cc J. Tuck
(1+2 only) J. Sombower
J. D. Welbon - Plaquemine
W. L. McDermott - Freeport
F. Haerger

R Dowd
J Howard (B2)
from Fred Haerger

Washington Bulletin

NATIONAL PETROLEUM REFINERS ASSOCIATION

Founded 1902
SUITE 802, 1725 DESALES STREET, N.W., WASHINGTON, D.C. 20036
TELEPHONE (202) 638-3722

January 7, 1977

Benzene Exposure

For the past several months, the Occupational Safety and Health Administration has been urged by the National Institute for Occupational Safety and Health to reduce the permissible exposure to benzene to the lowest feasible level based on a claim that benzene is leukemogenic, producing progressive, malignant disease of the blood-forming organs. NIOSH, established under the Occupational Safety and Health Act to function as a research entity, has strongly advocated that an emergency standard of 1 ppm be established until the present exposure level can be revised through the normal administrative processes. Current regulations allow occupational exposure to a 10 ppm time weighted level with a ceiling of 25 ppm and a peak of 50 ppm for no more than 10 minutes per 8 hour day. The 1 ppm standard recommended by NIOSH would be based on samples collected at 1 liter of air per minute for two hours.

There have been reports that an emergency standard has been advocated by the United Rubber Workers and it is likely that the Oil, Chemical and Atomic Workers Union will eventually become involved in efforts to lower exposure standards. Thus far, OSHA has resisted efforts to implement an interim 1 ppm standard, but it is understood that a "guideline" recommendation has been prepared for OSHA Administrator, Dr. Morton Corn's signature, but his intentions and tenure at OSHA are undetermined. The legal efficacy of a "guideline" which is not covered in the Act is somewhat in doubt.

Benzene is widely used, most notably as a solvent, but also is contained in many petroleum products. Some companies have reported that a 1 ppm standard may be exceeded by some degree in areas involving handling,

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shipping and transfer of benzene. There have been claims that, under certain conditions, retail dispensing operations of gasoline containing benzene expose motorists or attendants to levels above 1 ppm. Such a claim was voiced by the Environmental Defense Fund, at a hearing sponsored by the Environmental Protection Agency on January 5, 1976 concerning the implementation of vapor recovery systems at retail service stations. EDF's testimony included statements that..."gasoline evaporation is a major source of benzene emissions," and...a larger percentage of this evaporation occurs during the refueling of automobiles." Criticizing EPA's "failure to address the significant health hazard," EDF pointed to the growth of self service gasoline service stations and the fact that vapor recovery systems are required in 13 air quality control regions at about 15% of total U. S. service stations.

A statement presented by the American Petroleum Institute took issue with efforts to link benzene with leukemia, noting that a connection "had not been proven or established on a sound scientific basis." While conceding that toxic effects of high levels of benzene have been recognized for decades, the statement made the obvious point that toxic effects are readily prevented by controlling benzene levels to present allowed levels in the workplace. Numerous studies within the petroleum industry, and notably one involving data on 1,100 deaths among 20,000 refinery workers with an average work history of 20 years, have not revealed any evidence that benzene is a cause of leukemia. In fact, in this particular study, fewer deaths were related to leukemia than normal experience in the general population. Refinery operations should provide a convincing test since many refinery process streams contain benzene, often in concentrations far above those in gasoline.

While the regulatory agencies ponder the necessity for stricter benzene exposure standards, other concerns have arisen out of the allegations linking benzene with leukemia involving potential liability as a third party in civil damage proceedings. While employees generally are limited in recovering damages from their employer outside of Workmen's Compensation legislation, there is no similar constraint on recovery of damages from the employer's supplier of a substance deemed to be responsible for injuries or death. Some companies are considering distributing literature warning all recipients of their products containing benzene of its dangerous propensities, but the effect of such a warning is questionable.

NPRA has endeavored to apprise member companies' safety personnel of OSHA's activities on benzene exposure levels through its Fire and Accident Prevention Bulletins and regional Fire and Accident Prevention Group meetings, but it would appear that benzene exposure may soon become another controversial environmental issue.

