SM-32 (Rev. 9-57)

SHELL OIL COMPANY

PRIVATE & CONFIDENTIAL

DATE OCTOBER 24, 1972

TO SUPERINTENDENT OPERATIONS -
HYDROPROCESSING
MR. J. C. MERRITT

FROM PROCESS ENGINEER
HYDROPROCESSING
WOOD RIVER REFINERY

SUBJECT BENZENE EXPOSURE AT THE BEU

Due to increased awareness of the medical problems associated with benzene exposure, several projects have been initiated to reduce the benzene levels in the atmosphere at the BEU. These physical changes, coupled with an effective Operator and Operations Foreman training program, are expected to reduce benzene exposure to satisfy the restrictions as stated in the USA Standard USAS Z37.4-1969, "Acceptable Concentrations of Benzene".

The Operators are exposed to benzene vapors daily through normal sample-taking. In the past, they would drain the sample line to the pad to insure that a fresh sample was obtained. To eliminate these sources of benzene exposure, "fast-loop" sampling systems were installed on high-concentration benzene streams. These loops maintain circulation at all times, insuring a fresh sample without draining any benzene to the pad. Samples from hot streams are routed through a sample cooler to reduce their vapor pressure before the sample is drawn. Benzene concentrations resulting with the new sampling systems are reported in Table I. The high background and sampling values for the Col. 7 Sidedraw are attributed to a leaking seal on the Column 7 Side Reflux Pump. A mechanical seal has been ordered for this pump and will be installed as soon as it is received. At that time the benzene concentrations are expected to be reduced to a satisfactory level.

Periodically, the Column 7 Reboiler gauge glass and level control must be blown down to prevent the accumulation of clay which carries over from the Clay Contactors. This occurred once per week and was blown directly to the pad, exposing the Operator to an extremely high concentration of benzene vapor. This procedure has been revised by installing a line to route the blowdown back to the Clay Contactors. The gauge glass and level control are now purged once per shift and the system is completely enclosed with no benzene released to the atmosphere.

Once per month the Clay Contactors are sampled individually to determine when the clay is spent. This has involved draining approximately 30 feet of 1/2-inch line to the process sewer in order to get a fresh sample. This exposure has also been eliminated by creating a closed loop to circulate the sample stream until a fresh sample has been obtained.

The sampling loops described above have eliminated conditions where benzene was intentionally bled to the atmosphere. The Operators must be fully trained to take maximum advantage of these improvements, which are designed to minimize their exposure. To accomplish this, a series of short instructions have been included in the Daily Orders on proper sampling procedures, preparing equipment for maintenance, and precautions which must be taken when handling benzene. The toxicity and personnel exposure aspects of benzene handling are

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being emphasized repeatedly. These reminders will continue to appear in the Daily Orders, and permanent instructions are being prepared on the same subject.

Maintenance shutdowns at the BEU present a problem from the standpoint of adequate equipment washes to remove all traces of benzene. This has been accomplished in the past by water wash and steaming techniques. However, this only removed benzene from the BEU area and released it to the atmosphere at the Blowoff Pits (where the wash water is routed). Wash lines are being installed for the upcoming shutdown so that the unit can be flushed with Column T-2 bottoms to remove all traces of benzene prior to the water wash and steaming step. The hydrocarbon wash will be routed to motor gasoline. This wash will become a standard step before steaming and opening of any BEU process equipment.

Further monitoring of benzene levels at the BEU will continue to determine if additional equipment such as sampling hoods and pump seal aspirators are required to meet the rigid standards for benzene exposure set forth by the USA Standards.

RC Keeler

R. C. Keeler

RCK:mfz

Attachment

cc: Mr. P. J. Leininger, Alkylation
Hydroprocessing Files (2)

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ATTACHMENT

TABLE I - BENZENE VAPOR CONCENTRATIONS

The two readings listed are "background/sampling". All determinations were made in the breathing area of the Operator standing upwind of the sample point. Readings were taken with a Johnson-Williams Aromatic Hydrocarbon Indicator, Model SS.

WEATHER CONDITIONS	C-7 SIDEDRAW	C-7 BOTTOMS	T-2 TOPS	WASHED RAFFINATE
Humid, little wind.	150/200[a/]	ND/10	<5/5	ND/ND
Hot, strong wind.	7/15	5/5	<5/<5	ND/ND
Warm, little wind.	100/190[a/]	40/80[b/]	<5/15	ND/ND
Cool, little wind.	100/150[a/]	5/10	5/10	ND/ND
Cool, little wind.	80/120[a/]	5/5	<5/10	ND/ND
Cool, strong wind.	200/200[c/]	ND/ND		

a/ High background value due to leaking seal of spare pump sitting nearby.

b/ High values due to packing leak on sampling valve.

c/ High values due to leak which allowed benzene to sit in sample cooler.

