

INDUSTRIAL HYGIENE REPORT

EMPLOYEE EXPOSURE TO HEXANE IN THE
HIGH DENSITY POLYETHYLENE PLANT,
BLOCK 9, LOUISIANA DIVISION

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DATE 2-26-80

SUMMARY

Personnel breathing zone samples and area samples were taken during production operations in the High Density Polyethylene Plant, Block 9, for hexane. Seven job classifications and five areas were monitored during the survey. The exposure levels were acceptable when compared to an eight-hour time-weighted average. When performing short-term exposure sampling on specific job procedures, one job classification, SOT - Purification, revealed short-term exposure levels that were unacceptable. There were three areas monitored that had levels which were unacceptable.

While alternate operating procedures were under trial, respiratory protection (3M #8712 Organic Vapor Respirator) was required. Alternate operating procedures were put into effect and reduced short-term exposure and area levels to an acceptable range for SOT - Purification.

Engineer Controls (local ventilation with scrubber) in the two areas reduced unacceptable area levels to an acceptable range. The Industrial Hygiene Survey for Hexane at the High Density Polyethylene Plant was conducted from September, 1978 to November, 1979.

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INTRODUCTION

On September 28, 1978,, an Industrial Hygiene Survey to determine employee exposure to hexane was begun at the request of the supervision of the High Density Polyethylene Plant, Block 9.

EVALUATION CRITERIA

Dow Industrial Hygiene Guides (IHGs) are concentrations of airborne substances to which nearly all employees may be repeatedly exposed throughout a working lifetime without adverse effect. IHGs are established by the health professions of the Dow Industrial Health Board for Chemicals (raw materials, intermediates, byproducts, wastes and products) handled within The Dow Chemical Company. Published exposure criteria are available for many industrial chemicals. Examples include the Threshold Limit Values (TLVs) of the ACGIH (American Conference of Governmental Industrial Hygienists), the OSHA Standards of the Occupational Safety and Health Administration of the United States Department of Labor. For most of these chemicals, the Industrial Health Board has adopted the published exposure criteria as the Dow IHGs. In a few instances, the IHG set by the Industrial Health Board differs from the published exposure criteria. In establishing IHGs for chemicals which lack published exposure criteria, the Industrial Health Board considers toxicological information, occupational exposure data and medical experience.

Industrial Hygiene Guides do not represent fine lines between safe and dangerous exposures. As the name indicates, IHGs are properly used as guides for plant design and for evaluating occupational exposures. IHGs for gases and vapors are usually expressed in part per million (ppm, volume/volume); for dusts, fumes, aerosols, and mists, IHGs are usually expressed in milligrams of contaminant per cubic meter of air (mg/m³).

Most IHGs are time-weighted average (TWA) concentrations for an 8 - 12-hour work day and a 40-hour work week. Limited excursion exposures to concentrations exceeding the IHG are permitted, provided that the TWA exposure for the entire work day is acceptable and the consequences of exposure, within the excursion limit, are minimal and reversible. For most chemicals,

excursion limits are calculated from the IHGs and the excursion factors recommended by the ACGIH. Ceiling IHGs are assigned to those materials which cause significant or irreversible effects at concentrations exceeding the IHG. For these chemicals, no excursion exposures are allowed.

The following exposure criteria currently apply to the airborne contaminant referred to in this report:

<u>Compound</u>	<u>*TLV - 8-hr. TWA</u>	<u>*STEL - 15-min. Excursion</u>
Hexane	100 ppm	125 ppm

*Published in TLVs of ACGIH

EXPERIMENTAL

Employees actual breathing zone samples of the hexane vapor were collected using two methods:

1. SKC charcoal tubes containing 600 mg coconut base charcoal using small battery operated DuPont pumps (Model P200) at a flow rate of 100 cc/min.
2. 3M Organic Vapor Monitor #3500.

Comparison of the two sampling methods was acceptable.