DOW CHEMICAL U.S.A.

TEXAS DIVISION
FREEPORT, TEXAS 77541

June 10, 1983

Dr. Carol Stack
Chemical Manufacturers Association
2501 M Street, N.W.
Washington, D.C. 20037

Dear Carol:

Enclosed is the benzene exposure survey for Dow Chemical Company. If I can help in any way with problems of compilation please give me a call.

Very truly yours,

R. L. Daniel
Environmental Health Services

dsp

Enclosure

02844

BENZENE EXPOSURE SURVEY

Indicate Category: Producer X User X

1. Industrial Hygiene Guideline

(a) Does your company have an internal industrial hygiene guideline (exposure limit) for benzene?

Yes X No

If yes, what is it? _____ - HR. TWA
10 ppm - Ceiling limit

2. Producer/Processor Facilities Handling Benzene

(a) Number of locations with employees with possible exposure to benzene of 1 ppm TWA or greater 3.

(b) Total number of facilities (departments, plants, etc.) with employees with possible exposure to benzene of 1 ppm TWA or greater. 9.

3. Number of employees with possible exposure to benzene of 1 ppm TWA or greater.

(a) Routine* Basis 34.

(b) Intermittent** Basis 35.

* Routine means 3 or more work schedules per week.
** Intermittent - 2 or less work schedules per week.

4. Exposure Profile - TWA and Peak
Indicate number of employees per category.

TWA, PPM			PEAK, PPM	
1-3	4-7	8-10	10-25	> 25
35	34	1	8	12

NOTE: Individuals can be included in both the peak exposure category as well as the TWA category. All employees in 3(a) and 3(b) should be accounted f r in this profile.

5. Respiratory Protection

(a) Is your company using respirators to control employee exposures to benzene?

Yes X No

If yes, is application:

Routine
Intermitt nt
Both X

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(b) Indicate task, type respirator, numbers of employees using routinely and intermittently.

TASK	TYPE RESPIRATOR*	ROUTINE	INTERMITTENT
Training Equipment	AP		35
Repairing Equipment	AP		32
Barge Loading	AP	8	

* SCBA, Airline, Air Purifying (nose-mouth or full face).

(c) Is fit testing performed?

Yes X No

If yes, indicate type of fit test:

Qualitative Quantitative X

(d) Are respirators used to control exposure to benzene of contractor pers nn l on your premises*?

Yes X No

If yes, is application:

Routine
Intermittent
Both X

* Include barge loading/unloading

(e) Indicate task, type respirator, number of contractors using routinely and intermittently.

TASK	TYPE RESPIRATOR	ROUTINE	INTERMITTENT
Equipment Repairs	AP		20

6. Engineering Controls

(a) Is your company presently using engineering controls to minimize benzene exposure?

Yes X N

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(b) Engineering controls is use:

Automatic leak detection systems	X
Double mechanical seals	X
Double seated valves	X
Local exhaust systems*	X
Special sample points	X
Vapor recovery systems	X
Other (specify)	

* Exclude laboratory fume hoods

7. Administrative Controls

Does your company use administrative scheduling of work assignments to limit employee exposure to benzene?

Yes ____ No X

8. Training

Is there an established formal training program for employees with possible exposure to benzene?

Supervisors: Yes X No ____

Workers Yes X No ____

9. Medical Surveillance

(a) Are pre-employment physical examinations available for all employees with possible exposure to benzene?

Yes X No ____

If yes, are they mandatory?

Yes X No ____

(b) Are pre-employment physical examinations mandatory for those workers who may be directly exposed to benzene?

Yes X No ____

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(c) Which of the following are included in the pre-employment physical:

Occupational History	X
Family history (blood dyscrasias)	X
Personal history (complete)	X
CBC with differential	X
Platelet count	X
Hematocrit	X
Hemoglobin	X
Red cell indices (MCV, MCH, & MCHC)	X
Serum bilirubin	X
Reticulocyte count	X

(d) Are periodic physical examinations available for all employees with possible exposure to benzene?

Yes X No ____

If yes, at what frequency are they offered?
If frequency is age-adjusted, please specify.