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MANUFACTURING -- BENZENE MONITORING PROGRAM

SUMMARY

In accordance with the decisions reached at the meeting between Shell Chemical - Manufacturing and Public Affairs on April 19, a survey was conducted to determine potential for benzene exposure to refinery employees. Based on the information developed, we propose to embark, as soon as practical, on a program which would include the following three principal features:

1. A program of periodic medical surveillance as recommended by Dr. Joyner (see March 30, 1973, draft of proposal). An initial group of 61 employees assigned to benzene extraction units at Houston, Odessa, and Wood River Refineries would be included. The estimated initial annual cost of this program is $22,000, with an increase to approximately $25,000 within five years, due to a gradual increase in those covered resulting from personnel turnover.

2. A special study at Houston Refinery to more fully evaluate the benzene exposure potential of dock workers and certain laboratory employees. The study would include air sampling in conjunction with performance of specific activities where peak exposures are anticipated, plus a urinary phenol analysis of exposed employees at the conclusion of each shift that potential for exposure existed.

3. An expanded air sampling program at all refineries to develop extensive documentation on exposure levels for employees. This will include all locations where benzene content of streams being processed, stored, or otherwise handled exceeds five percent. This information will be utilized to determine if additional employees should be included in the medical surveillance program. The data will also provide a basis for evaluating the potential impact of requirements which are forthcoming as OSHA develops a standard on benzene.

DISCUSSION

Medical Surveillance Program

All refinery operations where potential exists for routine exposure to hydrocarbons with a benzene content greater than five percent by volume were reviewed. This included the catalytic reforming units which are operated to provide feed to the benzene manufacturing facilities, the benzene extraction units, laboratory locations where benzene samples are analyzed, and the various facilities where finished benzene is stored and handled in the process of

storage & Handling

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shipment to customers. The Kaiser light oil processing facility at Wilmington Refinery was also reviewed. As indicated on the attached tabulation, there are presently about 350 staff and hourly employees whose job assignments are directly related to the aforementioned operations. Recommendations covering the scope of the medical surveillance program were formulated from the following analysis of the potential for exposure to benzene at the various locations included in the survey.

Catalytic Reformers

On the reformers at Houston and Wood River which provide feed to the benzene extraction units, the feed contains less than three percent volume benzene. With the conversion of benzene precursers to benzene in the reforming process, the benzene concentration in the product separator liquid and in the stabilizer bottoms becomes 10-18 percent volume. Although these reformers operate 80 percent of the time or more in "benzene production", it was felt that, in view of the limited amount of equipment in which higher concentrations of benzene occur and the limited time spent by operators in the vicinity of this equipment, the probable exposure to benzene on a time weighted-average would be negligible. Consequently, personnel assigned to these units are not included in the medical surveillance program. Should the OSHA criteria for an exposed worker requiring medical surveillance be adopted significantly below the existing TLV (i.e., 1 ppm proposed as exposed versus 10 ppm TLV limit) further consideration for inclusion of these workers may be warranted.

Benzene Extraction Units

Since these facilities involve the fractionation and extraction of high purity benzene, much of the equipment in these units contains streams with a high benzene concentration. Therefore, these plants must be judged to provide one of the highest, if not the highest, risk of benzene exposure to employees. On this basis, the sixty-one benzene extraction unit operators, foremen, and selected maintenance personnel assigned to the Houston, Odessa, and Wood River extraction units were selected for inclusion in a continuing medical surveillance program.

Those employees noted above, and an additional five employees shown on the attachment, are to be included in an initial preplacement physical examination. The purpose of the preplacement examination is to identify employees who may require exclusion from job assignment in potential benzene exposure areas, and to provide a "base line" for possible future reference. The Medical Director will provide guidelines to be used for screening workers for assignment in potential benzene exposure areas.

Tank Truck and Tank Car Loading Racks

Tank truck rack operators were also considered for the program. Potential exposure does not warrant inclusion of these workers in the medical surveillance program. Truck rack operations at Wood River and Houston utilize

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an eductor which expels benzene vapors away from the area. Loading frequencies are only 1-2 trucks per day at Wood River (8-10 per day if barge facility not in service) and 1-5 trucks per month at Houston. In addition, the trucks are non-Shell driver loaded at both Houston and Wood River.

Tank car rack operators were not considered for the program as only 1-2 cars per month are loaded at Wood River and significantly fewer are loaded at Houston.

