam Kaplan, Enviro Control, Inc.
Clinton Cox, NIOSH

DATE OF SURVEY:
December 19-20, 1978

REPORT WRITTEN BY:
Stan Futagaki
Enviro Control, Inc.
NIOSH Contract No. 210-78-0082

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Industrial Hygiene Section
Industrywide Studies Branch
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Cincinnati, Ohio

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16. Abstract (Limit: 200 words)

Worker exposures to carbon-monoxide (630080), hydrogen-sulfide (7783064), and benzene (71432) were surveyed at the Shell Oil Company Refinery (SIC-2911) in Odessa, Texas on December 19 and 20, 1978. The facility was surveyed as part of a NIOSH study of the industrial hygiene characteristics of petroleum refineries. Approximately 100 of the employees at the facility were assigned to the production areas surveyed. All employees received preplacement medical examination and periodic medical examinations. Air samples for carbon-monoxide, hydrogen-sulfide, and benzene ranged from 1 to 10, 1 to 5, and 1 to 5 parts per million, respectively. No detectable concentrations of nitrogen-dioxide, ammonia, or aromatic amines were found. The author notes that data provided by this survey allowed development of a survey protocol which reduced the scope of the NIOSH petroleum refinery study to three key types of process units; the fluid catalytic cracker unit, the delayed coker unit, and the asphalt processing unit.

17. Document Analysis a. Descriptors

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b. Identifiers/Open-Ended Terms

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ABSTRACT

On December 19-20, 1978, Enviro Control, Inc. conducted a walk-through industrial hygiene survey at the Shell Oil Company Refinery in Odessa, Texas. The purpose of this survey was to familarize Enviro Control personnel with refinery operations and to do limited sampling to be used in narrowing the scope of the NIOSH project, "The Industrial Hygiene Characterization of Petroleum Refineries". During the first day, a detailed walk-through of the refinery was conducted. A limited amount of air sampling was conducted on the second day at the fluid catalytic cracking, vacuum distillation, atmospheric distillation, gas recovery, and hydeal process units. Only small amounts of carbon monoxide (<1 to 10 ppm), hydrogen sulfide (<1 ppm), and benzene (<1 ppm) were detected. No detectable levels of nitrogen dioxide, ammonia, or aromatic amines were measured. At the fluid catalytic cracking unit, five hydrocarbons were qualitatively identified in air samples: 3,3-dimethylhexane, ethylbenzene, and 2,6,10-trimethyltetradecane, 1-methyl-2-propylbenzene, and 1-propyne. The overall information collected during this survey was used to reduce the scope of this study.

PURPOSE OF SURVEY:	To conduct a walk-through survey to aid in the narrowing of the scope for the NIOSH contract study "Industrial Hygiene Characterization of Petroleum Refineries".
EMPLOYER REPRESENTATIVES CONTACTED:	Bill Bell, Refinery Manager George Pollard, Manager of Administrative Services Ron Hartman, Manager of Operations L.W. Terrill, Operations Supervisor Earl Gee, Safety Representative Dave Atwood, Senior Industrial Hygienist
EMPLOYEE REPRESENTATIVE CONTACTED:	Employees are not represented by a labor union.
STANDARD INDUSTRIAL CLASSIFICATION OF PLANT:	2911

PHASE I PRELIMINARY SURVEY
SHELL OIL COMPANY
ODESSA, TEXAS

SUMMARY

The preliminary industrial hygiene survey of the Shell Oil refinery in Odessa, Texas, took place on December 19 and 20, 1978. This was the second of three preliminary refinery surveys performed during Phase I of this National Institute for Occupational Safety and Health (NIOSH) study titled, "Industrial Hygiene Characterization of Petroleum Refineries." The plant visit began with a meeting during the morning of the first day with representatives from Enviro Control, Inc. (Enviro), NIOSH, and the refinery management. Attendees included:

Refinery: Mr. Bill Bell, Refinery Manager
Mr. George Pollard, Manager of Administrative Services
Mr. Ron Hartman, Manager of Operations
Mr. L.W. "Blackie" Terrill, Operations Supervisor
Mr. Earl Gee, Safety Representative
Mr. Dave Atwood, Senior Industrial Hygienist (Houston Office)

NIOSH: Mr. Clinton Cox, NIOSH Project Officer

Enviro: Mr. Sam Kaplan, Enviro Senior Industrial Hygienist
Mr. Stan Futagaki, Enviro Senior Industrial Hygienist

During the meeting, the members from Enviro explained the project and the specific objectives of this particular visit. The objectives emphasized included:

- Familiarization with a medium-sized oil refinery in areas such as process units, work force, work practices, control technology, and monitoring programs.
- Limited air sampling for range-finding data; more extensive sampling would be conducted during the next phases.
- Accumulation of information to help develop a manageable scope for the main body of this study.