Analysis for hexane was performed by gas chromatography. The instrument and conditions are listed below:

Instrument:	Hewlett-Packard 5730A/7123A Recorder
Column:	6' stainless steel with 15% TCP on 60/80 mesh Chrom W, acid washed
Oven Temp:	60°C
FID Detector Temp:	200°C
Inj. Temp:	200°C
Solvent:	CS ₂ (10 mls-tube) (2 mls-badge)
Injection:	2 μ l.
Flow Rates:	20 cc/min-N ₂ ; 30 cc/min-H ₂ ; 250 cc/min-Air
Min. Det. Limit	1 μ g/ml CS ₂

AREA SAMPLING DESCRIPTION

Area sampling was performed in areas where possible high levels of airborne hexane would occur leading to a potential overexposure if a job was performed over an extended period of time in those areas. The areas which were monitored are described below.

1. Area samples were taken at the calcium stearate additive valve which is approximately five (5) feet above the deck and eight (8) feet southwest of the skimmer tank vent on Train 1.
2. Area samples were taken at the calcium stearate additive valve which is approximately five (5) feet above the deck and eight (8) feet southeast of the skimmer tank vent on Train 2.
3. Area samples were taken at the guard rail approximately four (4) feet above the deck and six (6) feet southwest from the skimmer tank vent on Train 3.
4. Area samples were taken at the guard rail approximately four (4) feet above the deck and six (6) feet southwest from the skimmer tank vent on Train 4.
5. Area samples were taken five (5) feet above the ground at the northwest post approximately six (6) feet from hexane filter 202-D during filter cleaning.
6. Area samples were taken five (5) feet above the ground at the center post between hexane filters 202-C and 202-D during filter cleaning.
7. An area sample was taken five (5) feet above the ground at the southeast post approximately six (6) feet from hexane filter 202-C during filter cleaning.

JOB CLASSIFICATION DESCRIPTION

The job classifications are described from the viewpoint of personal contact with hexane and only those job classifications are discussed with a possible overexposure to hexane during normal operations.

Shift Supervisor

Shift Job - Coordinates shift activities. Outside activities dependent upon operational problems.

Senior Operating Technician - Purification

Shift Job - Performs all phases of operational work that is necessary for smooth operation of the area. Performance includes making two rounds per shift, unloading butene, alcohol and hexane rail cars, and cleaning polymer from hexane filters.

Senior Operating Technician - Reaction

Shift Job (two per shift) - Performs all phases of operational work that is necessary for smooth operation of the area. Makes two rounds per shift and hourly rounds for additives.

Lab Personnel

Shift Job (two per shift) - Must go outside to catch samples as often as hourly; remainder of time spent in lab running samples.

Expanded Day Operations

Day Job - Rotates every fifth month, consisting of one month of eight-hour days. Mostly outside work: maintenance, housekeeping, safety observers, etc.

Senior Operating Technician - Extrusion

Shift Job - Runs and maintains six extruders, checks and monitors additives. Makes two rounds per shift.

Maintenance - Crafts

Day Job - Time is spent in warehouse or in block area as required.

PRESENTATION OF DATA

The floor plan and flow chart of the High Density Polyethylene Plant, Block 9, are located in Figures 1 and 2. (See Attachments.)

The data is separated by job classification and area with the sampling date, duration (minutes) and hexane levels (ppm-v/v) listed for each.

The job classifications and areas are listed below with their respective reference tables. (See Attachments.)

<u>Job Classification</u>	<u>Table</u>
Purification	I
Reaction	II
Lab Personnel	III
EDO	IV
Extrusion	V
Supervisor	VI
Pipe Fitters	VII

<u>Area Classification</u>	<u>Table</u>
Above skimmer on Train 1	VIII
Above skimmer on Train 2	VIII
Above skimmer on Train 3	VIII
Above skimmer on Train 4	VIII

DISCUSSION AND CONCLUSIONS

The initial sampling of short-term exposures to hexane during normal operating conditions revealed one job classification with unacceptable levels. The job classification was Senior Operating Technician - Purification, while opening and cleaning

the hexane filters 202-C, 202-D, 201-A and 201-B. In April, 1979, alternate operating procedures were put into effect. The change in procedure consisted of extending the boil out with hot condensate time from four hours to eight hours on 202-C and 202-D and 24 hours to 48 hours on 201-A and 201-B. While this procedure change was being evaluated, respiratory protection (3M #8712 Organic Vapor Respirator) was required. The evaluation of the procedural change in cleaning the hexane filters indicated exposure levels were reduced to an acceptable range.

