

Anecdotal Health-Related Complaint Data Pertaining to Possible Exposures to Methyl Tertiary Butyl Ether (MTBE): 1993 and 1994 Follow-up Surveys (1984–1994)

Health and Environmental Sciences Department
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- ❖ To counsel customers, transporters and others in the safe use, transportation and disposal of our raw materials, products and waste materials.
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- ❖ To commit to reduce overall emission and waste generation.
- ❖ To work with others to resolve problems created by handling and disposal of hazardous substances from our operations.
- ❖ To participate with government and others in creating responsible laws, regulations and standards to safeguard the community, workplace and environment.
- ❖ To promote these principles and practices by sharing experiences and offering assistance to others who produce, handle, use, transport or dispose of similar raw materials, petroleum products and wastes.

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1993 and 1994 Follow-up Surveys (1984–1994)

Health and Environmental Sciences Department

API PUBLICATION NUMBER 4623

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ABSTRACT

The oxygenate methyl tertiary butyl ether (MTBE) is frequently added to gasoline during the winter driving season to reduce carbon monoxide (CO) emissions from motor vehicles and is frequently used in reformulated gasoline. In 1992, the U.S. Environmental Protection Agency (EPA) began receiving anecdotal health-related complaints allegedly associated with exposures to MTBE. In early 1993, EPA began planning a series of clinical research studies to investigate the validity of these claims. As part of its response, the American Petroleum Institute (API) promptly conducted an informal survey of API member companies to acquire their anecdotal complaint data relating to MTBE. A second survey was conducted in 1994. State petroleum council staff were also asked to poll state agencies for complaints received by state government. This report describes the development and administration of these surveys and provides a summary of their data.

The original and follow-up member company survey questionnaires were sent to industrial hygienists at 18 API member companies. Health-related MTBE complaint data allegedly associated with 71 occupational and 13 non-occupational MTBE exposures was compiled. Symptoms such as headaches, dizziness, nausea, and respiratory tract irritation are relatively common in the reported data. These symptoms are consistent with those complaints previously received by EPA. Additional symptoms, such as vomiting, fainting and diarrhea, were rarely reported. The relationship between these symptoms and MTBE exposure is unclear.

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Section 1

INTRODUCTION

The oxygenate methyl tertiary butyl ether (MTBE) is frequently added to gasoline during the winter driving season to reduce carbon monoxide (CO) emissions from motor vehicles and is frequently used in reformulated gasoline. In 1992, the U.S. Environmental Protection Agency (EPA) began receiving anecdotal complaints of headaches, nausea, dizziness, and other symptoms allegedly associated with exposure to MTBE. In early 1993, EPA began planning a series of clinical research studies to investigate the validity of these claims. As part of its response, the American Petroleum Institute (API) promptly conducted four surveys to acquire data relating to measured exposures to MTBE and to investigate anecdotal health-related complaints.

- The Occupational Exposure Survey: a survey of member companies to obtain their data on measured occupational MTBE exposures.
- The Company Complaint Survey: a survey of 18 member companies to obtain data on health-related complaints related to MTBE they had received prior to May 1993.
- Company Complaint Follow-up Survey: During the 1993-94 oxygenated fuel season, API conducted a survey of the same 18 companies to acquire the most recent data relating to health-related complaints allegedly related to MTBE exposures (through April 30, 1994, the close of the winter oxygenate program season).
- The State Complaint Survey: a survey of API state petroleum council directors and the officers of allied oil and gas associations to obtain data on any health-related complaints associated with possible exposures to MTBE they learned about from their respective states.

This introduction provides a brief description of each of the surveys. The remainder of the report provides more detailed descriptions of the complaint surveys. The procedures and results of the Exposure Survey have been described in detail in API Publication 4622.

During the Occupational Exposure Survey, IT Air Quality Services (ITAQS) sent a questionnaire to 17 API member companies. The survey produced a database listing over 1,800 separate exposure events. Each event was characterized by MTBE concentration, facility type and location, employee occupation, sample type (personnel or area), MTBE source, measurement location, exposure duration, and control equipment present. All data collected by the Exposure Survey related to employee exposures. None of the data related to specific complaints collected by the two company complaint surveys described below.

During the 1993 Company Complaint Survey, ITAQS sent a questionnaire requesting complaint data to industrial hygienists at 18 API member companies. Each respondent was asked to describe all complaints related to possible MTBE exposure which the company received between January 1, 1988 and April 30, 1993 (the close of the 1992-93 oxygenate season). Respondents were not asked to evaluate the reported complaints.

During the State Complaint Survey, API sent a questionnaire to 10 API state directors and to 11 state officers of allied oil and gas associations requesting that they seek data from their respective state governments on MTBE complaints. Appendix D of this report provides an overview of this survey and a copy of the survey questionnaire. Two survey respondents indicated that their states did not have oxygenated fuels programs. Three respondents stated that no MTBE-related complaints had been received. The responses of the remaining questionnaire recipients are summarized in Appendix D.

In the 1994 follow-up Company Complaint Survey, ITAQS sent a second questionnaire to the same 18 API member companies who received the original questionnaire. Each respondent was asked to describe complaints allegedly related to MTBE exposure which the company received between May 1, 1993 and April 30, 1994 (the close of the 1993-94 oxygenate season). Consistent with the original company complaint survey, respondents were not asked to evaluate the reported complaints.

The original 1993 Company Complaint Survey acquired data on 61 employee complaints and 9 customer complaints which listed a total of 149 individual symptoms. The 1994 follow-up Company Complaint Survey obtained a total of 42 symptoms, which were noted in 10 employee complaints and 4 customer complaints. Consequently, a total of 71 employee complaints and 13 customer complaints (listing a total of 191 individual symptoms) were collected by the two surveys. The two surveys also acquired data on the complainant's gender, age, and type (worker or consumer); exposure location; and probable MTBE source. The 1993 survey also requested data on medical treatment received (if any) and asked whether or not the alleged exposure incident was reported to a state or federal agency. The 1994 follow-up complaint survey made an additional request for any monitoring data related to the alleged exposure incident. ITAQS developed a database listing all data acquired through the two surveys, including a few complaints which were reported prior to the specified start date of January 1, 1988.

The remainder of this report provides a more detailed description of the two Company Complaint Surveys. It includes a copy of each survey questionnaire, discusses the selection of survey recipients, and describes the follow-up procedures employed used to increase response rate. The presentation of preliminary data given at July 1993 EPA workshop is included as Appendix E. The report concludes with a statistical analysis of the data acquired by the two surveys.

Section 2

QUESTIONNAIRE DISTRIBUTION AND FOLLOW-UP

The original 1993 survey questionnaire (Appendix A) requested that the respondent provide 10 data items for each complaint together with a brief description of the complaint. During March and April of 1993, API contacted 18 member companies to identify potential recipients for the complaint survey. The final version of the survey was transmitted on May 19, 1993 by API to industrial hygienists at each of the 18 API member companies. Each company was asked to return the completed forms and supplemental data by May 28, 1993.

ITAQS made telephone follow-up calls on June 8, 9, and 24, 1993. Consistent with guidance received from API, the final due date for completed complaint surveys was set for July 2, 1993. By July 2, 1993, 17 of the 18 recipient companies had replied giving a response rate of approximately 94 percent. Of the companies that responded, 13 submitted detailed complaint data and 4 indicated that they had no complaints.

The 1994 follow-up survey questionnaire (Appendix B) is similar to the original questionnaire except that it does not request data on any medical treatment associated with each complaint, or inquire if the alleged exposure incident was reported to a state or federal agency. The follow-up survey also differed from the original survey in that it requested any monitoring data available for a complaint. In January 1994, API re-contacted the 18 member companies who received the original questionnaire to identify recipients for the follow-up questionnaire. API transmitted the questionnaire to each of the 18 API member companies on February 9, 1994. Each company was asked to return the completed forms and supplemental data by May 31, 1994.

ITAQS made telephone follow-up calls periodically during the months of May and June 1994. By July 1, 1994, all 18 recipient companies had replied giving the follow-up survey a response rate of 100 percent. Of the companies that responded, 8 submitted detailed complaint data and 10 indicated that they had no additional complaints. No monitoring data were received from the 18 member companies.

Section 3

COMPLAINT SURVEY DATABASE DEVELOPMENT

The company complaint data collected during the two survey portions of this study consisted of 84 completed questionnaire forms. ITAQS reviewed these forms and developed a common data format applicable to all respondents. The resulting data were collected in a database suitable for statistical analysis. This database consists of the 20 data items listed in Table 3-1.

Table 3-1. Data Items in the MTBE Complaint Survey Database.

