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DEPARTMENT OF THE NAVY
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NAVAL FACILITIES ENGINEERING COMMAND
NORFOLK, VIRGINIA 23511

TELEPHONE NO.
444-7313
AUTOVON 690-7313
IN REPLY REFER TO:
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18 JUL 1980

From: Commander, Atlantic Division, Naval Facilities Engineering Command
To: Distribution

Subj: Trihalomethanes in drinking water

Ref: (a) 40 CFR Part 141, Federal Register, Vol. 44 of 29 Nov 1979

Encl: (1) Summary of Trihalomethanes Regulations
(2) "Questions and answers concerning the regulation of organic contaminants in drinking water with special emphasis on Trihalomethanes" - EPA's final draft

1. In compliance with requirements of the Safe Drinking Water Act, the Environmental Protection Agency (EPA) published final regulations in reference (a) for the control of total Trihalomethanes (TTHM) as an amendment to the National Primary Drinking Water Standards. Enclosure (1) is a complete summary of the monitoring and reporting requirements of the regulations.

2. The regulations establish a maximum contaminant level (MCL) of 0.10 mg/l for TTHM's, including chloroform, that are introduced into drinking water by the reaction of naturally occurring substances with chlorine in the course of water treatment. Hence, an EPA publication containing various questions and answers concerning regulation of the subject contaminant is forwarded for your information and use (enclosure (2)).

3. Guidance pertaining to the initiation of a sampling/monitoring program at impacted naval activities for TTHM will be provided by this Command at a later date. Questions regarding this matter may be directed to Wallace Carter, commercial (804) 444-7313 or AUTOVON 690-7313.

ANDRES TALTS
By direction

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SUMMARY OF TTHM REGULATIONS

Maximum Contaminant Level (MCL): 0.10 mg/l (100 micrograms per liter) Total Trihalomethanes

Applicability: Community water systems that add disinfectant to the treatment process (ground and surface)

Effective:
- Systems >75,000: 2 years after promulgation
- Systems 10-75,000: 4 years after promulgation
- Systems <10,000: State discretion

Monitoring requirements: Running annual average of a minimum of 4 samples per quarter per plant taken on same day. Systems using multiple wells drawing raw water from a single aquifer may, with State approval, be considered one treatment plant for determining the required number of samples.

Effective:
- Systems >75,000: 1 year after promulgation
- Systems 10-75,000: 3 years after promulgation
- Systems <10,000: State discretion

Sample Locations: 25% at extreme of distribution system; 75% at locations representative of population distribution.

Frequency:

For groundwater systems, reduced monitoring may be appropriate for certain systems; States may reduce the requirements through consideration of appropriate data including demonstration by the system that the maximum total trihalomethane potential (MTP) is less than 0.10 mg/l; the minimum frequency would be one sample per year for MTP.

For ground water systems not meeting the above MTP and for surface water systems, States may reduce the monitoring requirements if after one year of data collection, TTHM levels are consistently below 0.10 mg/l; the minimum frequency would be one sample per quarter for TTHM.

The original frequency would be reinstated if the levels exceed 0.10 mg/l or if the treatment or source is modified.

Reporting Requirements:

To State: Average of each quarterly analysis, within 30 days; until States have adopted the regulations, reporting will be to EPA unless State requests receipt of data from the public water systems.

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To Public and State: Running annual average of each quarterly sample if it exceeds MCL as prescribed by the public notification provisions.

Other Requirements:

To ensure microbiological quality: State approval of significant modifications in the treatment process for the purpose of meeting the TTHM MCL.

Analytical requirements: In accordance with specified methods (purge and trap or liquid/liquid extraction) conducted by certified laboratories.

Other Issues of Interest: Guidance on alternative disinfectants

- Conduct monitoring when chlorine dioxide is used and residual oxidants should not exceed 0.5 mg/l.
- The decision of using chloramines is best made on a case-by-case basis by the State.
- Standard plate count should be a condition for State approval of systems where process modifications are contemplated.

Laboratory Availability (interim certification):

- To qualify for interim certification. Laboratories will be required to demonstrate their ability to analyse the performance evaluation samples provided to them by EPA's Environmental Monitoring and Support Laboratory (EMSL) to within 20% of the "true value" for each THM as well as the total.
- A quality assurance program will be established to ensure a laboratory's ability to perform quality analyses.

FINAL DRAFT

DRAFT

QUESTIONS AND ANSWERS

CONCERNING THE

U. S. Environmental Protection Agency

REGULATION OF ORGANIC CONTAMINANTS

IN

DRINKING WATER

WITH SPECIAL EMPHASIS

ON

TRIHALOMETHANES

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Office of Research & Development
U.S. Environmental Protection Agency
Cincinnati, Ohio

January 28, 1980

TABLE OF CONTENTS

FOREWORD

This document had its genesis as the author's input to an Ad Hoc Committee of the Water Quality Division of American Water Works Association, of which he is a member. The charge to the Committee was to develop informational material about the new USEPA Regulation for Trihalomethanes in Drinking Water and related topics that the AWWA could distribute to water utilities and other interested members.

When my contribution to the Committee was completed, many of the USEPA reviewers (listed in the Acknowledgments) both in Cincinnati and at EPA Headquarters, thought that we should make this information directly available to interested parties. We hope this material will aid in your understanding of the Regulation. If you would like to distribute this to others, additional copies are available from the author at 26 West St. Clair Street, Cincinnati, Ohio 45268.