Are periodic physical examinations mandatory?

Yes ____ No X

(e) Which of the following are included in the periodic physical:

Occupational history update	X
Personal history (complete)	X
CBC with differential	X
Platelet count	X
Hemoglobin	X
Hematocrit	X

(f) Do you periodically update medical history and perform clinical laboratory tests excluding hands-on physical examination?

Yes X N ____

If yes, specify frequency. CBC Annually - other lab tests and health history every two years.

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(g) Are any biological tests used for removal purposes?

Yes _____ No X

If yes, explain. _____

(h) Do you use urinary phenols for:

(i) routine monitoring X

(ii) emergency exposure monitoring X

(iii) neither of the above _____.

Is adjustment made for specific gravity? No

If yes, state value _____.

Benzene File —
RECEIVED MAY 31 1983

Bethlehem Steel Corporation

BETHLEHEM, PA 18016

A. E. MOFFITT, JR., Sc. D.
Manager of
Environmental Health

May 27, 1983

Dr. Carol Stack
Manager - Benzene Program
Chemical Manufacturers Association
2501 M Street, N.W.
Washington, DC 20037

For Distribution by CMA
SPECIAL PROGRAMS DIVISION

From C. STACK
Ref. No. Benzene Program Panel + HTG
Date 6/1/83

Dear Dr. Stack:

Re: Benzene Hematology Study

Attached for the information of the Benzene Program Panel is a copy of a study entitled "Hematological Findings Among Workers Exposed to Benzene at a Coke Oven By-Product Recovery Facility", which Bethlehem recently submitted for publication. As you may recall, Gary Hancock summarized the results of this study at the March 15, 1983 Panel meeting. This study was also presented at the May 21, 1983 Spring Symposium of the Mid-Atlantic Chapter of the Society of Toxicology held in Wilmington, Delaware.

We tentatively plan to submit this report as new information into the hearing record of any future OSHA rulemaking activity on benzene, either independently or through our trade association, the American Iron and Steel Institute (AISI). Please contact Gary Hancock directly at 215/694-5105 with any comments or questions.

Sincerely yours,

A. E. Moffitt, Jr., Sc.D.
Manager of Environmental Health

Attachment

cc: P. A. Hernandez

RECEIVED
JUN 6 1983
R.L. DANIEL

02730

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CONFIDENTIAL

YZ0019781

HEMATOLOGICAL FINDINGS AMONG WORKERS EXPOSED TO BENZENE AT A COKE OVEN BY-PRODUCT RECOVERY FACILITY

D. Gary Hancock, M.S.
Augustine E. Moffitt, Jr., Sc.D.

Bethlehem Steel Corporation
Environmental Health Division
Bethlehem, PA 18016

Errol B. Hay, BECHE
Bethlehem Steel Corporation
Environmental Control
Sparrows Point, MD 21219

ABSTRACT

Hematological findings on a population of 70 male workers exposed to benzene revealed no significant differences when statistically compared t a set of 21 controls on the basis of estimated cumulative doses using analysis of variance (ANOVA) and only one significant difference using Student's t-test. The hematological data evaluated included the following parameters: red blood cell (RBC) counts, white blood cell (WBC) counts, and hemoglobin (Hb) levels. Cumulative benzene exposure indices for each employee were estimated utilizing available personal monitoring and general air sampling data, as well as the professional judgment of local environmental health engineers familiar with the operations. Although the accuracy of these exposure estimates is unknown, the results provide no evidence that the present OSHA standard (10 ppm) is inadequate with respect to the non-leukemogenic, hematotoxic effects of chronic benzene exposure.

INTRODUCTION

The hematopoietic system has been shown to be a major target site in chronic human benzene poisoning.[1-4] Observed blood abnormalities associated with benzene exposure include leukopenia, thromb cyt penia,

macrocytosis, aplastic anemia, and leukemia. Most of these effects, however, have developed in individuals exposed to relatively intense benzene levels (100 ppm) while the significance of low level exposures to the risk of incurring such conditions is largely unknown. Moreover, very little dose-response information is available on the hematotoxicity of benzene.