Item	Data item	Item	Data item
1	Company Name	11	Type of Exposure
2	API Category	12	Symptom: Headache
3	Month of complaint	13	Symptom: Dizziness
4	Day of complaint	14	Symptom: Nausea
5	Year of complaint	15	Symptom: Vomiting
6	Subject Gender	16	Symptom: Breathing Difficulty
7	Subject Age	17	Symptom: Other
8	State	18	Treatment Received
9	Nature of the Complaint	19	Was Incident Reported?
10	Likely Exposure Source	20	Total Number of Symptoms

Appendix C provides tables with frequency distributions for the database entries appearing under each data item. With the exception of one data item ("API

Category"), the categories listed in each table are self-explanatory. API Category is a single descriptor which indicates likely MTBE source, facility type, and subject type.

The API categories used in this study are defined as follows:

1. MTBE production: All refinery and chemical plant manufacturing personnel handling neat MTBE.
2. MTBE fuel blending, neat MTBE only: All personnel involved in the handling of neat MTBE during fuel blending activities;
3. MTBE fuel blending, fuel mixtures only: All personnel involved in the handling of fuel mixtures of MTBE during fuel blending activities;
4. MTBE transportation, neat MTBE only: All personnel involved in the transport of neat MTBE, which includes barging, pipeline, trucking, and rail car personnel;
5. MTBE transportation, fuel mixtures only: All personnel involved in the transport of fuel mixtures of MTBE, which includes barging, pipeline, and rail car personnel;
6. MTBE distribution, fuel mixtures only: All marketing terminal and trucking personnel involved in the handling of fuel mixtures of MTBE;
7. MTBE refueling, fuel mixtures only: All service station and retail outlet personnel;
10. Customers refueling: All customers performing refueling activities;
11. Customers other: All customers performing activities other than refueling;

Analysts from ITAQS examined each complaint and assigned it to the most appropriate API category. In cases where the API category could not be clearly assigned, ITAQS deferred the assignment decision to API, relying on their industry's best judgment and recognizing the uncertainties associated with this approach.

Section 4

COMPLAINT SURVEY DATA ANALYSES AND DISCUSSION

The two company complaint surveys acquired a total of 84 complaints containing 191 individual symptoms. Employees accounted for 71 complaints (85 percent) containing 154 individual symptoms (81 percent). Consumers accounted for 13 complaints (15 percent) containing 36 individual symptoms (19 percent).

Table 4-1 presents symptom frequencies by symptom category and API category for the combined (1993/1994) complaint surveys. Five of the symptom categories (headaches, dizziness, nausea, vomiting, and breathing difficulty) are identical to specific categories on the questionnaire. The remaining symptoms were categorized as either "respiratory tract irritation" or "other".

Of the symptoms listed in Table 4-1, headache was the most common with 55 complaints. Nausea and dizziness were the second and third most common complaints with 33 and 32 complaints, respectively. Respiratory tract irritation (15 complaints), odor (11 complaints), and breathing difficulty (8 complaints) were the only other complaints filed more than 5 times. Among the relatively serious acute symptoms alleged were vomiting (4 complaints), a pneumonia-like cough (2 complaints), nosebleed (2 complaints), loss of consciousness (1 complaint), diarrhea (1 complaint), and throat swelling (1 complaint). Other complaints were "fluttering" eyes, "clammy" skin, depression, loss of memory and coordination, insomnia, a decrease in cognitive skills and ability to function, sleepiness, melancholy, and slurred speech (one complaint each).

Table 4-1. Updated MTBE Complaint Survey Symptoms.

Employees										
API MTBE Category	Complaint Total	Headache	Dizziness	Nausea	Vomiting	Breath- ing Diffi- culty	Respiratory Tract Irritation	Other ^a	Symptom Total	
MTBE Production	11	4	4	5	2	1	3	3	22	
MTBE Blending, neat	2	2	1	0	0	1	2	0	6	
MTBE Blending, mixed	2	2	0	0	0	0	0	1	3	
MTBE Transportation, neat	7	5	3	4	0	2	1	3	18	
MTBE Transportation, mixed	5	3	1	1	0	2	1	2	10	
MTBE Distribution	31	24	11	9	2	1	4	13	64	
MTBE Refueling	13	10	5	6	0	0	3	7	31	
Employee Total	71	50	25	25	4	7	14	29	154	
Customers										
Vehicle refueling	11	4	7	8	0	1	1	13	34	
Undetermined	2	1	0	0	0	0	0	2	3	
Customer Total	13	5	7	8	0	1	1	15	37	
Survey Total	84	55	32	33	4	8	15	44	191	

^aIncludes: odor (1), "fluttering" eyes (1), miscellaneous complaint (1), pneumonia-like cough (2), tingling/numbness in lips and tongue (1), red dots on arms (1), reddening of skin (1), loss of consciousness (1), "clammy" skin (1), left work due to undescribed symptoms (1), blurred vision (1), fatigue (2), "burning" sensation in eyes and throat (1), diarrhea (1), depression (1), allergic reaction (2), loss of memory and coordination (1), insomnia (1), swelling in the hands (1), decrease in cognitive skills and ability to function (1), eye irritation (1), sleepiness (1), melancholy (1), numbness (1), skin rash (1), slurred speech (1), heart palpitations (1), nosebleed (2), burning in throat and upper chest (1), throat swelled (1).

A chi-squared test was applied to the entries in Table 4-1 to determine whether there were any significant associations between the API categories and the reported symptom categories. The analysis produced a p value (level of significance) equal to 0.3531, indicating that there are no significant associations.

Table 4-2 presents symptom frequencies by symptom category and API category for the 1992-1993 oxygenated fuel season (a subset of the combined complaint surveys). The most frequently reported symptoms were headache, nausea, and dizziness, with 33, 16, and 14 complaints, respectively. Respiratory tract irritation (10 complaints), and odor (7 complaints) were the only other complaints filed more than 5 times. Vomiting (2 complaints), a pneumonia-like cough (1 complaint), loss of consciousness (1 complaint), and diarrhea (1 complaint) were among the additional acute symptoms alleged.

Table 4-3 presents symptom frequencies by symptom category and API category for the 1993-1994 oxygenated fuel season (a subset of the follow-up complaint survey). Of the symptoms reported, nausea was the most common with 6 complaints, while dizziness and headache were the second and third most common complaints with 5 and 4 complaints, respectively. Among the additional acute symptoms were vomiting (1 complaint), respiratory tract irritation (1 complaint), and nosebleed (1 complaint).

Returning to Table 4-1, the API category MTBE distribution (fuel) applied to 31 complaints or 37 percent of all complaints. The MTBE refueling (fuel) category applied to 13 complaints or approximately 16 percent of the complaints received. The MTBE production and customer refueling (fuel) categories were each associated with 11 complaints or approximately 13 percent of the complaints received. All other API categories contain between one and eight complaints.

Table 4-2. October 1992 Through April 1993 Oxygenated Fuel Season Only.

Employees										
API MTBE Category	Complaint Total	Headache	Dizziness	Nausea	Vomiting	Breath- ing Diffi- culty	Respiratory Tract Irritation	Other ^a	Symptom Total	
MTBE Production	9	3	3	4	2	1	3	3	19	
MTBE Blending, neat	0	0	0	0	0	0	0	0	0	
MTBE Blending, mixed	0	0	0	0	0	0	0	0	0	
MTBE Transportation, neat	1	1	0	0	0	0	0	0	1	
MTBE Transportation, mixed	2	2	0	0	0	0	0	0	2	
MTBE Distribution	21	15	8	4	0	1	4	7	39	
MTBE Refueling	11	9	3	6	0	0	3	6	27	
Employee Total	44	30	14	14	2	2	10	16	89	
Customers										
Vehicle refueling	5	3	0	2	0	0	0	4	9	
Undetermined	1	0	0	0	0	0	0	1	1	
Customer Total	6	3	0	2	0	0	0	5	10	
Survey Total	50	33	14	16	2	2	10	21	99	

^aIncludes: odor (7), "fluttering" eyes (1), miscellaneous complaint (1), pneumonia-like cough (1), tingling/numbness in lips and tongue (1), red dots on arms (1), reddening of skin (1), loss of consciousness (1), left work due to undescribed symptoms (1), blurred vision (1), fatigue (1), "burning" sensation in eyes and throat (1), diarrhea (1), sleepiness (1), melancholy (1).

Table 4-3. October 1993 Through April 1994 Oxygenated Fuel Season Only.