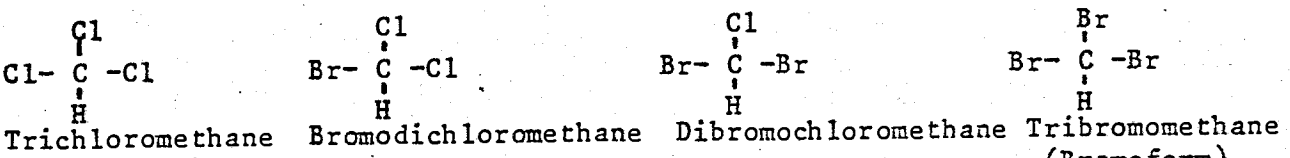
QUESTIONS AND ANSWERS CONCERNING THE REGULATION OF ORGANIC CONTAMINANTS IN DRINKING WATER WITH SPECIAL EMPHASIS ON TRIHALOMETHANES

QUESTIONS RELATED TO TRIHALOMETHANES

GENERAL QUESTIONS

1) WHAT ARE TRIHALOMETHANES?

ANSWER: They are members of a group of organic chemicals that contain a single carbon atom, one hydrogen atom, and three halogen (chlorine, bromine, or iodine, or a mixture) atoms. Other halogens are not significant in this context. The structural formulas of the four common trihalomethanes are shown below:



Trichloromethane (Chloroform) | Bromodichloromethane | Dibromochloromethane | Tribromomethane (Bromoform)

2) HOW ARE TRIHALOMETHANES FORMED?

ANSWER: Trihalomethanes are formed during drinking water chlorination by the reaction of free chlorine with organic compounds in the water, frequently called "trihalomethane precursors" or just "precursors".(1) Trihalomethanes are often called "chlorination by-products".

Chlorine + Precursors ---> Trihalomethanes

3) WHAT ARE PRECURSORS?

ANSWER: Most often precursors are organic compounds produced from decaying vegetation, humic and fulvic acids. These are frequently called "natural" organics. "Synthetic" or man-made organics are not usually trihalomethane precursors.

4) IS LIQUID/GASEOUS CHLORINE MORE LIKELY TO FORM TRIHALOMETHANES THAN SODIUM OR CALCIUM HYPOCHLORITE?

ANSWER: No. Whenever a free chlorine residual exists in water, trihalomethanes will be created if precursors are present.

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(1) Stevens, A.A. and Symons, J.M., "Formation and Measurement of Trihalomethanes in Drinking Water," In: Proceedings, Control of Organic Chemical Contaminants in Drinking Water, USEPA, Washington, D.C., In Press.

5) DO DISINFECTANTS OTHER THAN CHLORINE FORM TRIHALOMETHANES?

ANSWER: Neither ozone, chlorine-free chlorine dioxide, nor chloramines will react with precursors to form trihalomethanes. They may, however, form other yet unidentified disinfection by-products. Bromine chloride and iodine will form trihalomethanes when precursors are present.

6) WHEN TRIHALOMETHANES ARE CREATED, IS CHLOROFORM ALWAYS THE TRIHALOMETHANE PRESENT IN THE HIGHEST CONCENTRATION?

ANSWER: No. Any of the four common trihalomethanes (see Question 1) may be present in the highest concentration in a given circumstance. Usually, however, chloroform is present in the highest concentration.

7) WHAT IS THE SOURCE OF THE BROMINE THAT RESULTS IN THE BROMINE-CONTAINING TRIHALOMETHANES?

ANSWER: Bromide is present in the water, and the free chlorine will convert it to bromine species, which will then react with the precursors to form the bromine-containing trihalomethanes. Further, bromine may be present in gaseous chlorine as an impurity.

8) DOES FREE CHLORINE REACT WITH FLUORIDE, NATURAL OR ADDED DURING FLUORIDATION, TO PRODUCE SIMILARLY REACTIVE FLUORINE SPECIES?

ANSWER: No.

9) ARE TRIHALOMETHANES EVER PRESENT IN SOURCE (RAW) WATERS?

ANSWER: Usually not in significant concentrations.

10) ARE OTHER BY-PRODUCTS FORMED DURING CHLORINATION?

ANSWER: Yes. Free chlorine reacts with organic compounds to produce halogen containing organic by-products other than trihalomethanes. Few of these compounds can be identified individually, but they can be measured as a group as "total organic halogen." Oxidation (non-halogen containing) by-products of chlorination generally cannot be measured.

11) WHAT IS THE DANGER OF HAVING TRIHALOMETHANES IN DRINKING WATER?

ANSWER: Chloroform is carcinogenic to test animals and, therefore, is considered a potential human carcinogen. The other trihalomethanes are toxic chemicals and possibly carcinogenic.

12) ARE PRECURSORS THEMSELVES DANGEROUS IN DRINKING WATER?

ANSWER: Probably not. Precursors are significant, however, because of their role in the formation of trihalomethanes and other disinfection by-products. Further, in high concentrations they may cause an objectionable color in water and sometimes taste and odor; also they may act as nutrients for microbiological growth.

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QUESTIONS ABOUT THE REGULATION

13) WHAT TRIHALOMETHANES ARE REGULATED?

ANSWER: Four of the ten possible trihalomethanes, chloroform (trichloromethane), bromodichloromethane, dibromochloromethane, and bromoform (tribromomethane) are regulated. Their concentrations are added together for compliance purposes (total trihalomethanes).(2)

14) WHY ARE THE FOUR TRIHALOMETHANE CONCENTRATIONS ADDED TOGETHER?

ANSWER: Because the four common trihalomethanes are a family of compounds, are formed by similar reactions, are measured by similar techniques, all have some toxic effects, and are controlled by similar treatment techniques, the United States Environmental Protection Agency (USEPA) determined that excluding any of them from the Regulation would be inappropriate. Therefore, their concentrations (in weight per unit volume - ug/L, not micro moles per unit volume) are added together to produce the parameter "total trihalomethanes."

15) WHAT IS THE MAXIMUM CONTAMINANT LEVEL (MCL) FOR TOTAL TRIHALOMETHANES?

ANSWER: 0.10 mg/L

16) ARE CONCENTRATIONS OF 0.10 mg/L (PPM) and 100 ug/L (PPB) IDENTICAL?