Also, test of engineering controls on Train 4 (a steam-still modification) indicates the frequency of hexane filters cleaning will be reduced due to less powder carry-over, resulting in a decrease in the number of times the personnel are exposed to hexane during filter cleaning.

The area sampling indicated unacceptable levels of airborne hexane were present at the calcium stearate additive valves around the skimmer tanks on Trains 1 and 2 and in the immediate area of the hexane filters during the opening and cleaning procedures.

Engineering controls (duct work with a water screen) reduced the airborne hexane levels at the calcium stearate additive valves on Trains 1 and 2 to an acceptable range. The procedure change in cleaning the hexane filters reduced area levels to an acceptable range during that operation.

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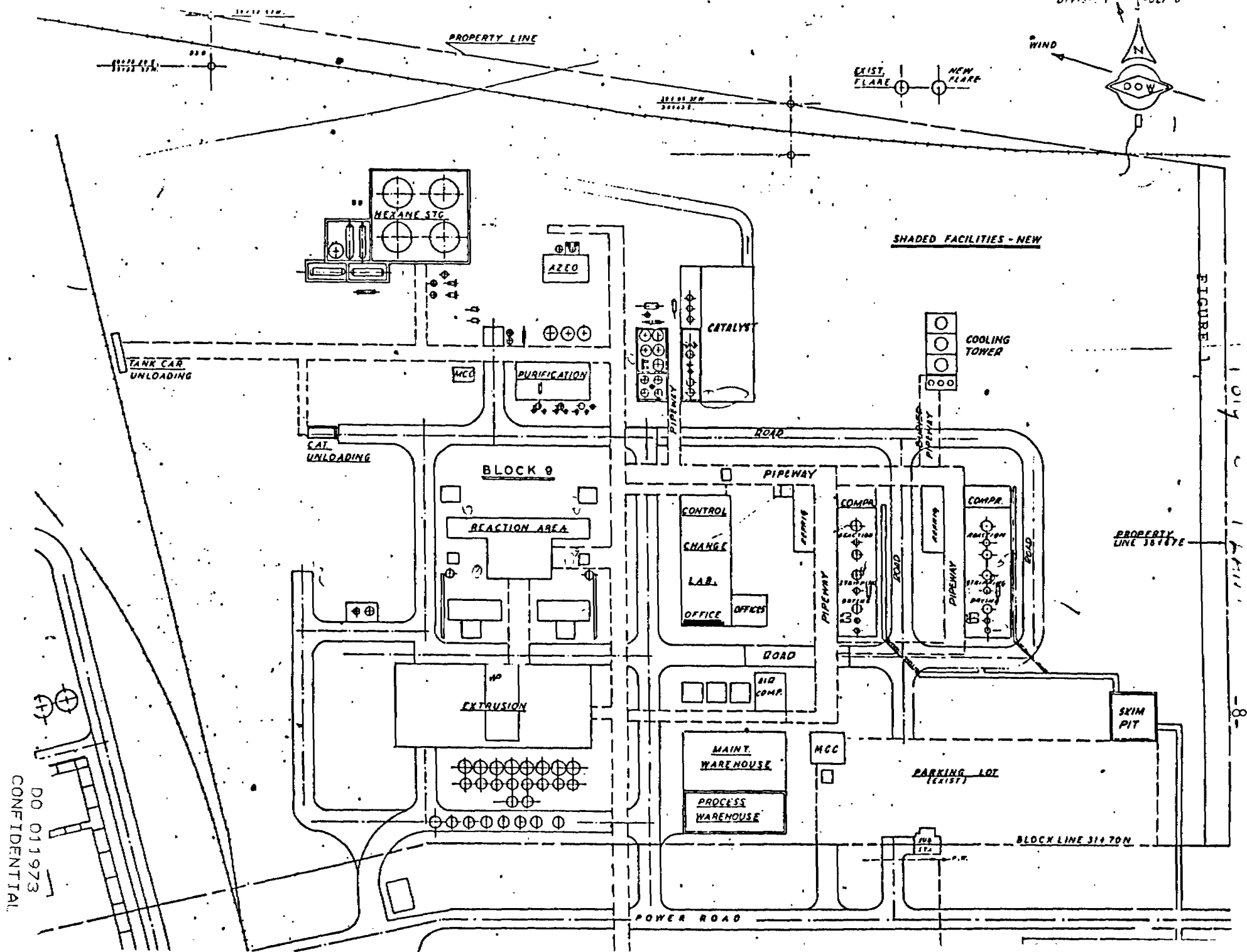