Tank Gauging and Sampling

The frequency of gauging and sampling of benzene tankage is insignificant for potential day-in and day-out exposure to current TLV levels of benzene. Frequencies vary from one sample per day at Houston to four samples every four days, plus two tank gauges every four days at Wood River.

Barge Loading

The Wood River barge loading facility in addition to being in benzene service on a very infrequent basis (average one benzene barge every four days), is operated in such a manner that potential benzene exposure to the dockmen is negligible. A non-Shell employee, "tankerman", is a member of the barge crew. This man is totally responsible for loading and sampling as well as making the actual physical connections. The Shell dockman only insures proper connections are made and then returns to his remote control center to start up the loading operation. The Wood River dockmen are not included in the medical surveillance program.

Barge loading operations at the Houston Refinery may warrant inclusion of these workers in the medical surveillance program. Loading and sampling of pure benzene into an estimated four barges per week results in potential exposure to the dockmen, cargo inspectors, helpers, and foremen. Proximity of the loading manifolds to barges is a factor of concern. The intermittent nature of the operation and the large number of workers involved justify a more detailed study of this operation. Should the thirty-six Houston barge loading operations personnel be included in the medical surveillance program, the additional annual cost is $13,000. This would make the total estimated current annual cost $35,000.

How is it done

An analysis of phenol concentration in urine is a widely recognized method for evaluating an individual's exposure to benzene on a daily basis. By taking a sample at the end of a shift, exposures of 10 ppm (time-weighted average) can be detected. Fairly reliable correlations are available between phenol concentration in urine versus benzene exposure during a work period immediately preceding sampling.

We propose to explore with Houston Refinery the possibility of utilizing their facilities for GLC analyses of the urine to determine phenol concentrations. We are awaiting further specific details from Dr. Joyner as to the GLC procedure to be used.

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It is intended to use urinary phenol analyses coupled with air sampling for peak levels during exposure periods to develop data for determining the need for including the Houston barge loading personnel in the medical surveillance program. This special program is to be implemented as soon as possible with staff workers being monitored if the current strike is still in progress.

Barge loading dockmen, cargo inspectors, and helpers will be requested to provide urine samples for phenol analysis at the end of each shift they work during which a benzene barge is loaded. In addition, refinery lab tester No. 1 and special tester No. 1 will be requested to do the same on days which they handle benzene samples. The estimated cost for these laboratory analyses is $20 per day. It is anticipated that this program would continue for approximately one month.

Refinery Laboratories

To minimize exposure of refinery laboratory personnel to benzene vapors, it is proposed that wherever feasible all pouring, mixing, compositing, etc., of all samples containing greater than five percent volume benzene be performed under ventilated hoods with a minimum face velocity of 125 fpm. Although these controls should keep exposure at a level which would not require medical surveillance, it is intended to include certain refinery lab personnel from Houston Refinery in the urinary phenol analysis/air sampling program discussed above for the Houston barge loading workers. With the sampling and analyzing procedures set up at Houston, inclusion of these workers can be accomplished at minimum expense and the data accumulated should be valuable in verifying that refinery lab workers can be excluded from the medical surveillance program.

Wilmington Kaiser Light Oil Operation

Wilmington Refinery processes a 65-75 percent volume benzene stream (Kaiser light oil) on its KLO column. Column onstream time is less than 70 percent and the operations personnel have additional responsibilities in operating four other columns as well as two fired heaters and a cooling water tower. Since the KLO column is but a small part of these workers' responsibility, the routine potential for day-in and day-out exposure at TLV levels did not warrant their inclusion in the medical surveillance program.

AIR MONITORING PROGRAM

An expanded air monitoring program will be initiated at all refineries. Sampling of the employees' breathing zones will be performed initially on a monthly basis with care taken to insure sampling representative of potential exposure to benzene in the work situation. Sampling should be accomplished around refinery laboratories and other operations in which benzene in concentrations of five percent volume or greater are found.

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Initially, detector tubes will be utilized for checking peak exposure. Eventually, with procedures still to be developed by the Industrial Hygiene Department, more sophisticated air monitoring techniques will be used in order to check for exposure levels below 5 ppm (time-weighted average).

If, after monitoring for six months, the benzene in air concentrations are consistently below the TLV, the frequency of monitoring will be reduced to the quarterly basis currently recommended within Manufacturing for air contaminents.