Employees										
API MTBE Category	Complaint Total	Headache	Dizziness	Nausea	Vomiting	Breath- ing Diffi- culty	Respiratory Tract Irritation	Other ^a	Symptom Total	
MTBE Production	0	0	0	0	0	0	0	0	0	
MTBE Blending, neat	0	0	0	0	0	0	0	0	0	
MTBE Blending, mixed	0	0	0	0	0	0	0	0	0	
MTBE Transportation, neat	0	0	0	0	0	0	0	0	0	
MTBE Transportation, mixed	1	0	0	0	0	0	0	1	1	
MTBE Distribution	2	2	0	1	1	0	0	1	5	
MTBE Refueling	1	0	1	0	0	0	0	1	2	
Employee Total	4	2	1	1	1	0	0	3	8	
Customers										
Vehicle refueling	2 ^b	1	4	5	0	0	1	1	12	
Undetermined	1	1	0	0	0	0	0	1	2	
Customer Total	3 ^b	2	4	5	0	0	1	2	14	
Survey Total	7	4	5	6	1	0	1	5	22	

^aIncludes: Slurred speech (1), nosebleed (1), skin rash (1), fatigue (1), and odor (1).

^bOne complaint reported symptoms from four passengers in the same vehicle.

While MTBE had been present in lower concentrations in many fuels for a number of years, during the early 1990s, the use of an increased amount of oxygenates in fuels to reduce CO emissions from automobiles during the colder months of the year was implemented throughout much of the United States. The majority of the complaints (77 percent) collected by the two surveys were received between September and February (Figure 4-1) when oxygenated fuel use is at its maximum. Approximately 83 percent of the complaints were also received during 1992, 1993, and 1994 (Figure 4-2) rather than from the previous years (1984 to 1991).

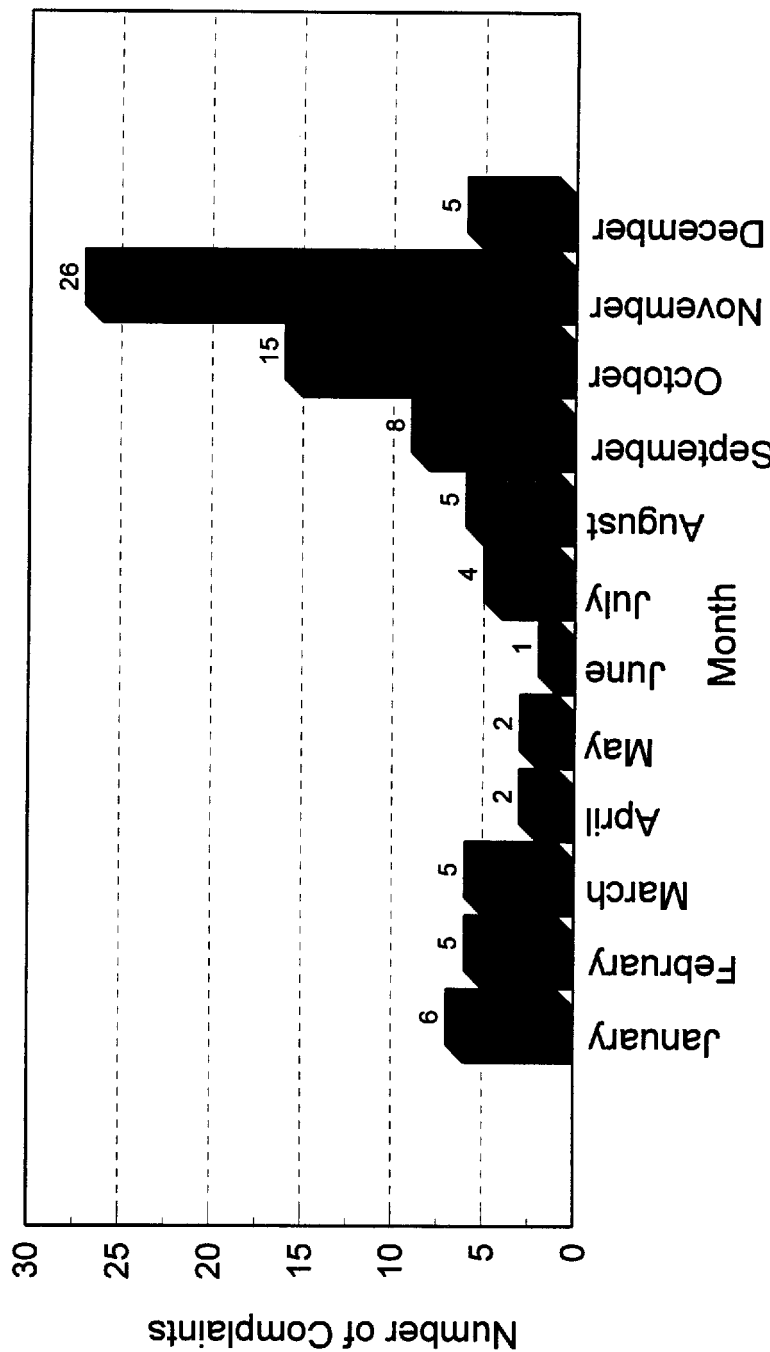
Figure 4-3 is a summary of occupational complaints collected by the two surveys by month from January 1, 1992 through April 30, 1994. During 1992 there were a total of 42 complaints with the majority falling in the months of October (14 complaints) and November (21 complaints). During 1993 there were a total of 15 complaints with the majority falling in the months of January (4 complaints), February (3 complaints), and September (3 complaints). Between January 1 and April 30, 1994 there were a total of two complaints: one in February and one in March.

Of the companies participating, member companies in California received the highest number of complaints (29) of any state. California accounted for 35 percent of all the complaints (Figure 4-4). Companies in New Jersey received 19 complaints (23 percent). All other states received between one and seven complaints.

Approximately 94 percent of the complaints collected by both surveys were health related (Table C-7 located in Appendix C). The remaining 6 percent of the complaints pertained to a combination of health and non-health related symptoms.

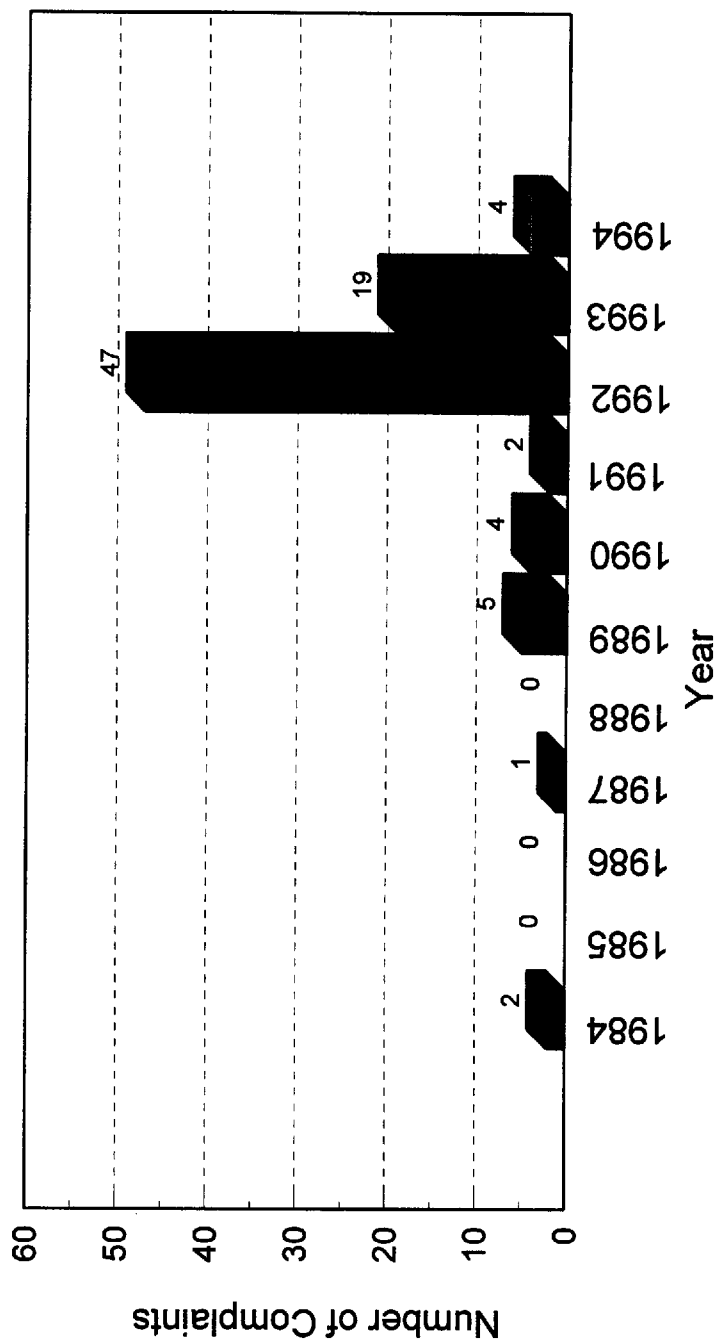
Table C-8 located in Appendix C presents a frequency of the MTBE source information obtained by the two complaint surveys. Of the complaints reported, 34 (41 percent) were reported or interpreted by API as likely to reflect truck drivers involved in fuel transfer activities. Employees and consumers involved in refueling activities were interpreted to account for 22 complaints (26 percent).