$0.10\ mg/l = 1.0 \times 10^{2}\ ug/l$

ANSWER: Not exactly, because they do not contain the same number of significant figures, although they are often loosely used interchangeably.

17) WHY WAS THE MAXIMUM CONTAMINANT LEVEL (MCL) OF 0.10 mg/L CHOSEN?

ANSWER: The USEPA determined that reduction of trihalomethanes to this concentration was technically achievable; that this concentration was a reasonable national standard, taking costs into consideration; and that achieving this concentration would provide health protection to consumers presently using drinking water containing higher concentrations. USEPA encourages utilities to reduce trihalomethane concentrations to as low a value as feasible, however.

18) WHEN WAS THE REGULATION PROMULGATED?

ANSWER: November 29, 1979

19) WHAT UTILITIES ARE COVERED BY THE REGULATION?

ANSWER: Community water systems that serve a population of 10,000 or more individuals and that add a disinfectant (oxidant) to the water in any part of the drinking water treatment process and, at the discretion of the Primacy State, community water systems that serve a population of less than 10,000 individuals. Non-community water systems are not included.

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(2) Federal Register, 44, No. 231, 68624-68707 (Nov. 29, 1979), See Appendix.

20) HOW MANY WATER UTILITIES ARE COVERED BY THE REGULATION?

ANSWER: Approximately 2,700 utilities serving about 167 million people.

21) WHEN IS THE REGULATION EFFECTIVE?

ANSWER: For community water systems serving a population of 75,000 individuals or more, monitoring must start by November 29, 1980 and compliance must be achieved by November 29, 1981. For community water systems serving from 10,000 to 75,000 individuals, monitoring must start by November 29, 1982 and compliance must be achieved by November 29, 1983.

22) WHAT ADMINISTRATIVE GROUP IS RESPONSIBLE FOR CARRYING OUT THE PROVISIONS OF THE REGULATION?

ANSWER: The Regulatory Agency in the States that have been granted Primacy or the USEPA in States that do not have Primacy. Wherever the term "Primacy Agency" is mentioned in this document, the term "Primacy State or USEPA where applicable" should be understood.

23) HAS THE REGULATION BEEN CHALLENGED IN COURT?

ANSWER: Yes. On January 11, 1980 the American Water Works Association together with the City of Englewood, Colorado and the Capital City Water Company, a Missouri corporation, filed a Petition for Review with the U.S. Court of Appeals for the District of Columbia Circuit, asking the court for "review of a final rule" as allowed by Section 1448(a)(1) of the Safe Drinking Water Act (P.L. 93-523). At this writing, January 28, 1980, no action has been taken on this Petition. The closing date for filing such actions was January 14, 1980.

24) WHY WAS THE POPULATION SERVED REDUCED FROM 75,000 to 10,000 FOR INCLUSION IN THE REGULATION?

ANSWER: Most of those who commented on the proposed Regulation,(3) February 9, 1978, said coverage should be broadened to provide the health benefits to as many consumers as possible. The USEPA agreed and increased the coverage from about 50 percent to about 80 percent of the country's population served by community water systems.

25) WHY WERE THE SYSTEMS SERVING LESS THAN 10,000 INDIVIDUALS NOT SELECTED FOR REGULATION AT THIS TIME?

ANSWER: Although about 20 percent of the country's population is served by community water systems of this size, the number of these systems, more than 57,000, made careful supervision to avoid errors during treatment changes almost impossible. Furthermore, many of these systems use ground water and, therefore, probably would not exceed the Maximum Contaminant Level for total trihalomethanes in their drinking water.

(3) Federal Register, 43, No. 28, 5756-5780 (February 9, 1978).

26) WHEN WILL SYSTEMS SERVING LESS THAN 10,000 INDIVIDUALS BE COVERED BY A USEPA REGULATION?

ANSWER: This decision will be made after some experience has been gained in implementing the current Regulation.

27) UNDER WHAT CONDITIONS MIGHT THE MAXIMUM CONTAMINANT LEVEL (MCL) BE LOWERED BELOW 0.10 mg/L?

ANSWER: The MCL will be reconsidered in the National Revised Primary Drinking Water Regulations based upon an updated assessment of technological and economic feasibility, implementation experience and additional toxicological information. Further public comment would be involved in any future decision. Note: The current Trihalomethane Regulation is an amendment to the National Interim Primary Drinking Water Regulations.

28) HOW MANY SAMPLES MUST BE TAKEN TO MEET THE MONITORING REQUIREMENTS?

ANSWER: For each treatment plant in the system at least 4 samples per quarter of a year must be taken. All samples for each quarter must be collected on the same day. With Primacy Agency approval, systems using multiple wells drawing from a single aquifer may be considered to have one treatment plant.

29) WHERE IN THE SYSTEM MUST THE SAMPLES BE TAKEN?

ANSWER: At least 25 percent of the samples must be taken at locations within the distribution system reflecting the maximum residence time of the water in the system. The remainder of the samples may be taken from the central portion of the distribution system. The selection of the sampling points must be approved by the Primacy Agency. Samples taken at the entry point to the distribution system may not be included in the compliance sampling.

30) MAY THE SAMPLING FREQUENCY BE REDUCED IF THE TOTAL TRIHALOMETHANE CONCENTRATIONS IN THE COMPLIANCE SAMPLES ARE ALWAYS WELL BELOW 0.10 mg/L?

ANSWER: Yes. For surface water systems, the Primacy Agency may reduce the sampling frequency to a minimum of one (instead of four) samples per quarter of a year per treatment plant at any time upon written request from the utility when the data for one year show total trihalomethane concentrations to be consistently below 0.10 mg/L. If the total trihalomethane concentration ever exceeds 0.10 mg/L or a change in source or treatment occurs, the original sampling frequency is restored. If only a single sample per quarter of a year is collected, it must be collected near the extremity of the distribution system.