The objective of this investigation was to assess the hematologic status of a population of workers in relation to their cumulative benzene exposure during a portion of their employment history. If benzene does indeed adversely affect the blood parameters at the chronic exposure levels examined herein, it would be expected that different doses would produce different degrees of hematologic change in accordance with classical dose-response relationships. Consequently, statistical analyses were performed to determine whether any such changes could be discerned among exposed employees.

MATERIALS AND METHODS

Exposure Levels and Environmental Considerations

The study population consisted of 70 males who are presently or were formerly employed at the Coke Oven By-Product Recovery Facility (also referred to as the Coal Chemical Facility) of an integrated steel plant. Job histories of these workers between the years January, 1957 - September, 1977 were acquired from company records and used to ascertain work sites and employment positions during this period. This information

was subsequently utilized in estimating cumulative benzene exposures for each employee.

The Coal Chemical Facility is an operation primarily involved with the collection and refining of volatile aromatic hydrocarbons from nearby coking processes. Such compounds, which among others include benzene, toluene, and xylenes, are present as by-products in the coke oven gas generated from these processes. This particular facility is geographically separated into the following five production areas: acid plant, plant A, plant B, light oil plant, and benzene plant. Plants A and B are involved with the production of primary light oil (a mixture primarily composed of benzene, toluene, and xylenes) while the acid plant (which is no longer in operation) was the site of sulfuric acid production. Each employee in the Coal Chemical Facility has a distinct job classification based on the production site and the specific nature of the job function (e.g., saturator operator - plant A).

In estimating cumulative benzene exposures for the subject worker population during the approximately 20-year study interval, information on benzene levels was obtained from industrial hygiene survey data and from estimates based on discussions with plant environmental health engineers. Industrial hygiene survey data consisted of both time-weighted average personal monitoring (i.e., breathing zone) and general air sampling values; however, these data were only available for the last two years (i.e., 1976 and 1977) of the investigation. Furthermore, the aforementioned data did not cover all job classifications (i.e., employee positions) or all production areas, but was rather limited in scope. Personal monitoring data was available for 27 of 48 employee positions,

while general air sampling had only been performed in 3 of the 5 production areas (Table 1). Consequently, many of the benzene exposure level calculations were based on estimates provided by plant environmental health engineers. Since the Coke Oven By-Product Recovery Facility had not changed dramatically between 1957 and 1977, the engineers recommended that the more recent personal monitoring and general air sampling data could also be generally applied to job classifications and production areas, respectively, for the entire study period. When no personal monitoring data for a specific employee position were available, general air sampling data were used. If the latter were also not available, estimates of average benzene levels (as provided by environmental health engineering personnel) for a particular production area were utilized.

In some instances, a number of employee positions (e.g., General Coal Chemical Turn Foreman) were not associated with a specific production area, but rather involved job duties at all five coal chemical plants. As a result, an average of the benzene levels at the five major sites was used in computing cumulative benzene exposures for individuals who had such work experiences during their employment history. In addition, some employees in the study group did not always work at the Coal Chemical Facility during the 1957-1977 period (e.g., some worked elsewhere in the coke plant for part of their work history); however, in these cases, previous work site exposures were estimated by local environmental health engineers to be about 0.1 ppm.

Cumulative benzene exposures were expressed as ppm-months. The rationale for the selection of 'ppm-months' as the cumulative benzene exposure index is essentially the same as that given by Mazumdar et al.[5]

Table 1. - Benzene Levels Associated With Different Production Areas Within The Coke Oven By-Product Recovery Facility

Production Area	Benzene Levels (ppm)
Acid Plant	0.1*
Plant A	1.9*
Plant B	1.9†
Benzene Plant	31.5†
Litol Plant	1.8†

* Estimates based on discussions with plant environmental health personnel.