FIGURE 1

POLY-B

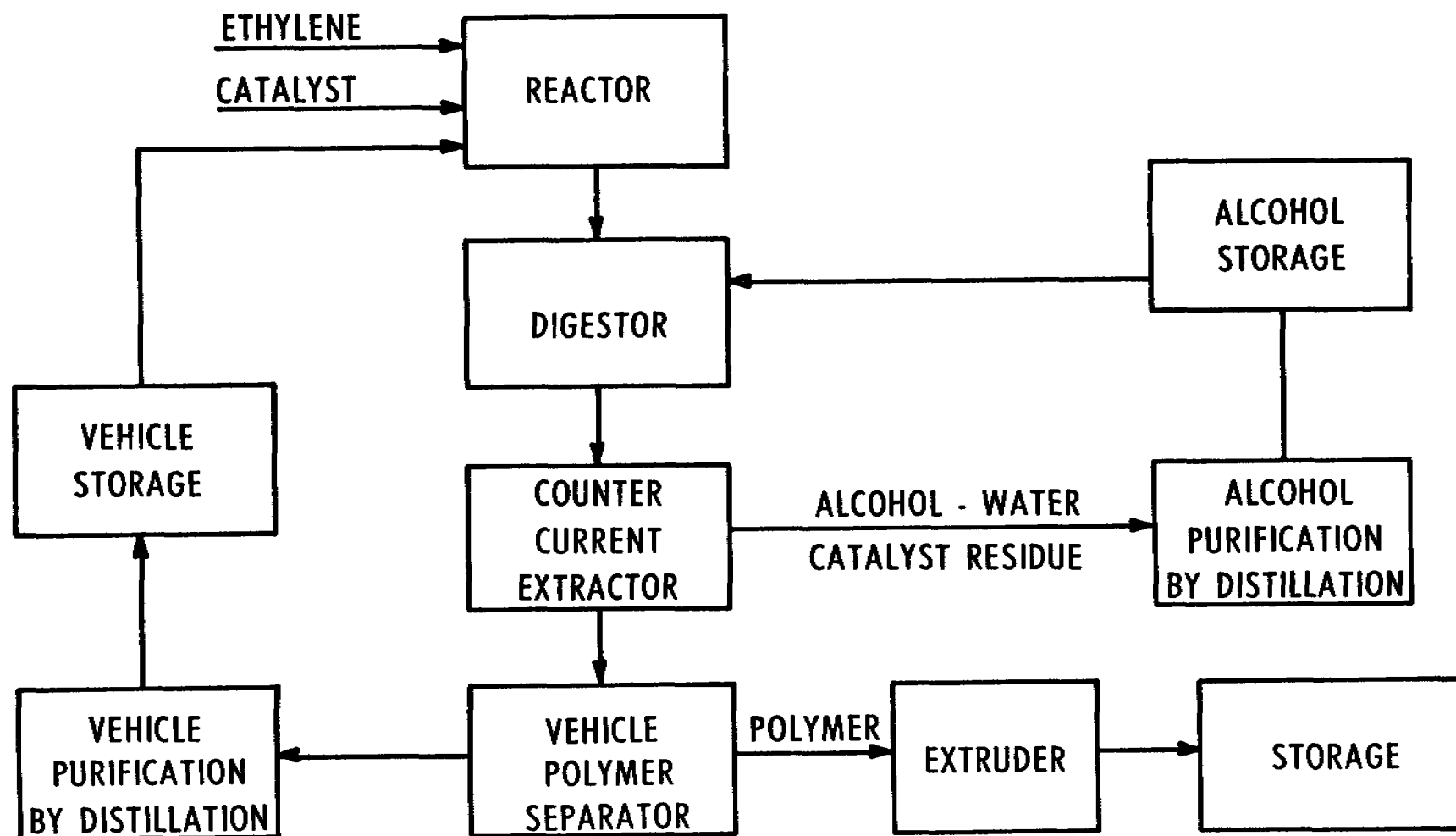


FIGURE 2

TABLE I
PERSONNEL EXPOSURE TO HEXANE
SOT - PURIFICATION

<u>Sample Description</u>	<u>Date</u>	<u>Time (Min.)</u>	<u>Amount (ppm-v/v)</u>
Short-term exposure opening and cleaning 201-A filter	10-9-78	90	189.0
Short-term exposure opening and cleaning 201-B filter	11-1-78	45	50.2
Changed alcohol filters general rounds	10-13-78	440	20.3
Short-term exposure checking gauges in catalyst area *(two hexane pumps leaking)	9-28-78	45	82.4
Short-term exposure changed filters in alcohol area	9-28-78	40	1.3
General rounds, opened and cleaned 201 filter	10-10-78	315	60.0
General rounds and maintenance, opened and cleaned 201 filter	10-9-78	360	5.9
Short-term exposure opening and cleaning 202 filter	11-6-78	90	638.0
Short-term exposure unloaded tank car of hexane	11-2-78	180	4.0
Short-term exposure opening and cleaning 202 filter	3-7-79	20	92.0
Short-term exposure opening and cleaning 202 filter	3-13-79	16	1104.0

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TABLE I
PERSONNEL EXPOSURE TO HEXANE

SOT - PURIFICATION (continued)			
<u>Sample Description</u>	<u>Date</u>	<u>Time (Min.)</u>	<u>Amount (ppm-v/v)</u>
Short-term exposure opening and cleaning 202 filter	4-12-79	13	7.5