Groundwater systems may request in writing at any time that their sampling frequency be reduced to a minimum of one sample per year per treatment plant if they can demonstrate that the "maximum total trihalomethane potential" (see Question 35) concentration in their drinking water is less than 0.10 mg/L. In such cases, the yearly sample is for the maximum total trihalomethane potential concentration; it is not a regular total trihalomethane sample. Even if the maximum total trihalomethane potential concentration is greater than 0.10 mg/L, groundwater systems may apply to the Primacy Agency for a reduction in sampling frequency to one sample per quarter of a year per treatment plant on the same basis as surface water systems, as described in the previous paragraph. Here again, any single sample must be taken near the extremity of the distribution system.

31) HOW ARE THE COMPLIANCE DATA CALCULATED FOR SYSTEMS WITH ONE TREATMENT PLANT?

ANSWER: For compliance purposes, each individual trihalomethane concentration is calculated in ug/L, rounded to the nearest ug/L or to two significant figures, and then added together to obtain total trihalomethanes. This value is then converted to mg/L to the nearest hundreth. All the samples collected in a quarter are arithmetically averaged and become the one compliance concentration for that quarter. Compliance for any quarter is then calculated by arithmetically averaging the four most recent quarterly concentrations (running annual average). If this running annual average concentration is equal to or less than 0.10 mg/L, the utility is in compliance.

For example:

Quarter	D,J,F*	M,A,M,	J,J,A	S,O,N**	D,J,F	Treatment Change	M,A,M
	<----------Compliance Samples---------->						
	Total Trihalomethane Concentrations, mg/L						
	0.15	0.19	0.14	0.18	0.13		0.02
	0.06	0.17	0.06	0.08	0.05		0.01
	0.05	0.23	0.05	0.07	0.05		0.01
	0.07	0.18	0.09	0.10	0.15		0.03
				0.09			
Average (Quarter) Concentration, mg/L	0.08	0.19	0.09	0.10	0.10		0.02
Running Annual Avg., mg/L	-	-	-	(0.08+0.19+ 0.09+0.10)/4 = 0.12 Out of Compliance	(0.19+0.09+ 0.10+0.10)/4 =0.12 Out of Compliance		(0.09+0.10+ 0.10+0.02)/4 =0.08 In Compliance

*The first quarter begins in December, because the Regulation was promulgated November 29, 1979.
**More than the minimum number of samples collected this quarter.

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32) HOW ARE THE COMPLIANCE DATA CALCULATED FOR A SYSTEM WITH MORE THAN ONE TREATMENT PLANT?

ANSWER: All the samples collected in a quarter from all of the treatment plants are arithmetically averaged and become the one compliance total trihalomethane concentration for that quarter. Compliance for any quarter is then calculated by arithmetically averaging the four most recent quarterly concentrations (running annual average). If this running annual average concentration is equal to or less than 0.10 mg/L, the utility is in compliance.

For example, for two treatment plants in the same system:

Quarter	D,J,F*	M,A,M	J,J,A	S,O,N**	D,J,F	Treatment Change	M,A,M,
	<----------Compliance Samples---------->						
	Total Trihalomethane Concentrations, mg/L						
Plant A	0.07	0.19	0.16	0.18	0.08		0.02
	0.05	0.17	0.18	0.19	0.09		0.02
	0.04	0.23	0.19	0.21	0.07		0.01
	0.11	0.18	0.20	0.23	0.15		0.01
				0.24			
Plant B	0.15	0.16	0.14	0.18	0.13		0.02
	0.06	0.10	0.06	0.08	0.05		0.01
	0.05	0.09	0.05	0.07	0.05		0.01
	0.07	0.11	0.09	0.10	0.08		0.03
				0.09			
Average (Quarter) Concentration, mg/L	0.08	0.15	0.13	0.16	0.09		0.02
Running Annual Avg., mg/L	-	-	-	(0.08+0.15+ 0.13+0.16)/4 =0.13	(0.15+0.13+ 0.16+0.09)/4 =0.13		(0.13+0.16+ 0.09+0.02)/4 =0.10
				Out of Compliance	Out of Compliance		In Compliance

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*The first quarter begins in December because the Regulation was promulgated November 29, 1979.

**More than the minimum number of samples collected this quarter.

33) WHO IS DESIGNAT TO COLLECT THE COMPLIANCE SA ES?

ANSWER: The utility.

34) WHAT ARE THE SAMPLING/SHIPPING/STORAGE REOUIREMENTS FOR REGULAR COMPLIANCE SAMPLES?

ANSWER: Special sampling bottles are required. The samples must be collected in such a manner as to ensure that the bottle is completely full; no bubble. A dechlorinating (reducing) agent, such as sodium thiosulfate, must be added to the bottle prior to sampling. The samples should be analyzed within 14 days of sampling and need not be refrigerated during storage. Special shipping containers are required - dry ice shall not be used to avoid sample breakage from freezing. Note: See Question 35 for techniques to be used for the special Maximum Total Trihalomethane Potential Test.

35) HOW IS THE SPECIAL MAXIMUM TOTAL TRIHALOMETHANE POTENTIAL TEST PERFORMED?

ANSWER: In general, this parameter is determined by storing a sample without adding a dechlorinating (reducing) agent in a closed container for 7 days at 25°C or above, then adding a dechlorinating agent, and then measuring the total trihalomethane concentration. To be a valid test, a disinfectant residual must be present in the sample at the end of the storage period. This is determined from a duplicate stored sample to which no dechlorinating agent is added.

36) WHAT ANALYTIC PROCEDURES MAY BE USED TO MEASURE THE TRIHALOMETHANES?

ANSWER: A gas chromatographic technique is used to measure the trihalomethanes, with two variations of the basic method being approved by the USEPA. These are frequently called the "Purge and Trap" and the "Liquid-Liquid Extraction" methods.

37) IS A MASS SPECTROMETER REQUIRED FOR THE TRIHALOMETHANE DETERMINATION?