† Based on 1976 and 1977 general air sampling data (time-weighted average).

for coal tar pitch volatiles exposures among coke oven workers; specifically, both concentration and duration of exposure are considered to be important factors in the development of chronic benzene poisoning. The calculation of the cumulative benzene exposure index is as follows:

$$\text{Cumulative Exposure Index} = \sum_{\substack{\text{all} \\ \text{jobs}}} \left[\text{Mean Level Exposure of Job}\right] \times \left[\text{Months at Job}\right]$$

Mean benzene exposure levels for all jobs were also computed for each individual by the following equation:

$$\text{Mean Level of Exposure (all jobs)} = \frac{\text{Cumulative Exposure Index}}{\text{Total Months (all jobs)}}$$

The employment period (and therefore exposure time) among exposed workers during 1957-1977 study interval varied with a minimum of 30 months, a maximum of 249 months, and an average of 207.4 months. Cumulative exposure indices for benzene ranged from 11.7 to 26,898 ppm-months with a mean of 2026.9 ppm-months, while mean exposure level values varied between 0.1 and 167 ppm with an average of 10.5 ppm.

Analysis of Hematological Data

Hematological data has been collected annually on workers at the study facility since the early 1950s. These data generally include values for such parameters as red blood cell (RBC) counts, white blood cell (WBC) counts, hemoglobin (Hb) levels, mean corpuscular volumes, platelet counts, hematocrits, and others. Most analyses were conducted by outside laboratories, although some limited tests have been performed in-house.

In order to evaluate the effects of chronic benzene exposures on the human hematopoietic system, certain blood parameters (i.e., WBC counts, RBC counts, and Hb content) of the study group were statistically compared to those of a control population. With regard to temporal aspects, two sets of blood values, average and most recent, were used for each hematological parameter of each study employee during the 1957-1977 interval in making the statistical comparisons. Mean values would be influenced by hematological effects manifested over any part of the entire study period, while the most recent values would be useful for detecting any latent or chronic effects of benzene without being diluted or "normalized" by previous normal or typical blood parameter values as might occur with the use of average values alone. The control group consisted of 21 male supervisory employees located at the study operation for whom hematological data had also been collected during the 1957-1977 interval. Since these supervisory personnel did not hold positions in the Coal Chemical Facility, the cumulative benzene exposures for controls were assumed to be zero. For the purpose of comparing the possible effects of different dose levels, the 70-member exposed group was divided into three cumulative exposure categories: < 240 ppm-months (low), 240-2400 ppm-months (intermediate), and > 2400 ppm-months (high). These particular quantities were selected for a number of reasons. First, it is important to note that the low, intermediate, and high exposure categories are mathematically equivalent to average benzene levels of < 1 ppm, 1-10 ppm, and > 10 ppm, respectively, for a 20-year employment period. Since a 1.0 ppm permissible exposure limit (PEL) was promulgated by the Occupational Safety and Health Administration (OSHA) on February 10, 1978,

but was subsequently invalidated on July 2, 1980, by the U.S. Supreme Court and because 10 ppm is the current OSHA PEL, these exposure categories are important from a regulatory perspective. Although not all employees worked in the Coke Oven By-Product Recovery Facility for the entire study period, these different dose levels can nonetheless serve as a crude basis for making statistical comparisons. In addition, selecti n of these exposure categories was such that sample sizes were sufficiently large so that any significant hematological differences could be detected with relatively good sensitivity.

Analysis of variance (ANOVA) was used to determine if statistically significant differences were present in any of the hematological parameters under investigation. ANOVA tests the null hypothesis that there is no difference in the means of the populations from which separate samples have been drawn. In this case, four populations are involved, three different exposure groups and the controls (or the zero exposure group). In addition to ANOVA, Student's t-tests were conducted on each exposure group versus control group for each hematological parameter examined, both most recent and average blood values. The t-tests were performed in order to determine if there were any significant differences between each exposure group and controls that might have been missed by ANOVA which only tests whether significant differences exist among the means of several sample groups. Even though the results were not age-adjusted, the findings of Frederik[6] indicate that age-related differences in the blood parameters examined are very small.

RESULTS

Statistical analyses of the data via ANOVA revealed no significant differences among the various exposure and control groups at $P < 0.05$ for all of the blood variables examined. Tables 2, 3, and 4 statistically depict hematological data for WBC counts, RBC counts, and Hb content, respectively.