*Short-term exposure opening and cleaning 202 filter	5-16-79	13	127.0
*Short-term exposure opening and cleaning 202 filter	10-23-79	37	60.0
*Short-term exposure opening and cleaning 202 filter	11-5-79	28	61.0

*NOTE: Beginning April 2, 1978, the cleaning procedure of the 202 filters was changed from boiling with hot condensate for four hours prior to opening, to eight hours in an effort to reduce hexane content in the polymer.

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TABLE II
PERSONNEL EXPOSURE TO HEXANE
SOT - REACTION

<u>Sample Description</u>	<u>Date</u>	<u>Time (Min.)</u>	<u>Amount (ppm-v/v)</u>
Changed pump at cooling tower, general rounds	10-9-78	315	1.3
Maintenance on compressor deck, general rounds	10-9-78	360	2.6
General rounds	10-13-78	440	12.8
Short-term exposure blew out calcium stearate at additive station	11-6-78	4	19.4
Short-term exposure opened post reactor	11-3-78	75	23.0
Short-term exposure opened post reactor	11/3/78	75	23.7
Short-term exposure blew out calcium stearate at additive station	10-26-78	8	43.4
Short-term exposure - spill interphase pump	11-6-78	38	739.0
General maintenance, general rounds	10-16-78	510	3.1
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TABLE III
PERSONNEL EXPOSURE TO HEXANE
LAB PERSONNEL