Figure 4-1
MTBE Health Complaints by Month
Reported by API Member Company Survey Participants



API Company Surveys - May 1993 and 1994

Figure 4-2
MTBE Health Complaints by Calendar Year
Reported by API Member Company Participants



API Company Surveys - May 1993 and 1994

Figure 4-3

Occupational Complaints by Month

(January 1992 - April 1994)

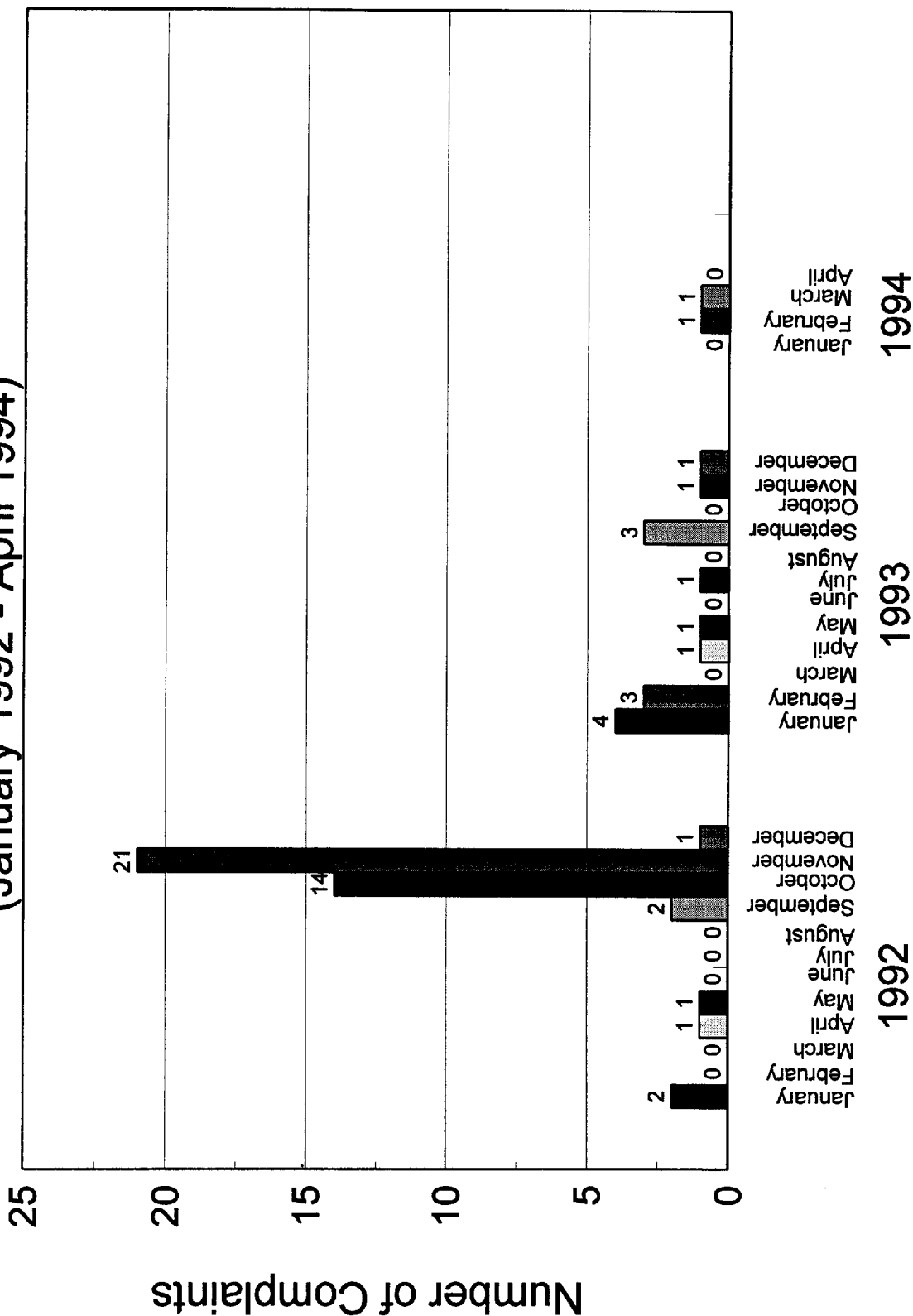
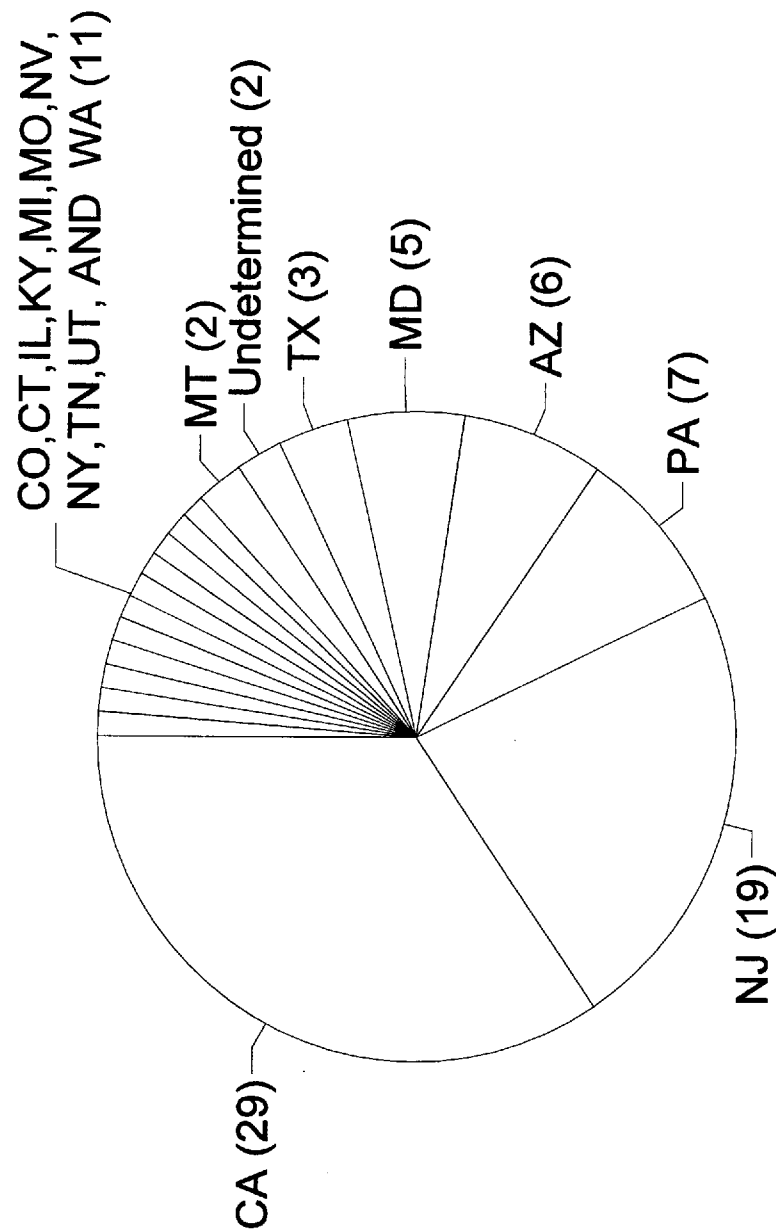


Figure 4-4
MTBE Health Complaints by State
Reported by API Member Company Survey Participants



API Company Surveys - May 1993 - 1994

Approximately 19 percent of the complaints (16) fell in the other/non-specific source category. Of the remaining source categories, each contained between one and six complaints.

As noted in Table C-9 of Appendix C, employees accounted for 85 percent of the complaints collected by the two surveys, while consumers accounted for 15 percent. About 16% of the complainants in the initial 1993 survey were known to receive medical treatment. The question was not asked during the 1994 survey (Table C-10). None of the complaints, obtained by the two surveys, were known to have been reported to the state government. Four percent were known to have been reported to the federal government, and the reporting status of 96 percent of the complaints was either unknown or not reported (Table C-11).

Section 5

REFERENCES

IT Corporation (ITAQS, a Division of IT Corporation; M. McCoy and T. Johnson, authors). 1995. *Petroleum Industry Data Characterizing Occupational Exposures to Methyl Tertiary Butyl Ether (MTBE)*. API Publication Number 4622. American Petroleum Institute, Washington, D.C.