Statistical analyses of the data via Student's t-tests also indicated no significant differences between benzene exposure groups and controls except for the intermediate exposure group with respect to the most recent white blood cell counts which was of borderline significance. However, this exception seems to be due to an unusually low average WBC count (i.e., 6.4×10^3 cells/mm^3) for the control group rather than a high value for the exposure group (i.e., 7.4×10^3 cells/mm^3). This is supported by a mean normal WBC count value given by Lewis[7] as $7.8 \pm 1.5 \times 10^3$ cells/mm^3. In addition, since this was the only exposure group to exhibit a significant difference, further credence is given to the suggestion that this was a spurious result caused by the chance event of abnormally low control group value.

Because of the lack of significant differences (with the aforementioned exception) among and between exposure and control groups, no statements about dose-response relationships can be made regarding these benzene exposure levels. Consequently, it appears that th estimated cumulative exposures examined in this investigation represent doses which fall below the threshold at which non-leukemogenic, hematotoxic effects on humans are manifested, at least in adult males. Although the accuracy of these exposure estimates is unknown, the results nonetheless indicate that the benzene levels experienced by these groups

Table 2. - Group White Blood Cell Values in a Population of Male Coal Chemical Facility Workers, Exposed to Various Doses of Benzene

Benzene Exposure Group (ppm - months)	n	WBC Values (x 10^3 cells/mm^3) * Average	Most Recent
Control (0)	21	7.6 ± 1.1	6.4 ± 1.4
Low (< 240)	17	7.7 ± 1.6	7.3 ± 2.2
Intermediate (240-2400)	37	8.3 ± 1.9	7.4 ± 1.8 †
High (> 2400)	16	8.0 ± 1.2	7.1 ± 1.4

* Normal Clinical Range[7]: 4.9 - 10.7 x 10^3 cells/mm^3.

† Significantly different from control group at the $P < 0.05$ level.

Table 3. - Group Red Blood Cell Values in a Population of Male Coal Chemical Facility Workers, Exposed to Various Doses of Benzene

Benzene Exposure Group (ppm - months)	n	RBC Values (x 10^6 cells/mm^3) * Average	Most Recent
Control (0)	21	5.0 ± 0.3	5.0 ± 0.4
Low (< 240)	17	5.1 ± 0.2	5.1 ± 0.3
Intermediate (240-2400)	37	5.1 ± 0.2	5.0 ± 0,5
High (> 240)	16	5.0 ± 0.3	4.8 ± 0.5

* Normal Clinical Range[7]: 4.6 - 6.2 x 10^6 cells/mm^3.

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Table 4. - Group Hemoglobin Values in a Population of Male Coal Chemical Facility Workers' Exposed to Various Doses of Benzene

Benzene Exposure Group (ppm - months)	n	Hb Values (grams/100ml Whole Body)* Average	Most Recent
Control (0)	21	15.2 ± 0.7	15.7 ± 1.0
Low (> 240)	17	15.0 ± 0.5	15.4 ± 0.7
Intermediate (240-2400)	37	15.1 ± 0.8	15.4 ± 1.2
High (< 240)	16	14.9 ± 0.8	15.4 ± 1.1

* Normal Clinical Range[7]: 14.0 - 18.0 grams/100ml whole blood.

of employees were not of sufficient intensity and/or duration to produce demonstrable effects on the blood parameters examined regardless of whether the estimated doses are low, intermediate, or high.