The areas that Shell considered to be proprietary information were also discussed at this time.

After the meeting, the Enviro and NIOSH personnel were taken on a brief tour of the plant facilities; this was conducted primarily by the operations supervisor. A more detailed tour was conducted during the afternoon and included short interviews with some of the production workers. The corporate senior industrial hygienist from Houston was also interviewed.

The second day was devoted to performing the limited sampling schedule which included a variety of colorimetric detector tube determinations and charcoal and silica gel tube samples. After this was completed, there was a brief closing meeting in the afternoon to answer questions and to tentatively set up contact arrangements for the next phase's activities involving Shell Oil.

PLANT AND PROCESS INFORMATION

This petroleum refinery is located near Odessa in the Permian Basin area of west Texas. Based on its crude capacity of 35,000 bbl/day, the refinery was categorized as "medium-sized" for this study. In area, the refinery was quite compact, occupying about 75 acres. The refinery was relatively new, having been built in 1957 by El Paso Products Company. It was purchased by Shell in 1964.

The crude oil processed here (termed West Texas Intermediate Sweet or Sprayberry crude) was from the local area and contained about 0.5% sulfur by weight. Incoming starting materials included the crude oil (up to 30,000 bbl/day) and natural gasoline (up to 5,000 bbl/day) which were received by pipeline and to a lesser extent by tank trucks. Isobutane was purchased for the alkylation unit and n-butane was purchased mainly in the Winter for gasoline blending. In addition to petroleum refining, there were also limited petrochemical operations (benzene production) at this location.

There were three control rooms spread over the refinery for the approximately 10 process units. There was also a separate control room for the boiler house.

- Control room #1:
  - crude unit
  - vacuum distillation unit
  - fluid catalytic cracker unit (FCCU)
  - gas concentration unit
- Control room #2:
  - HF alkylation unit
- Control room #3:
  - unifiner
  - motor fuel platformer
  - benzene recovery units

This refinery produced the following end products:

- three grades of gasoline
- jet fuel (ATF)
- mineral spirits
- #2 Diesel fuel
- light cycle oil
- sand fract oil (~#5 oil)
- propane
- butane
- benzene
-

WORK FORCE

Like other refineries, this one operated 24 hours per day, 7 days per week, with four work crews alternating on the three shifts (0700-1500, 1500-2300, 2300-0700). The production workers were assigned to one of the four control rooms. Each control room had an operator who was in charge of the various process units associated with the control room. The total number of production workers at this refinery was less than 100. The actual number of employees assigned to each control room was considered proprietary information.

While the inside operator spent almost all of his time inside the control room, the other workers spent from 30 to 90% of their time outside in the production areas. The operator monitored the control board and gave special instructions

to the others to ensure the proper functioning of the assigned unit(s). The outside production workers had a variety of duties which included:

- visual inspection of equipment and processes
- collection of quality control samples
- checking all meters and gauges
- adding chemicals such as corrosion inhibitors to process streams
- regular cleanups
- running tests on process streams, e.g., caustics, sulfur
- checking oil levels in pumps.

The on-site laboratory also operated 24 hours a day. The technicians ran routine tests on octane rating, stability, lead, density, water analysis, metals on catalyst, etc.

This refinery employed only a small number of full-time maintenance workers; however, the company did most maintenance work through a full-time maintenance contractor. Additional support was also available from other company refineries during special occasions such as turnarounds.

COMPANY ENVIRONMENTAL AND MEDICAL MONITORING

Worker exposures to noise and benzene had been studied extensively at this refinery. Quarterly sampling for benzene started in September 1973 with both area and personal samples collected on charcoal tubes. Various other potential hazards, such as carbon monoxide, sulfur dioxide, hydrogen sulfide, and hydrogen fluoride, were determined periodically by colorimetric detector tubes. The available company monitoring data were reviewed by the Enviro team during the visit.

All employees were given preplacement phsycial examinations. Those over 40 years of age were given periodic examinations every 2 years, and those under 40 years, every 3 years.