APPENDIX A

ORIGINAL MTBE COMPLAINT SURVEY QUESTIONNAIRE

EXAMPLES: API MTBE Survey #2 (Health Complaints) May, 1993

The American Petroleum Institute is collecting information on consumer and worker health effects complaints associated with MTBE or with fuels containing MTBE. For each complaint that has come to your attention regarding your company's facilities or products, please provide the information requested. Please include only complaints containing accounts of health effects symptoms. At the top of each column, codes are provided for each response. Simply circle the appropriate code for each response box and provide any supplementary information not included in the coded response in a brief summary of the complaint. If complaints on more than one date were received from the same person, please mark as cases 1A, 1B, etc. Circle as many column choices as apply and add any further details in the space provided below. Two hypothetical examples are provided below. If you have any question concerning this survey, please contact: Inez vanArsdall (ITAQS) at (919) 493-3661; Jim Vall (API) at (202) 682-8305 or Will Ollison (API) at (202) 682-8262. Please return the completed forms to Inez vanArsdall, IT Corporation, South Square Centre One, Suite 201, 3710 University Drive, Durham, NC 27701. FAX (919) 493-1773.

RESPONDENT NAME Joe Smith COMPANY Jones Oil Company 1 PAGE OF 3 PAGES
TELEPHONE (713) 555-1234 DATE 5-28-93 Attention: Inez vanArsdall

Complaint #	Date of Complaint	Sex	Age	Complaint Exposure Location	Nature of Complaint	Exposure Source	Type of Exposure	Health Effects	Treatment(s)	Reported to State-Federal Government by Affected Person?
1	11-9-93	M	?	S - (State) Is Affected Person a State Resident? 1 - yes 2 - no 3 - ?	1 - Health effect only 2 - Both a health & non-health complaint made	1 - Gas Station Refueling 2 - Driving Automobile 3 - Tanker Truck Fuel Transfer Operations 4 - Ship/Barge Fuel Transfer 5 - Ref. Process Upset/ 6 - Ref. Process Upset/ 7 - Storage Tank Sampling 8 - Storage Tank Cleaning 9 - Other (specify below)	1 - Consumer 2 - Occupational 3 - Both	1 - Headache 2 - Dizziness 3 - Nausea 4 - Vomiting 5 - Breathing difficulty 6 - Other (describe below)	1 - First aid 2 - nurse 3 - MD 4 - hospital/emergency 5 - hospital/non-emerg. 6 - other (describe) 7 - none 8 - ?	1 - state 2 - fed 3 - no 4 - ?
2	2-10-93	F	39	S - TX 1 - 2 - 3	1 - 2	1 2 3 4 5 6 7 8 9	1 2 3	1 2 3 4 5 6	1 2 3 4 5 6 7 8	1 2 3 4

Briefly describe the health related complaint (including a description of symptoms, severity, and recurrence/duration of symptoms):
Customer complained to service station owner about higher prices, and that the smell of the "new" gasoline made her "sick to her stomach". She also complained of occasional mild headaches by the time she had finished driving to work.

Briefly describe the health related complaint (including a description of symptoms, severity and recurrence/duration of symptoms):
Tanker truck driver complained of occasional headaches after finishing deliveries to service stations on his route. He also mentioned having more frequent "sore throats" during the last winter.

RESPONDENT NAME _____ COMPANY _____ page of _____ pages
 TELEPHONE _____ DATE _____ Attention: Inez vanArsdall

Complaint #	Date of Complaint	Sex	Age	Complaint Exposure Location	Nature of Complaint	Exposure Source	Type of Exposure	Health Effects	Treatment(s)	Reported to State-Federal Government by Affected Person?
		M F		S (State) Is Affected Person a local Resident? 1 - yes 2 - no 3 - ?	1 - Health effect only 2 - Both a health & non health complaint made	1 - Gas Station Refueling 2 - Driving Automobile 3 - Tanker Truck Fuel Transfer Operations 4 - Ship/Barge Fuel Transfer 5 - Ref. Process Upset/Turnaround Maintenance 7 - Storage Tank Sampling 8 - Storage Tank Cleaning 9 - Other (specify below)	1 - Consumer 2 - Occupational 3 - Both	1 - Headache 2 - Dizziness 3 - Nausea 4 - Vomiting 5 - Breathing difficulty 6 - Other (describe below)	1 - First aid 2 - nurse 3 - MD 4 - hospital/emergency 5 - hospital/non-emerg. 6 - other (describe) 7 - none 8 - ?	1 - state 2 - fed. 3 - no 4 - ?
Briefly describe the health related complaint (including a description of symptoms, severity, and recurrence/duration of symptoms):										
		M F		S 1 2 3	1 2	1 2 3 4 5 6 7 8 9	1 2 3	1 2 3 4 5 6	1 2 3 4 5 6 7 8	1 2 3 4
Briefly describe the health related complaint (including a description of symptoms, severity and recurrence/duration of symptoms):										

APPENDIX B

FOLLOW-UP MTBE COMPLAINT SURVEY QUESTIONNAIRE

B-1

Examples: API MTBE Survey #2 (Health Complaints) Spring, 1994

The American Petroleum Institute is collecting information on consumer and worker health effects complaints associated with MTBE or fuels containing MTBE. For each complaint that has come to your attention regarding your company's facilities or products, please provide the information requested. Please include only complaints containing accounts of health effects symptoms. At the top of each column, codes are provided for each response. Simply circle the appropriate code for each response box and provide any supplementary information not included in the coded response in a brief summary of the complaint. If complaints on more than one date were received from the same person, please mark as cases 1A, 1B, etc. Circle as many column choices as apply and add any further details in the space provided below. A hypothetical example is provided below. Under the column "Exposure Source", we are using the categorization adopted by API in its presentation at the July 1993 MTBE Workshop. Here, the term, "transportation" means the movement of neat MTBE or the blended fuel by tank wagon or tank truck. We are requesting some additional data. If you have exposure data relevant to the specific complaint, please indicate what this is on the last column on the form or the description section below it. Please describe the nature of the data and its relationship to the complaint. We would appreciate copies of the data itself as well. If you have any question concerning this survey, please contact: Ted Johnson (ITAQS) at (919) 493-3661; Jim Vail (API) at (202) 682-8305 or Will Ollison (API) at (202) 682-8262. Please return the completed forms to Ted Johnson, IT Corporation, South Square Centre One, Suite 201, 3710 University Drive, Durham, NC 27701. FAX (919) 493-1773.

RESPONDENT NAME Joe Smith COMPANY Jones Oil Company DATE 2-15-94 ATTENTION: Ted Johnson
TELEPHONE (713) 555-1234 1 PAGE OF 3 PAGES

Complaint #	Date of Complaint	Sex	Age	Complaint Exposure Location	Nature of Complaint	Exposure Source	Type of Exposure	Job Category - If occupational exposure (describe below)	Health Effects	Associated MTBE Monitoring Data, if Available (describe below - please attach copies of the data)
1	1-12-94	MF	?	SNJ 1 2 3	1 - Health effect only 2 - Both a health & non-health complaint made	1 - Transporting Neat MTBE 2 - Blending Neat MTBE 3 - Service Station MTBE/Fuel Mix 4 - Transporting MTBE/Fuel Mix 5 - Manufacturing - Maintenance 6 - Distributing 7 - Manufacturing - Routine 8 - Blending MTBE/Fuel Mix 9 - Other (specify below)	1 - Consumer 2 - Occupational 3 - Both		1 - Headache 2 - Dizziness 3 - Nausea 4 - Vomiting 5 - Breathing difficulty 6 - Other (describe below)	NO

Briefly describe the health related complaint (including a description of symptoms, severity, and recurrence/duration of symptoms and any relevant exposure data):

Sample: Customer complained to service station owner about higher prices, and that the smell of the "new" gasoline made her "sick to her stomach". She also complained of an occasional mild headache driving after refueling. No exposure data available.