ANSWER: No. The gas chromatographic detectors required are "a halide specific" detector for the Purge and Trap method and a "linearized electron capture" detector for the Liquid-Liquid Extraction method.

38) MUST PRECURSORS BE MEASURED FOR COMPLIANCE?

ANSWER: No.

39) WHO IS DESIGNATED TO ANALYZE THE NECESSARY TRIHALOMETHANE SAMPLES REOUIRED TO SATISFY THE REGULATION?

ANSWER: Any laboratory either "interim approved" by USEPA or certified by a Primacy State. The USEPA is in the process of developing a certification program for the trihalomethane analysis.

40) WHAT IS THE COST OF ONE TOTAL TRIHALOMETHANE ANALYSIS?

ANSWER: Costs at commercial laboratories vary. The USEPA has estimated the annual monitoring cost to be about $800 per utility, which, for the minimum 16 samples per year, is about $50 per analysis. The USEPA expects these costs to decline in the future. Some Primacy States may not charge or may reduce the cost for the utilities in that State.

41) WHAT IS THE COST OF THE ANALYTIC EQUIPMENT TO MEASURE TRIHALOMETHANES?

ANSWER: Equipment costs vary, but $8,000 to $15,000 is the probable range for the necessary analytic equipment, installed in an existing laboratory.

42) WHAT ACCURACY IS REQUIRED IN THE MEASUREMENT OF TRIHALOMETHANES?

ANSWER: To be approved, a laboratory must be able to measure a standard trihalomethane quality control sample supplied by the USEPA to within $\pm$ 20 percent of the true value for each trihalomethane and the total trihalomethanes.

43) WHAT ARE THE REPORTING REQUIREMENTS?

ANSWER: All compliance data must be reported to the Primacy Agency.

44) WHEN MUST THE PUBLIC BE NOTIFIED OF A VIOLATION?

ANSWER: Whenever the running annual average total trihalomethane concentration, calculated as outlined in the answer to Questions 31 and 32, exceeds 0.10 mg/L.

45) HOW MANY UTILITIES MIGHT NEED TO CHANGE THEIR TREATMENT BECAUSE THEY EXCEED THE MAXIMUM CONTAMINANT LEVEL?

ANSWER: The USEPA estimates that only about 20 percent of the 2,700 utilities presently included in the Regulation might have to alter their treatment scheme to comply with the Maximum Contaminant Level. The USEPA expects that the first year of monitoring data from the other 80 percent of the utilities presently included in the Regulation will show the annual average concentration of total trihalomethanes in their drinking water to be less than 0.10 mg/L.

46) WHO DECIDES WHAT TECHNIQUES SHOULD BE USED TO LOWER THE TRIHALOMETHANE CONCENTRATION, IF THAT IS REQUIRED?

ANSWER: The utility, with the approval of the Primacy Agency, and, in many cases, with the aid of a consulting engineer.

47) IS GRANULAR ACTIVATED CARBON ADSORPTION THE REQUIRED TREATMENT TECHNIQUE FOR TRIHALOMETHANE CONTROL?

ANSWER: No.

48) WHAT ARE THE TREATMENT OPTIONS?

ANSWER: Two general approaches exist for controlling trihalomethanes: (one), continue to chlorinate, but remove precursor material prior to chlorination and (two), use a disinfectant that does not produce trihalomethanes. (4) Several options exist in the first category:

- Move the point of application of chlorine to as late in the treatment train as practical so that as much precursor as possible is removed prior to chlorination. Note: Reduction of chlorine dose is also often helpful.

- If chlorine is applied after coagulation (softening)/ settling, improve those processes to optimize precursor removal.

- Use off-stream storage for precursor removal.

- Use an adsorbent, either powdered activated carbon or granular activated carbon, for precursor removal prior to chlorination.

- Select an alternative source of water containing less precursor.

- Use a combination of the above.

In the second (alternative disinfectant) category, because neither chloramines, chlorine-free chlorine dioxide, nor ozone form trihalomethanes, these disinfectants may be substituted for chlorine to effect a reduction in total trihalomethane concentration.

(4) Symons, J.M., "Utilization of Various Treatment Unit Processes and Treatment Modifications for Trihalomethane Control," In: Proceedings, Control of Organic Chemical Contaminants in Drinking Water, USEPA, Washington, D.C., In Press.

49) WHAT RESTRICTIONS EXIST ON THE ALTERNATIVE DISINFECTANTS THAT MAY BE USED?

ANSWER: Situations in which ozone, chlorine dioxide, chloramines or other disinfection techniques may be used are at the discretion of the Primacy Agency. The USEPA does suggest, however, that when chlorine dioxide is used, residual oxidants (chlorite, chlorate, chlorine dioxide) should be monitored and kept below a total concentration of 0.5 mg/L. When necessary, USEPA will provide guidance related to analytic methods.

50) DOES BOILING REDUCE THE CONCENTRATION OF TRIHALOMETHANES?

ANSWER: Yes. Although time consuming and energy consuming, boiling for 3 to 5 minutes will drive off most of the trihalomethanes. Note: Simple warming may increase the trihalomethane concentration.

51) ARE HOME TREATMENT DEVICES EFFECTIVE FOR REDUCING THE CONCENTRATIONS OF TRIHALOMETHANES?

ANSWER: Devices that use reverse osmosis (RO) as the treatment principle do not significantly remove trihalomethanes. Devices that use activated carbon (often incorrectly called charcoal) as an adsorbent may be effective, but the adsorptive capacity of some units is limited because the quantity of adsorbent used is too small.

52) WHAT MUST THE UTILITY DO BEFORE IT ALTERS ITS TREATMENT?