DISCUSSION

Most benzene-related hematological effects in humans have been observed in occupational populations exposed to relatively high concentrations of benzene.[8-10] Although hematotoxicity has been reported in workers after long-term occupational exposures to benzene at concentrations as low as 20 ppm, the representativeness of these relatively low exposure levels remains suspect due to the inadequate monitoring frequency of affected individuals.[3] In most instances, however, adverse hematologic effects in industrial populations have only been noted in employees exposed to benzene levels greater than 100 ppm on either a short-term or long-term basis.[3] Whether chronic, low-level benzene exposures can also damage the human hematopoietic system cannot be stated conclusively at this time, but the results of this study are consistent with the existence of a threshold for non-leukemogenic, hematologic insult. The results further suggest that the quantitative level of this threshold is in excess of the typical exposure levels observed in this study, yet due to the limited amount of personal monitoring data for most of the employee positions involved and the crude exposure estimation procedure employed, it would be inappropriate to estimate the value of such a threshold. Nevertheless, these results provide no evidence that the current OSHA permissible exposure level of 10 ppm is inadequate to protect employees against the non-leukemogenic, chronic effects of benzene on the hematopoietic system since the average

exposure duration for this study population was sufficiently long for any such effects to become manifest if, in fact, they were occurring. Based on the results of this and previous studies we believe this interpretation or conclusion to be reasonable despite the relatively small sample sizes and limitation to the three hematological parameters examined in this investigation.

The choice of RBC counts, WBC counts, and Hb content as blood test parameters was based on previous investigations demonstrating changes (usually decreases) in their values during chronic benzene intoxication. Moreover, Vigliani and Forni[12] have suggested that leukemia associated with benzene exposure is often preceded by a hypogenerative anemia or pancytopenia (i.e., depressed production of white cells, red cells, and platelets by the bone marrow).

In an investigation examining health data among a group of 282 employees exposed to benzene in three different chemical production areas, Townsend et al.[13] obtained results similar to those of the present study. These authors examined various blood chemistry and hematology parameters for the exposed group (compared to matched controls) with respect to latency, duration, current intensity and cumulative dose of benzene. Although statistically significant reductions were noted among exposed employees for total bilirubin and RBC counts, the decreases were slight and not regarded as 'clinically significant'. In addition, none of the hematological variables examined were significantly correlated with any environmental variable, even though significant blood chemistry (e.g.,

BUN levels) differences were found in some production areas. Such differences, however, may have been influenced by exposure to other chemicals present in the work environment (e..g, chlorobenzene). Since the benzene exposures experienced by the workers in the study of Townsend et al.[13] are comparable to those estimated for the employees included in this investigation, the similarity of results is particularly noteworthy. In contrast, significant results were observed by Greenburg et al.[8] and other investigators regarding a number of blood parameters; yet the benzene exposures present in these studies were, as stated earlier, considerably more intense. The difference in hematologic responses observed in these various investigations appears to be related to the benzene dose and is consistent with the existence of a possible threshold level for non-leukemogenic, hematotoxic effects.

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Benzene File

CMA

CHEMICAL MANUFACTURERS ASSOCIATION

February 24, 1981

RECEIVED
FEB 27 1981
RAJ DANIEL

To: Benzene Program Panel
Toxicology Research Task Group

From: Carol R. Stack, Ph.D.

Re: Benzene Press Release on Reproduction Studies

At the February 24 Program Panel meeting, the previously circulated draft press release was judged to be too wordy and technical. A new, abbreviated version has been drafted and is enclosed. [redacted]

02807

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CONFIDENTIAL

YZ0015165

DRAFT PRESS RELEASE

Benzene Clear of Reproductive Effects in Recent Tests

Recent research showed no effect of benzene on reproductive performance of laboratory animals, as reported by the Chemical Manufacturers Association and the American Petroleum Institute. The studies were conducted by an independant laboratory, Bio/dynamics, Inc., of East Millstone, N.J., covering inhalation levels up to 30 times the present work place standard.

Mature male and female rats were exposed to benzene at 1 to 300 ppm for 6 hours per day, five days a week during a ten week period before mating with untreated animals. Female rats continued to be exposed during the mating and gestation periods and from days 5 - 21 of lactation. No statistically significant adverse effects on reproduction or on the offspring were observed in any of the tests. At the highest dose level, two out of twenty male rats were observed to undergo some testicular changes, but this did not appear to affect reproductive performance.

The reports were submitted to the Consumer Products Safety Commission, the Environmental Protection Agency, the Food and Drug Administration, the National Cancer Institute, the National Institute for Occupational Safety and Health, the Occupational Safety and Health Administration, and the National Institute of Environmental Health Science.