RESPONDENT NAME _____ COMPANY _____ PAGE OF _____ PAGES
 TELEPHONE _____ DATE _____ Attention: Ted Johnson

Complaint #	Date of Complaint	Sex	Age	Complaint Exposure Location	Nature of Complaint	Exposure Source	Type of Exposure	Job Category - If occupational exposure (describe below)	Health Effects	Associated MTBE Monitoring Data, if Available (describe below - please attach copies of the data)
		M F		S - (State) Is Affected Person a State Resident? 1 - yes 2 - no 3 - ?	1 - Health effect only 2 - Both a health & non-health complaint made	1 - Transporting Near MTBE 2 - Blending Near MTBE 3 - Service Station 4 - Transporting MTBE/Fuel Mix 5 - Manufacturing - Maintenance 6 - Distributing 7 - Manufacturing - Routine 8 - Blending MTBE/Fuel Mix 9 - Other (specify below)	1 - Consumer 2 - Occupational 3 - Both		1 - Headache 2 - Dizziness 3 - Nausea 4 - Vomiting 5 - Breathing difficulty 6 - Other (describe below)	
<p>Briefly describe the health related complaint (including a description of symptoms, severity, and recurrence/duration of symptoms and any relevant exposure data):</p>										
		M F		S - 1 2 3	1 2	1 2 3 4 5 6 7 8 9	1 2 3		1 2 3 4 5 6	
<p>Briefly describe the health related complaint (including a description of symptoms, severity, and recurrence/duration of symptoms):</p>										

B-3

APPENDIX C

FREQUENCY ANALYSES

COMBINED (1993/1994) COMPANY COMPLAINT SURVEYS

Table C-1. Frequency distribution of API category (OLLICAT). [best estimates]

Response	Frequency	
	n	Percent
1: MTBE production	11	13.1
2: MTBE blending-neat MTBE	2	2.4
3: MTBE blending-fuel mixtures	2	2.4
4: MTBE transport-neat MTBE	7	8.3
5: MTBE transport-fuel mixtures	5	6.0
6: MTBE distribution (fuel)	31	36.9
7: MTBE refueling (fuel)	13	15.5
10: Customer refueling (fuel)	11	13.1
11: Customer unknown	2	2.4
Missing	0	0
Total	84	100

Table C-2. Frequency distribution of month (MONTH).

Response	Frequency	
	n	Percent
1: January	6	7.1
2: February	5	6.0
3: March	5	6.0
4: April	2	2.4
5: May	2	2.4
6: June	1	1.2
7: July	4	4.8
8: August	5	6.0
9: September	8	9.5
10: October	15	17.9
11: November	26	31.0
12: December	5	6.0
Missing	0	0
Total	84	100.0

Table C-3. Frequency distribution of year (YEAR).

Response	Frequency	
	n	Percent
1984	2	2.4
1987	1	1.2
1989	5	6.0
1990	4	4.8
1991	2	2.4
1992	47	56.0
1993	19	22.6
1994	4	4.8
Missing	0	0
Total	84	100.0

Table C-4. Frequency distribution of subject gender (SEX).

Response	Frequency	
	n	Percent
1: Male	55	65.5
2: Female	14	16.7
Missing	15	17.8
Total	84	100.0

Table C-5. Frequency distribution of subject age (AGE).

Response	Frequency	
	n	Percent
1: 24 years of age	1	1.2
2: 26 years of age	1	1.2
3: 28 years of age	1	1.2
4: 32 years of age	1	1.2
5: 33 years of age	1	1.2
6: 34 years of age	1	1.2
7: 35 years of age	1	1.2
8: 38 years of age	1	1.2
9: 41 years of age	1	1.2
10: 44 years of age	1	1.2
11: 45 years of age	1	1.2
12: 48 years of age	2	2.4
13: 52 years of age	1	1.2
14: 53 years of age	2	2.4
15: 60 years of age	1	1.2
16: 61 years of age	1	1.2
Missing	63	78.4
Total	84	100.0

Table C-6. Frequency distribution of state (STATE).

Response	Frequency	
	n	Percent
4: Arizona	6	7.1
6: California	29	34.5
8: Colorado	1	1.2
9: Connecticut	1	1.2
17: Illinois	1	1.2
21: Kentucky	1	1.2
24: Maryland	5	6.0
26: Michigan	1	1.2
29: Missouri	1	1.2
30: Montana	2	2.4
32: Nevada	1	1.2
34: New Jersey	19	22.6
36: New York	1	1.2
42: Pennsylvania	7	8.3
47: Tennessee	1	1.2
48: Texas	3	3.6
49: Utah	1	1.2
53: Washington	1	1.2
Missing	2	2.4
Total	84	100.0

Table C-7. Frequency distribution of nature of complaint (NATURE).

Response	Frequency	
	n	Percent
1: Health effects only	79	94.0
2: Health and non-health effects	5	6.0
Missing	0	0
Total	84	100.0

Table C-8. Frequency distribution of estimated MTBE exposure source (EXPSRCE).

Response	Frequency	
	n	Percent
1: Gas station refueling	22	26.2
3: Truck fuel transfer	34	40.5
4: Ship/barge fuel transfer	2	2.4
5: Refinery process operation	1	1.2
6: Refinery process upset/turnaround maintenance	1	1.2
7: Storage tank sampling	2	2.4
8: Storage tank cleaning	6	7.1
9: Other/non-specific	16	19.0
Missing	0	0
Total	84	100.0

Table C-9. Frequency distribution of type of exposure (TYPEEXP).

Response	Frequency	
	n	Percent
1: Consumer	13	15.5
2: Occupational	71	84.5
Missing	0	0
Total	84	100.0

Table C-10. Frequency distribution of treatment received (TREATMENT).*

Response	Frequency	
	n	Percent
1: First aid	1	1.2
3: Doctor	5	6.0
4: Hospital emergency room	2	2.4
5: Hospital non-emergency room	2	2.4
6: Other	1	1.2
7: None	21	25.0
8: Unknown	38	45.2
Missing	14	16.7
Total	84	100.0

* Question only asked in initial 1993 survey.

Table C-11. Frequency distribution of complaint history (REPORTED).

Response	Frequency	
	n	Percent
2: Reported to Federal Government	3	3.6
3: Not reported	32	38.1
4: Unknown	35	41.7
Missing	14	16.7
Total	84	100.0

APPENDIX D
STATE QUESTIONNAIRE AND COMPLAINT SURVEY

Table D-1. Classification of complaints received by the State Complaint Survey.

State agency or petroleum council	Number of oxygenated fuel complaints	Number of health-related complaints	Number of odor-related complaints	Number of other complaints (costs, mileage, etc.)	Number of complaints related to MTBE
Alaska	349	100	Remainder ^a	Remainder ^a	349
Arkansas Petroleum Council	No oxygenated fuels program	NA	NA	NA	NA
Colorado Air Pollution Control Division	< 50	2	1	All other calls	1
Connecticut	21	1	3 - 4	16	Unknown
Maryland State Motor Fuel Tax Division	0	0	0	0	0
Maryland Department of The Environment	20 - 25	0	5 or less	15 - 20	20 - 25
Montana Department of Health	< 10	Unknown	Unknown	Unknown	Unknown
Montana, Missoula County Health Department	30	15	30 ^b	15 ^c	Unknown
New Jersey	21	4	14 ^c	3	6
New Mexico	No oxygenated fuels program	NA	NA	NA	NA
New York State Petroleum Council and New York State Department of Health	14	4	10	0	14

(continued)

Table D-1 (Continued)

State agency or petroleum council	Number of oxygenated fuel complaints	Number of health-related complaints	Number of odor-related complaints	Number of other complaints (costs, mileage, etc.)	Number of complaints related to MTBE
North Carolina Petroleum Council	11,000 ^d	5	30 (a few dozen)	250 (several hundred)	30 (a few dozen)
Ohio Environmental Protection Agency	250	3	7	240	3 or more
Pennsylvania	4-5 calls and 1 letter	1	0	2	2
Utah	52	3	0	49	1
Utah Petroleum Association	60 - 70	0	5	55 - 60	5
Virginia Department of Health	0	0	0	0	0
Virginia Department of Agriculture and Consumer Services	0	0	0	0	0

^aRemainder of calls were grouped into the odor and other category in unknown proportions.

^bAlways mentioned when complaints were registered.

^cRemainder of unaccounted for complaints.

^dIn 1992-1993, North Carolina's Division of Environmental Management (DEM) provided a toll-free hotline which featured pre-recorded information about the oxygenated fuel program. From a total of 11,000 calls, only 500 requested a follow-up call from DEM. According to DEM staff, most callers were seeking information and not making complaints. Essentially all the calls were about vehicle performance and fuel costs, not health (D. Redmond to W. Weatherspoon, NC Petroleum Council, August 1995).

State: _____
 Your Name: _____
 Your Phone Number: _____

SURVEY OF OXYGENATED FUELS COMPLAINTS FILED WITH STATE AGENCIES

If more than one agency provided the information, please complete one form for each agency and indicate the name(s) and telephone number(s) of the state agency contacts that supplied the information on page 2 of this form.