ANSWER: Effective November 29, 1979, a utility planning to make any significant modifications in treatment to lower trihalomethane concentrations must submit a plan to the Primacy Agency for approval.* The purpose of this plan is to ensure the maintenance of the microbiological quality of the water during treatment modifications. As a minimum, this plan shall cover:

(1) A sanitary survey of the system,

(2) An evaluation of existing treatment and the proposed modifications,

(3) Baseline water quality data. Such data should include the results from monitoring for coliform and fecal coliform bacteria, fecal streptococci, and standard plate count at 35°C and 20°C, in the distribution system,

(4) Proposed additional monitoring to ensure continued maintenance of optimal microbiological quality in the finished water,

(5) Discussion of the proposed program with respect to an active disinfectant residual throughout the distribution system during and after any treatment changes.

*Note: USEPA intends to provide the Primacy States with further guidance concerning this requirement.

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53) ARE THE REQUIREMENTS FOR MICROBIOLOGICAL MONITORING CHANGED IF TREATMENT IS CHANGED?

ANSWER: This is the decision of the Primacy Agency, but the Regulation suggests additional monitoring, as appropriate, to "assure continued maintenance of optimal biological [sic] quality in finished water."

54) WHAT WILL THE TREATMENT CHANGES COST?

ANSWER: Costs will vary depending on the choice of treatment options. Many utilities have actually saved money by moving the point of chlorination to later in the treatment train because of a reduced chlorine demand. Although chloramines, chlorine dioxide, and ozone are all somewhat more expensive than chlorine, their use would only add about 1 to 3 cents per 1000 gallons to the cost of producing water. Further, coagulation/settling improvements for precursor removal would also be inexpensive. The USEPA estimates that about 95 percent of those utilities that must change their treatment scheme will be able to employ these low cost solutions. In the rare cases where adsorbents must be used for precursor removal, costs would be higher, possibly 10 to 15 cents per 1000 gallons if granular activated carbon adsorption were used.(5) As a national average, considering all possible treatment alternatives, the USEPA has estimated an increase in the annual water bill for a typical family of three to be $1.40 in systems required to practice trihalomethane control.

55) IS MONEY AVAILABLE TO HELP SYSTEMS THAT MUST MAKE TREATMENT CHANGES?

ANSWER: Not from USEPA. Technical assistance is available from the Primacy State and the USEPA Regional Office, see Question 57. Under certain circumstances, some funds are available from the following groups: Department of Agriculture Soil Conservation Service, Corps of Engineers, Economic Development Administration, Housing and Urban Development, Indian Health Service, Power and Water Resources Service (formerly Bureau of Reclamation), Small Business Administration, Office of Water Resources Research in the Department of the Interior, Department of Labor (CETA Program), Office of Revenue Sharing in the Department of the Treasury, and various Regional Commissions. Operator Training support is available through the Department of Education.

56) WHAT SHOULD A UTILITY DO IF IT CANNOT MEET THE DEADLINE?

ANSWER: Under these circumstances the utility should communicate the problem to the Primacy Agency.

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(5) Clark, R.M. and Dorsey, P., "Water Utility Costs for Organics Regulations," Journal American Water Works Association, In Press.

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57) WHERE CAN I OBTAIN MORE INFORMATION?

ANSWER: See the attached bibliography, or for technical assistance contact your State Regulatory Agency, or your USEPA Regional Water Supply Representative (names attached), or call or write to Mr. Lowell Van Den Berg, Director, Technical Support Division, Office of Drinking Water, USEPA, 5555 Ridge Ave., Cincinnati, OH 45268 (513-684-4374) or Mr. Gordon G. Robeck, Director, Drinking Water Research Division, Office of Research and Development, USEPA, 26 W. St. Clair St., Cincinnati, OH 45268 (513-684-7201). For further information on the Regulation call or write Dr. Joseph A. Cotruvo, Director, Criteria and Standards Division, Office of Drinking Water, USEPA, 401 M Street, S.W., Washington, D.C. 20460 (202-472-5016).

QUESTIONS RELATED TO OTHER ORGANIC CONTAMINANTS

58) ARE ANY OTHER ORGANIC CONTAMINANTS IN DRINKING WATER REGULATED?

ANSWER: Yes. Effective June 24, 1978 Maximum Contaminant Levels for the following six pesticides were established:(6)

Endrin	0.0002 mg/L	Toxaphene	0.005 mg/L
Lindane	0.004 mg/L	2,4-D	0.1 mg/L
Methoxychlor	0.1 mg/L	2,4,5-TP (Silvex)	0.01 mg/L

59) WHAT IS THE DIFFERENCE BETWEEN "SYNTHETIC ORGANIC CONTAMINANTS" AND TRIHALOMETHANES?

ANSWER: As most frequently used, the term "synthetic organic contaminants" refers to man-made pollutants in source waters, while trihalomethanes, although synthetic organic contaminants, are treated differently because they are created during the water treatment (disinfection) process. Synthetic organic contaminants are frequently toxic or potentially carcinogenic compounds.

60) WHY WAS A MAXIMUM CONTAMINANT LEVEL (MCL) ESTABLISHED FOR TRIHALOMETHANE CONTROL, BUT A TREATMENT TECHNIQUE, RATHER THAN MCL's, PROPOSED FOR CONTROL OF "SYNTHETIC ORGANIC CONTAMINANTS"?

ANSWER: Monitoring for all of the synthetic organic contaminants found in source waters was not technically feasible. Under these circumstances the Safe Drinking Water Act (P.L. 93-523) allows the USEPA to adopt an alternative regulatory approach. Therefore, the USEPA proposed, on February 9, 1978,(3) The use of a "broad-spectrum" treatment technique that would, at once, control most synthetic organic contaminants at the few locations where organic pollution is judged hazardous.

61) WHAT IS THE STATUS OF THE REGULATION FOR THE CONTROL OF SYNTHETIC ORGANIC CONTAMINANTS?

ANSWER: Because of the objections raised during the public comment period, it may be reproposed for additional public comment sometime in 1980.

62) WHAT ARE USEPA'S PLANS CONCERNING CHLORINATED SOLVENTS, SUCH AS TRICHLOROETHYLENE, FREQUENTLY FOUND IN GROUND WATERS?