BCE/bam
5/14/73

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Attachment

MANUFACTURING - BENZENE EXPOSURE - MEDICAL SURVEILLANCE PROGRAM

Plant	Employees Considered[1]								Proposed Medical Surveillance		Estimated Annual Surveillance Cost		Initial Preplacement Physical Examination		
	Operators		Operations Foremen		Other Staff		Routine Maintenance								
	Present	In Five Years	Permanent	Temporary	Present	In Five Years	Pipeftr.	Instrument	Present	In Five Years	Present[2]	In Five[4] Years	Additional Personnel	Total Exams	Estimat Cost[3]
							WOOD RIVER REFINERY								
CR-3	16	56	4	3	-	-	-	-	-	-	-	-	-	-	-
Benzene Extraction	12	27	4	-	-	-	1	2	19	35	6,840	8,440	3-Temp.Fore	22	2,200
Tank Truck Rack	8	28	-	-	-	-	-	-	-	-	-	-	-	-	-
Barge Loading	9	14	-	-	-	-	-	-	-	-	-	-	-	-	-
Benzene Tankage	10	15	-	-	-	-	-	-	-	-	-	-	-	-	-
Refinery Lab	45	90	4	3	5	10	-	-	-	-	-	-	-	-	-
Total Wood River	100	230	12	6	5	10	1	2	19	35	6,840	8,440	3	22	2,200
							HOUSTON REFINERY								
CR-3	38	53	4	1	3	4	-	1	-	-	-	-	-	-	-
Benzene Extraction	19	29	4	-	-	-	-	2	25	35	9,000	10,000	1-Proc.Mgr. 1-Maint.Cor.	27	2,700
Tank Truck Rack	2	4	-	-	-	-	-	-	-	-	-	-	-	-	-
Barge Loading	32	52	4	-	-	-	-	-	-	-	-	-	-	-	-
Benzene Tankage	20	40	4	-	-	-	-	-	-	-	-	-	-	-	-
Refinery Lab	41	46	4	-	4	5	-	-	-	-	-	-	-	-	-
Total Houston	152	224	20	1	7	9	-	3	25	35	9,000	10,000	2	27	2,700
							ODESSA REFINERY								
Benzene Extraction	12	15	5	-	-	-	-	-	17	20	6,120	6,420	-	17	1,700
Benzene Tankage	6	6	-	-	-	-	-	-	-	-	-	-	-	-	-
Refinery Lab	10	10	-	-	-	-	-	-	-	-	-	-	-	-	-
Total Odessa	28	31	5	-	-	-	-	-	17	20	6,120	6,420	-	17	1,700
							WILMINGTON REFINERY								
KLO Column	7	17	-	-	-	-	-	-	-	-	-	-	-	-	-

1 - Turnover not estimated for operations foremen, and routine maintenance.

2 - Estimated present annual surveillance cost includes medical costs, overtime pay, and transportation costs for quarterly laboratory and X-ray examinations plus annual cost for history and physical examination plus random urinalysis annually per individual (i.e., per person equals 4(32+33+20) + 15 = $[illegible]/person or $[illegible]/person.

3 - Estimated cost preplacement physical exam includes history and physical exam ($15) plus laboratory and X-ray ($31.50 plus overtime pay ($33).

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BENZENE TOXICITY AWARENESS PROGRAM

I. Operator Awareness/Training

A. Dangers of aromatic hydrocarbons discussed in departmental safety meetings as early as 1970 and have continued.

B. New employees indoctrinated on the hazards of hydrocarbon vapors - part of departmental orientation.

C. Operators since 1/73 have monitored BEU area for benzene concentrations with a Johnson-Williams Aromatic Hydrocarbon Analyzer. Training in use of instrument also included discussion on hazards and precautions of handling high-benzene-concentration streams.

D. Additional awareness achieved by:

1. Safety Dept. monitors the BEU confines periodically.

2. Supervisor safety meetings.

3. Periodic paragraphs in Daily Orders on proper sampling techniques, equipment preparation for maintenance, and precautions when handling benzene.

II. Mechanical/Operational Changes

A. Mechanical improvements since 10/72:

1. Closed, fast-loop sample systems.

2. Closed system on clay contactor gauge glass blowdown.

3. Program of changing 5 pumps to mechanical seals; 2 changed out so far.

4. Improved clean-out procedure on shutdowns to remove benzene prior to water wash and steaming.

5. Removal of steam traps from sewers that could contain benzene.

III. On-Going Program

A. Continue weekly Operator monitoring of concentrations. Trouble areas are to be corrected when/if found.

B. Supervisor/Operator safety meetings.

C. Periodic reminders in Daily Orders.

D. Implement mechanical changes where necessary:

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BENZENE TOXICITY AWARENESS PROGRAM

III. On-Going Program (Continued)

D. 1. Complete pump seal installation.

2. Install clay contactor purge line to MDO, not Blowoff Pits.

3. Install additional unit wash lines for proper clean-out during shutdowns.

5/24/73

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