SAMPLING

Limited area sampling, consisting of a variety of colorimetric detector tubes and a small number of integrated samples using charcoal and silica gel tubes, was performed during this preliminary survey. The objectives of the limited sampling program conducted here were to determine concentration ranges for selected agents and possibly to provide information for the development of the study protocol for the next phase.

Table 1 shows the sampling sites and type of samples collected at each site. It was emphasized to the company personnel that there was a good possibility that all the integrated samples would not be analyzed. The The questions of which samples would be analyzed and for what compounds would be determined later when it was decided what types of information would best help in the development of the project scope.

TABLE 1. Area Sampling Sites

Process Unit	Location	Detector Tube	Charcoal Tube	Silica Gel Tube
FCCU	Downwind of pump area CO boiler	X X	X	X
Vacuum Distillation	Near pumps	X	X	X
Atmospheric Distillation	Near pumps	X		
Control Room #1		X	X	X
Gas Recovery	Compressor platform area	X		
HYDEAL	Near pumps	X	X	X

The sampling was started on the morning of the second day and was completed by early afternoon. The temperature ranged between 50°F (10°C) and 60°F (16°C) during the sampling period. At 1:30 p.m., the relative humidity was 27% with winds between 15 and 20 mph out of the west and northwest.

RESULTS

Table 2 presents the semiquantitative area sampling data obtained using the colorimetric detector tubes. A decision was made later in the project to analyze only those long-term samples collected in the FCCU (one of the three selected study process units for Phases II-IV). Table 3 presents the sampling information and results for the two long-term samples collected at the FCCU. The charcoal tube samples were qualitatively screened for organic compounds using gas chromatography/mass spectrometry. The computer library contains approximately 25,000 compounds. The silica gel tube sample was analyzed for four aromatic amines: N,N-dimethylaniline, aniline, o-anisidine, and p-anisidine.

The primary emphasis during these Phase I surveys was to collect information through observation and interaction with key personnel. The sampling data generated during 1 day was limited and used only to further familiarize the team with all aspects of refineries. The overall information accumulated during Phase I did allow Enviro to develop a protocol which reduced the scope of the petroleum refinery study to three key types of process units—the FCCU, the delayed coker unit, and the asphalt processing unit.

TABLE 2. Results of Detector Tube Readings

Process Unit	Location	Type of Detector Tube	Results (Detection Limit)
FCCU	Downwind of pump area	Carbon monoxide	neg (5 ppm)
		Nitrogen dioxide	neg (2 ppm)
		Hydrogen sulfide	neg (5 ppm)
		Ammonia	neg (5 ppm)
	Near CO boiler	Carbon monoxide	10 ppm
		Hydrogen sulfide	neg (5 ppm)
Vacuum Crude Distillation	Near pumps	Hydrogen sulfide	neg (5 ppm)
		Carbon monoxide	<1 ppm
		Ammonia	neg (5 ppm)
		Benzene	<1 ppm[a]
Atmospheric Crude Distillation	Near pumps	Carbon monoxide	neg (5 ppm)
		Hydrogen sulfide	neg (5 ppm)
Control Room #1 (Crude and FCCU)		Carbon monoxide	<1 ppm
		Benzene	neg (5 ppm)
		Hydrogen sulfide	neg (5 ppm)
Gas Recovery	Compressor platform area	Hydrogen sulfide	~1 ppm[b]
		Benzene	~1 ppm[a]
HYDEAL	Near pumps	Carbon monoxide	neg (5 ppm)
		Hydrogen sulfide	neg (5 ppm)

[a] Possible cross-sensitivity to toluene, xylene, and other petroleum hydrocarbons.

[b] Possible interference from SO_2 and other sulfide compounds.

a- and b-values, which are below designated detection limits, are rough estimations based on discoloration of tubes.

TABLE 3. Results of Long-Term Area Sampling at the FCCU

Location	Sample Type	Sample Duration (min)	Flow Rate	Sample Volume (ℓ)	Results
Downwind of pump area	2 large charcoal tubes in series	247	2 ℓ/min	494	Five compounds identified as present: 3,3-Dimethylhexane Ethylbenzene 1-Methyl-2-propylbenzene 1-Propyne 2,6,10-Trimethyltetradecane
	Silica gel tube	245	100 mℓ/min	24.5	No aromatic amines detectable