ANSWER: This is a significant, newly recognized problem. Preliminary surveys have shown that trichloroethylene and related chlorinated solvents are often present in ground waters in significant concentrations. The USEPA may propose Maximum Contaminant Levels for these compounds in 1980. Most of the compounds discovered thus far can be removed by aeration or adsorption.

(3) Federal Register, 43, No. 28, 5756-5780 (February 9, 1978).
(6) Federal Register, 40, No. 248, 59582 - 59583 (December 24, 1975). See also EPA 570/9-76-003, USEPA, Washington, D.C.

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63) WHAT FUTURE REGULATIONS ARE CONTEMPLATED BY THE USEPA?

ANSWER: The National Interim Primary Drinking Water Regulations may be further amended to include Maximum Contaminant Levels (MCL's) for some of the chlorinated solvents, as well as to include the treatment regulation for the control of general synthetic organic chemicals. Further, the USEPA is required by the Safe Drinking Water Act to promulgate National Revised Primary Drinking Water Regulations. These will require a comprehensive review of all Regulations established thus far.

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Accordingly, Part 141, Title 40 of the Code of Federal Regulations is hereby amended as follows:

1. By amending § 141.2 to include the following new paragraphs (p) through (t):

§ 141.2 Definitions.

* * * * *

(p) "Halogen" means one of the chemical elements chlorine, bromine or iodine.

(q) "Trihalomethane" (THM) means one of the family of organic compounds, named as derivatives of methane, wherein three of the four hydrogen atoms in methane are each substituted by a halogen atom in the molecular structure.

(r) "Total trihalomethanes" (TTHM) means the sum of the concentration in milligrams per liter of the trihalomethane compounds (trichloromethane [chloroform], dibromochloromethane, bromodichloromethane and tribromomethane [bromoform]), rounded to two significant figures.

(s) "Maximum Total Trihalomethane Potential (MTP)" means the maximum concentration of total trihalomethanes produced in a given water containing a disinfectant residual after 7 days at a temperature of 25° C or above.

(t) "Disinfectant" means any oxidant, including but not limited to chlorine, chlorine dioxide, chloramines, and ozone added to water in any part of the treatment or distribution process, that is intended to kill or inactivate pathogenic microorganisms.

2. By revising § 141.6 to read as follows:

§ 141.6 Effective dates.

(a) Except as provided in paragraph (b) of this section, the regulations set forth in this part shall take effect on June 24, 1977.

(b) The regulations for total trihalomethanes set forth in § 141.12(c) shall take effect 2 years after the date of promulgation of these regulations for community water systems serving 75,000 or more individuals, and 4 years after the date of promulgation for communities serving 10,000 to 74,999 individuals.

3. By revising the introductory paragraph and adding a new paragraph (c) in § 141.12 to read as follows:

§ 141.12 Maximum contaminant levels for organic chemicals.

The following are the maximum contaminant levels for organic chemicals. The maximum contaminant levels for organic chemicals in paragraphs (a) and (b) of this section apply to all community water systems. Compliance with the maximum contaminant levels in paragraphs (a) and (b) is calculated pursuant to § 141.24. The maximum contaminant level for total trihalomethanes in paragraph (c) of this section applies only to community water systems which serve a population of 10,000 or more individuals and which add a disinfectant (oxidant) to the water in any part of the drinking water treatment process. Compliance with the maximum contaminant level for total trihalomethanes is calculated pursuant to § 141.30.

* * * * *

(c) Total trihalomethanes (the sum of the concentrations of bromodichloromethane, dibromochloromethane, tribromomethane (bromoform) and trichloromethane (chloroform)) 0.10 mg/l.

4. By revising the title, the introductory text of paragraph (a) and paragraph (b) of § 141.24 to read as follows:

§ 141.24 Organic chemicals other than total trihalomethanes, sampling and analytical requirements.

(a) An analysis of substances for the purpose of determining compliance with § 141.12(a) and § 141.12(b) shall be made as follows:

(b) If the result of an analysis made pursuant to paragraph (a) of this section indicates that the level of any contaminant listed in § 141.24 (a) and (b) exceeds the maximum contaminant level, the supplier of water shall report to the State within 7 days and initiate three additional analyses within one month.

5. By adding a new § 141.30 to read as follows:

§ 141.30 Total trihalomethanes sampling, analytical and other requirements.

(a) Community water system which serve a population of 10,000 or more individuals and which add a disinfectant (oxidant) to the water in any part of the drinking water treatment process shall analyze for total trihalomethanes in accordance with this section. For systems serving 75,000 or more individuals, sampling and analyses shall begin not later than 1 year after the date of promulgation of this regulation. For systems serving 10,000 to 74,999 individuals, sampling and analyses shall begin not later than 3 years after the date of promulgation of this regulation. For the purpose of this section, the minimum number of samples required to be taken by the system shall be based on the number of treatment plants used by the system, except that multiple wells drawing raw water from a single aquifer may, with the State approval, be considered one treatment plant for determining the minimum number of samples. All samples taken within an established frequency shall be collected within a 24-hour period.

(b)(1) For all community water systems utilizing surface water sources in whole or in part, and for all community water systems utilizing only ground water sources that have not been determined by the State to qualify for the monitoring requirements of paragraph (c) of this section, analyses for total trihalomethanes shall be performed at quarterly intervals on at least four water samples for each treatment plant used by the system. At least 25 percent of the samples shall be taken at locations within the distribution system reflecting the maximum residence time of the water in the system. The remaining 75 percent shall be taken at representative locations in the distribution system, taking into account number of persons served, different sources of water and different treatment methods employed. The results of all analyses per quarter shall be arithmetically averaged and reported to the State within 30 days of the system's receipt of such results. Results shall also be reported to EPA until such monitoring requirements have been adopted by the State. All samples collected shall be used in the computation of the average, unless the analytical results are invalidated for technical reasons. Sampling and analyses shall be conducted in accordance with the methods listed in paragraph (e) of this section.