1. How many people either called or wrote to complain about the oxygenated fuels program during the 1992-1993 winter season (November 1992 to the present)

If none, please skip to question #4

2. Of these, how many people complained about

A. Health issues (e.g. headache, nausea, skin and/or eye irritation, coughing, etc.)

B. Odor _____

C. Other issues (e.g. fuel costs, mileage, etc.) ? _____

3. Can you determine which of these individuals were complaining specifically about Methyl Tertiary Butyl Ether (MTBE)?

No _____

Yes _____

If yes, about how many individuals complained about MTBE _____ or _____%

If complaint information cannot be categorized as above, please describe below what information was compiled by the agency.

4. Is there additional written information e.g., summaries, complaint details, complaint logs, etc., that is available to supplement the information provided? If available, please attach a copy.

Additional information attached?

_____ yes _____ no
 _____ pending

If pending, please estimate when you expect the information will be received:

5. What is the name and telephone number of the state employee providing the information for this survey?

Name _____

Phone Number _____

Can IT contact this individual directly regarding the information provided?

_____ yes _____ no

Please send your completed forms and any related written information directly to Ms. Inez vanArsdall by June 25, 1993 at:

International Technology Corporation
 South Square Corporate Centre One, Suite 201
 3710 University Drive
 Durham, North Carolina 27707
 Phone (919) 493-3661, FAX (919) 493-1773

APPENDIX E

PRESENTATION OF PRELIMINARY MTBE COMPLAINT FINDINGS TO EPA CONFERENCE ON MTBE AND OTHER OXYGENATES: A RESEARCH UPDATE, JULY 26-28, 1993, FALLS CHURCH, VA

PLEASE NOTE: This presentation is based on an incomplete data set; i.e., 16 of the 17 companies that submitted data for the original survey. The follow-up survey was conducted after this presentation and its results are not included here.

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E-2

American Petroleum Institute Health Complaint Survey.
Gerhard K. Raabe, Dr.P.H., Mobil Corporation

The American Petroleum Institute (API) initiated a number of studies during the 1992/93 oxygenate season in response to the unanticipated consumer complaints being reported from Alaska and the news media in several other states. Two of these studies were surveys of health complaints. One survey was conducted to assemble in some detail health complaints received by API member companies. The second survey polled State Petroleum Councils and State Offices of Health, Environment or Transportation to whom consumers were likely to complain if they objected to MTBE's odor or claimed adverse health effects.

In the API member company survey 18 US gasoline producers, including a number of the largest companies, received a questionnaire to be completed for every health complaint received. The questionnaire requested date, location, demographic, exposure and health related information.

As of July 9, 1993 sixteen companies have responded. Sixty one occupational complaints and nine consumer complaints were reported. The small number of consumer complaints reflects reporting limitations from retail service stations. Most retail service stations in the United States are operated by independent businessmen and are exempted from maintaining records of health complaints. Health complaints received by the API member companies from their employees are more accurately recorded because of company recording systems put in place in part to satisfy TSCA recording obligations. Because of these difference in reporting, only the occupational complaint data were reviewed in detail.

Over seventy percent of the employee complaints came from California, New Jersey and Pennsylvania. One can only speculate on the possible reasons for this observation, but it is interesting to note that New Jersey and Pennsylvania had significant media coverage regarding MTBE and California accounts for a significant percentage of US gasoline consumption.

Over seventy percent of the complaints were recorded in 1992 even though production of MTBE as a gasoline additive had not grown significantly over the four year period 1989 through 1992.

When occupational complaints were examined by month, the significant majority of complaints occurred in October and November at the beginning of the oxygenate season. This is an unusual pattern for an occupationally exposed group. Manufacturing and transportation workers would have experienced significant MTBE exposure months earlier than the

G. K. Raabe Abstract Con't.
Page -2-

official start date for the oxygenate program. This may suggest factors other than actual MTBE exposure may have influenced the complaint rate.

Headache, dizziness and nausea accounted for the majority of the symptoms reported. Complaints were further grouped by worker exposure class and contrasted with exposure data summarized in the API Exposure Survey. The number of complaints appears to be unrelated to both average short term exposures and average time weighted average exposures.

In summary API member companies reported very few complaints from their employees. Examination of these complaints suggests factors other than (or in addition to) MTBE exposure may have influenced the reporting of complaints.

In the second survey 14 of the 21 States with oxygenated fuels programs responded with information on their complaint experience. Although some States received hundreds, and in one State thousands, of calls about the oxygenated fuels program only Alaska experienced more than a few health complaints.

Overall API member companies and State agencies received relatively few MTBE related complaints. Alaska's experience remains inexplicable when contrasted with the vastly larger population exposed in the remainder of the US.

American Petroleum Institute Health Complaint Survey

Gerhard K. Raabe, Dr.P.H., M.S.
July 27, 1993

Complaint Survey

18 Companies Surveyed
(Representing 60.3% of US Gasoline Sales)

16 Responded as of July 9, 1993
(Representing 55.5% of US Gasoline Sales)

Complaint Survey Questions

Date of Complaint

Sex

Age

State

Nature of Complaint

Exposure Source

Occupational vs. Consumer

Health Effect

-Headache -Vomiting

-Dizziness -Breathing Difficulty

-Nausea -Other (described)

Treatment (if any)

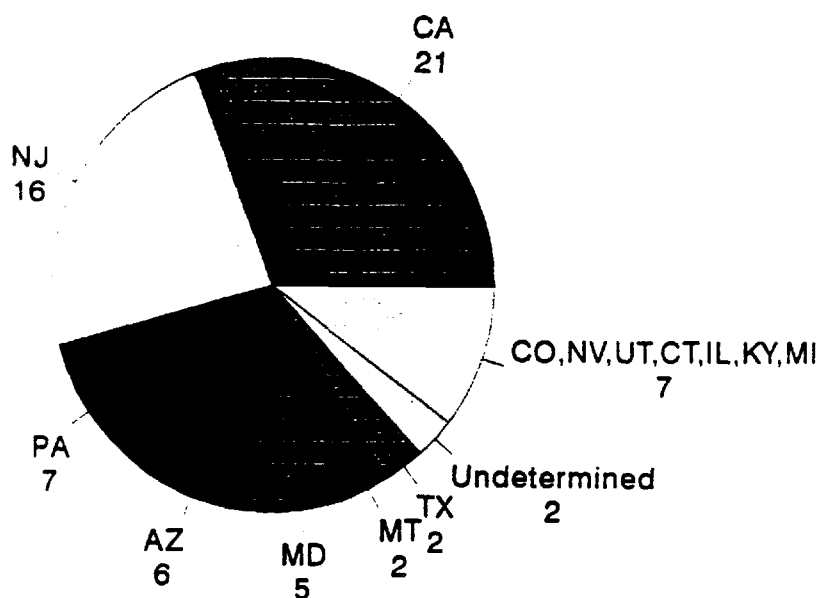
Reported to State or Federal Govt.

Complaint Summary

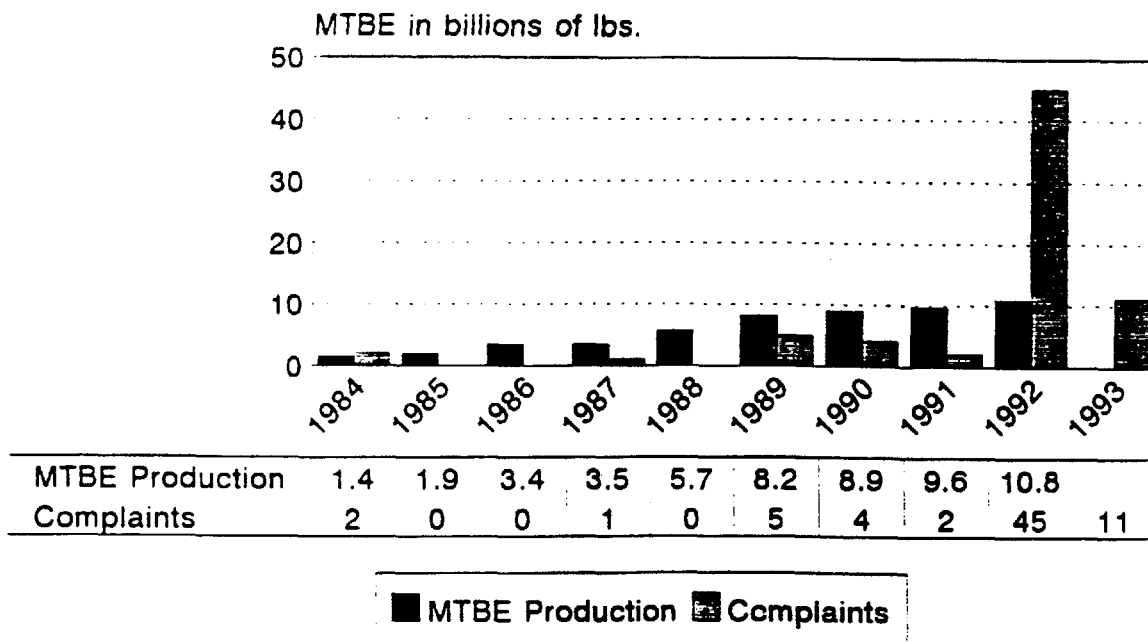
61 Occupational Complaints
(Representing 130 categories)