<u>Sample Description</u>	<u>Date</u>	<u>Time (Min.)</u>	<u>Amount (ppm-v/v)</u>
General lab duties including catching slurry samples	10-16-78	360	4.0
General lab duties including catching slurry samples	10-18-78	420	10.0
General lab duties including catching slurry samples	10-19-78	615	12.0
General lab duties including catching slurry samples	10-20-78	210	13.0
Short-term exposure collecting slurry samples on Trains 1 and 2, empties samples under hood	10-26-78	12	11.0
Short-term exposure collected slurry sample from Train 3, emptied sample under hood	10-26-78	7	7.0
Short-term exposure collected slurry samples from Trains 1 and 2, emptied samples under hood	10-26-78	9	16.0
Short-term exposure collected slurry sample from Train 1, emptied sample under hood	11-6-78	5	85.0

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TABLE III
PERSONNEL EXPOSURE TO HEXANE

LAB PERSONNEL (continued)			
<u>Sample Description</u>	<u>Date</u>	<u>Time (Min.)</u>	<u>Amount (ppm-v/v)</u>
Short-term exposure collected slurry sample, from Train 4, emptied sample unde hood	11-6-78	6	0.5
Short-term exposure collected slurry sample, emptied sample under hood	11-6-78	5	134.0

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TABLE IV
PERSONNEL EXPOSURE TO HEXANE
EXPANDED DAY OPERATIONS

<u>Sample Description</u>	<u>Date</u>	<u>Time (Min.)</u>	<u>Amount (ppm-v/v)</u>
General maintenance by graphic panel room	10-16-78	510	2.7

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TABLE V
PERSONNEL EXPOSURE TO HEXANE
EXTRUSION OPERATION

<u>Sample Description</u>	<u>Date</u>	<u>Time (Min.)</u>	<u>Amount (ppm-v/v)</u>
General maintenance and housekeeping in extrusion area	10-18-78	435	1.0

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TABLE VI
PERSONNEL EXPOSURE TO HEXANE
SUPERVISOR

<u>Sample Description</u>	<u>Date</u>	<u>Time (Min.)</u>	<u>Amount (ppm-v/v)</u>
Worked in control room and in Trains 1,2,3, and 4	10-20-78	610	1.1

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TABLE VII
PERSONNEL EXPOSURE TO HEXANE
CRAFTS - PIPE FITTERS

<u>Sample Description</u>	<u>Date</u>	<u>Time (Min.)</u>	<u>Amount (ppm-v/v)</u>
Short-term exposure removing heat exchanger from Train 3	11-6-78	45	17.0
Short-term exposure removing heat exchanger from Train 3	11-6-78	45	7.0
Short-term exposure removing heat exchanger from Train 3	11-6-78	45	9.0
Short-term exposure Removing heat exchanger from Train 3	11-6-78	45	21.0

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TABLE VIII
AREA SAMPLING FOR HEXANE

<u>Sample Description</u>	<u>Date</u>	<u>Time (Min.)</u>	<u>Amount (ppm-v/v)</u>
Sample at calcium stearate valve by skimmer vent on Train 1	9-28-78	95	1067.0
Sample at calcium stearate valve by skimmer vent on Train 1	9-28-78	115	2076.0
Sample at calcium stearate valve by skimmer vent on Train 1	9-28-78	115	504.0
Sample at calcium stearate valve by skimmer vent on Train 1	9-29-78	60	1033.0
Sample at calcium stearate valve by skimmer vent on Train 1	9-29-78	80	579.0
Sample at calcium stearate valve by skimmer vent on Train 1	9-29-78	60	855.0
Sample at calcium stearate valve by skimmer vent on Train 2	9-28-78	95	44.0
Sample at calcium stearate valve by skimmer vent on Train 2	9-28-78	115	621.0
Sample at calcium stearate valve by skimmer vent on Train 2	9-28-78	115	725.0