(2) Upon the written request of a community water system the monitoring frequency required by paragraph (b)(1) of this section may be reduced by the State to a minimum of one sample analyzed for TTHMs per quarter taken at a point in the distribution system reflecting the maximum residence time of the water in the system, upon a written determination by the State that the data from at least 1 year of monitoring in accordance with paragraph (b)(1) of this section and local conditions demonstrate that total trihalomethane concentrations will be consistently below the maximum contaminant level.

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(3) If at any time during which reduced monitoring frequency prescribed under this paragraph applies, the results from any analysis exceed 0.10 mg/l of TTHMs and such results are confirmed by at least one check sample taken promptly after such results are received, or if the system makes any significant change to its source of water or treatment program, the system shall immediately begin monitoring in accordance with the requirements of paragraph (b)(1) of this section, which monitoring shall continue for at least 1 year before the frequency may be reduced again. At the option of the State, a system's monitoring frequency may and should be increased above the minimum in those cases where it is necessary to detect variations of TTHM levels within the distribution system.

(c)(1) Upon written request to the State, a community water system utilizing only ground water sources may seek to have the monitoring frequency required by subparagraph (1) of paragraph (b) of this section reduced to a minimum of one sample for maximum TTHM potential per year for each treatment plant used by the system taken at a point in the distribution system reflecting maximum residence time of the water in the system. The system shall submit to the State the results of at least one sample analyzed for maximum TTHM potential for each treatment plant used by the system taken at a point in the distribution system reflecting the maximum residence time of the water in the system. The system's monitoring frequency may only be reduced upon a written determination by the State that, based upon the data submitted by the system, the system has a maximum TTHM potential of less than 0.10 mg/l and that, based upon an assessment of the local conditions of the system, the system is not likely to approach or exceed the maximum contaminant level for total TTHMs. The results of all analyses shall be reported to the State within 30 days of the system's receipt of such results. Results shall also be reported to EPA until such monitoring requirements have been adopted by the State. All samples collected shall be used for determining whether the system must comply with the monitoring requirements of paragraph (b) of this section, unless the analytical results are invalidated for technical reasons. Sampling and analyses shall be conducted in accordance with the methods listed in paragraph (e) of this section.

(2) If at any time during which the reduced monitoring frequency prescribed under paragraph (c)(1) of section applies, the results from any analysis taken by the system for maximum TTHM potential are equal to or greater than 0.10 mg/l, and such results are confirmed by at least one check sample taken promptly after such results are received, the system shall immediately begin monitoring in accordance with the requirements of paragraph (b) of this section and such monitoring shall continue for at least one year before the frequency may be reduced again. In the event of any significant change to the system's raw water or treatment program, the system shall immediately analyze an additional sample for maximum TTHM potential taken at a point in the distribution system reflecting maximum residence time of the water in the system for the purpose of determining whether the system must comply with the monitoring requirements of paragraph (b) of this section. At the option of the State, monitoring frequencies may and should be increased above the minimum in those cases where this is necessary to detect variation of TTHM levels within the distribution system.

(d) Compliance with § 141.12(c) shall be determined based on a running annual average of quarterly samples collected by the system as prescribed in subparagraphs (1) or (2) of paragraph (b) of this section. If the average of samples covering any 12 month period exceeds the Maximum Contaminant Level, the supplier of water shall report to the State pursuant to § 141.31 and notify the public pursuant to § 141.32. Monitoring after public notification shall be at a frequency designated by the State and shall continue until a monitoring schedule as a condition to a variance, exemption or enforcement action shall become effective.

(e) Sampling and analyses made pursuant to this section shall be conducted by one of the following EPA approved methods:

(1) "The Analysis of Trihalomethanes in Finished Waters by the Purge and Trap Method," Method 501.1, EMSL, EPA Cincinnati, Ohio.

(2) "The Analysis of Trihalomethanes in Drinking Water by Liquid/Liquid Extraction," Method 501.2, EMSL, EPA Cincinnati, Ohio.

Samples for TTHM shall be dechlorinated upon collection to prevent further production of Trihalomethanes, according to the procedures described in the above two methods. Samples for maximum TTHM potential should not be dechlorinated, and should be held for seven days at 25° C prior to analysis, according to the procedures described in the above two methods.

(f) Before a community water system makes any significant modifications to its existing treatment process for the purposes of achieving compliance with § 141.12(c), such system must submit and obtain State approval of a detailed plan setting forth its proposed modification and those safeguards that it will implement to ensure that the bacteriological quality of the drinking water served by such system will not be adversely affected by such modification. Each system shall comply with the provisions set forth in the State-approved plan. At a minimum, A State approved plan shall require the system modifying its disinfection practice to:

(1) Evaluate the water system for sanitary defects and evaluate the source water for biological quality;

(2) Evaluate its existing treatment practices and consider improvements that will minimize disinfectant demand and optimize finished water quality throughout the distribution system;

(3) Provide baseline water quality survey data of the distribution system. Such data should include the results from monitoring for coliform and fecal coliform bacteria, fecal streptococci, standard plate counts at 35° C and 20° C, phosphate, ammonia nitrogen and total organic carbon. Virus studies should be required where source waters are heavily contaminated with sewage effluent;

(4) Conduct additional monitoring to assure continued maintenance of optimal biological quality in finished water, for example, when chloramines are introduced as disinfectants or when pre-chlorination is being discontinued. Additional monitoring should also be required by the State for chlorate, chlorite and chlorine dioxide when chlorine dioxide is used as a disinfectant. Standard plate count analyses should also be required by the State as appropriate before and after any modifications;

(5) Demonstrate an active disinfectant residual throughout the distribution system at all times during and after the modification.

This paragraph (f) shall become effective on the date of its promulgation.