9 Consumer Complaints
(Representing 19 categories)

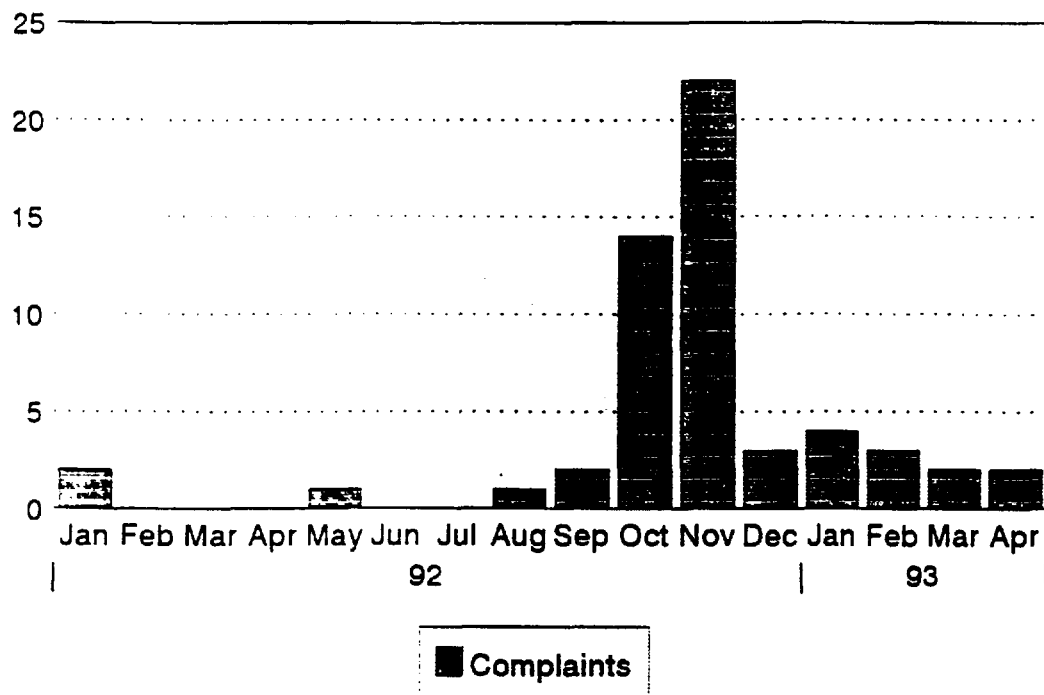
Occupational Complaints by State



Occupational Complaints and MTBE Production by Year



Occupational Complaints by Month



Complaints by Exposure Source

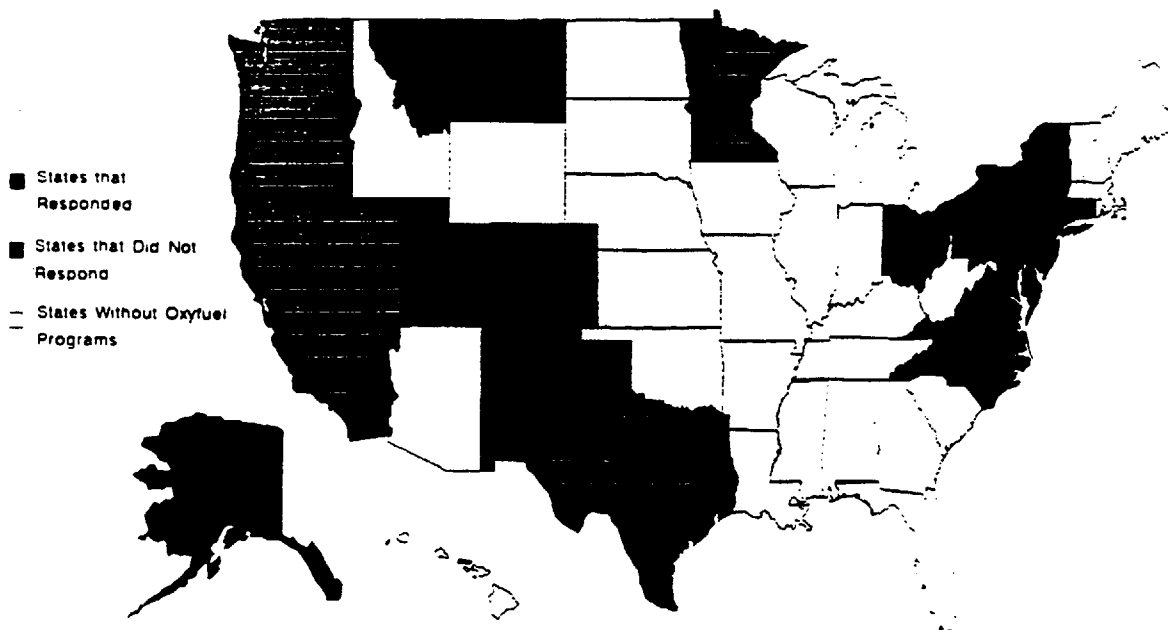
Source	Total	Headache	Dizziness	Nausea	Vomiting	Breathing Difficulty	Other
MTBE Manufacturing	11	4	4	5	2	1	6
Blending, Neat	2	2	1	0	0	1	2
Blending, Mixed	2	2	0	0	0	0	1
Trans., Neat	7	5	3	4	0	2	4
Trans., Mixed	4	3	1	1	0	2	2
Distribution	24	18	9	5	0	1	12
Service Station	11	10	4	5	0	0	8
Total	61	44	22	20	2	7	35

Occupational Settings and Complaints Ranked by Exposure Potential

	ppm G.M. Short Term	ppm G.M. TWA	Total Complaints
Transporting Neat MTBE	11.0	0.24	7
Blending Neat MTBE	5.1	0.58	2
Service Station	4.7	0.77	11
Trans., MTBE/Fuel Mix	3.3	0.13	4
Manufacturing-Maintenance	1.0	0.14	-----
Distribution	0.85	0.13	24
Manufacturing-Routine	0.84	0.06	11
Blending MTBE/Fuel Mix	0.58	0.10	2

State Oxygenate Complaint Survey

Responding States in the MTBE State Survey



Survey of Complaints Received by States

State & Agency	Number of Oxygenated Fuel Complaints	No. of Complaints Related to MTBE	Number of Health Complaints
Alaska	349	349	100
Arkansas Petroleum Council	No oxygenated fuels program	NA	NA
Colorado Air Pollution Control Division	<50	1	2
Connecticut	21	unknown	1
Maryland State Motor Fuel Tax Div.	0	0	0
Maryland Dept. of the Environment	20-25	20-25	0

Survey of Complaints Received by States (Continued)

State & Agency	Number of Oxygenated Fuel Complaints	No. of Complaints Related to MTBE	Number of Health Complaints
Montana Department of the Environment	< 10	unknown	unknown
MT, Missoula County Health Department	30	unknown	15
New Jersey	21	6	4
New Mexico	No oxygenated fuel program	NA	NA
New York State Petro. Council and New York State Dept. of Health	14	14	4

Survey of Complaints Received by States (Continued)

State & Agency	Number of Oxygenated Fuel Complaints	No. of Complaints Related to MTBE	Number of Health Complaints
North Carolina Petroleum Council	11000	30 (a few dozen)	5
Ohio Environmental Protection Agency	250	3 or more	3
Pennsylvania	4-5 calls & 1 letter	2	1
Utah	52	1	3
Utah Petroleum Assoc.	60 - 70	5	0
Virginia Dept. of Health	0	0	0
Virginia Dept. Agricul. of & Consumer Services	0	0	0

RELATED API PUBLICATIONS ...

- | | |
|------------|---|
| Publ. 4553 | Gasoline Vapor Exposure Assessment at Service Stations,
March, 1993 |
| Publ. 4592 | Odor Threshold Studies Performed with Gasoline and
Gasoline Combined with MTBE, ETBE and TAME,
January 1994 |
| Publ. 4619 | A Study to Characterize Air Concentrations of MTBE
at Representative Service Stations in the Northeast,
April, 1994 |
| Publ. 4622 | Petroleum Industry Data Characterizing Occupational
Exposures to MTBE: 1983-1993, August, 1995 |
| Publ. 4625 | Service Station Personnel Exposures to Oxygenated Fuel
Components, August, 1995 |

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