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TABLE VIII
AREA SAMPLING FOR HEXANE
(continued)

<u>Sample Description</u>	<u>Date</u>	<u>Time (Min.)</u>	<u>Amount (ppm-v/v)</u>
Sample at calcium sterate valve by skimmer vent on Train 2	9-29-78	60	261.0
Sample at calcium sterate valve by skimmer vent on Train 2	9-29-78	95	192.0
Sample at calcium sterate valve by skimmer vent on Train 2	9-29-78	80	87.0
Sample at calcium sterate valve by skimmer vent on Train 2	9-29-78*	60	208.0
Sample at guardrail by skimmer vent on Train 3	10-2-78	60	7.0
Sample at guardrail by skimmer vent on Train 3	10-2-78	120	4.4
Sample at guardrail by skimmer vent on Train 3	10-2-78	120	2.5
Sample at guardrail by skimmer vent on Train 4	10-2-78	60	3.0
Sample at guardrail by skimmer vent on Train 4	10-2-78	120	4.1
Sample at guardrail by skimmer vent on Train 4	10-2-78	120	13.5

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TABLE VIII
AREA SAMPLING FOR HEXANE
(continued)

<u>Sample Description</u>	<u>Date</u>	<u>Time (Min.)</u>	<u>Amount (ppm-v/v)</u>
*Sample at calcium sterate valve by skimmer tank on Train 1	10-5-78	60	11.0
*Sample at calcium sterate valve by skimmer tank on Train 1	10-5-78	90	3.4
*Sample at calcium sterate valve by skimmer tank on Train 1	10-5-78	60	0.2
*Sample at calcium sterate valve by skimmer tank on Train 1	10-5-78	120	30.0
*Sample at calcium sterate valve by skimmer tank on Train 2	10-5-78	60	63.0
*Sample at calcium sterate valve by skimmer tank on Train 2	10-5-78	90	61.0
*Sample at calcium sterate valve by skimmer tank on Train 2	10-5-78	60	62.0
*Sample at calcium sterate valve by skimmer tank on Train 2	10-5-78	120	0.2

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TABLE VIII
AREA SAMPLING FOR HEXANE
(continued)

<u>Sample Description</u>	<u>Date</u>	<u>Time (Min.)</u>	<u>Amount (ppm-v/v)</u>
Purification area, cleaning 202 filter, sample at 5 ft above ground on N.W. post	3-13-79	16	431.0
Purification area, cleaning 202 filter, sample at 5 ft above ground on post between 202-C and 202-D	3-13-79	16	513.0
Purification area, cleaning 202 filter, sample at 5 ft above ground on N.W. post	4-12-79	13	11.0
Purification area, cleaning 202 filter, sample at 5 ft above ground on post between 202-C and 202-D	4-12-79	13	16.0
*Purification area, cleaning 202 filter, sample at 5 ft above ground on N.W. post	5-16-79	13	52.0
**Purification area, cleaning 202 filter, sample at 5 ft above ground on post between 202-C and 202-D	10-23-79	37	61.0
**Purification area, cleaning 202 filter, sample at 5 ft above ground on S.E. post	10-23-79	37	30.0

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TABLE VIII
AREA SAMPLING FOR HEXANE
(continued)

<u>Sample Description</u>	<u>Date</u>	<u>Time (Min.)</u>	<u>Amount (ppm-v/v)</u>
**Purification area, cleaning 202 filter, sample at 5 ft above ground on post between 202-C and 202-D	11-5-79	28	64.0
**Purification area, cleaning 202 filter, sample at 5 ft above ground on post between 202-C and 202-D	11-5-79	28	60.0

- * In September, 1979, the skimmer vent opening was relocated by duct work with a water screen to reduce hexane emissions.
- ** Beginning April 28, 1979, the cleaning procedure of the 202 filters was changed from boiling out with hot condensate for four hours prior to opening to eight hours in an effort to reduce hexane content in the polymer.

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