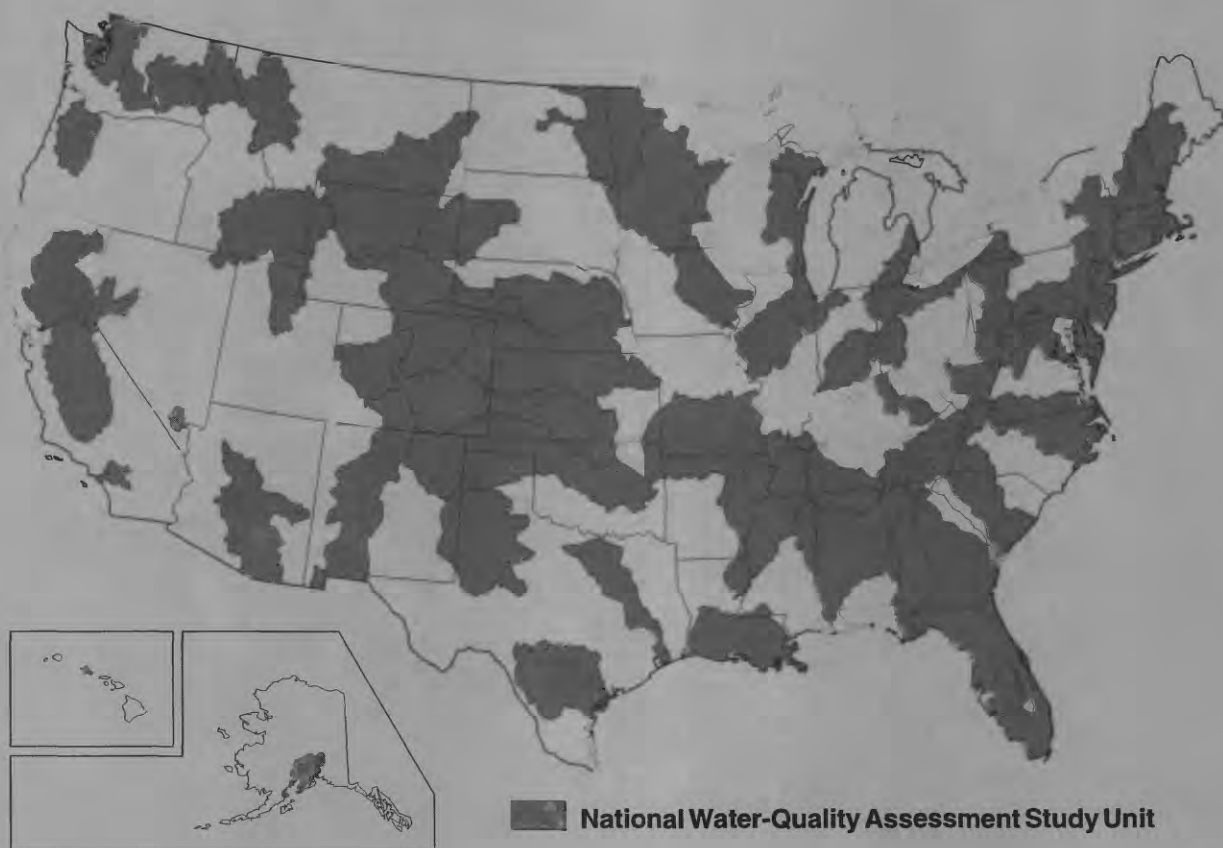


SELECTED BIBLIOGRAPHY OF THE FUEL OXYGENATE METHYL *tert*-BUTYL ETHER (MTBE) WITH EMPHASIS ON WATER QUALITY

U.S. GEOLOGICAL SURVEY

Open-File Report 97-564



NATIONAL WATER-QUALITY ASSESSMENT PROGRAM



SELECTED BIBLIOGRAPHY OF THE FUEL OXYGENATE METHYL *tert*-BUTYL ETHER (MTBE) WITH EMPHASIS ON WATER QUALITY

By Elise V. Brachtel, Curtis V. Price, and Rick M. Clawges

U.S. GEOLOGICAL SURVEY

Open-File Report 97-564

Rapid City, South Dakota
1997



U.S. DEPARTMENT OF THE INTERIOR
BRUCE BABBITT, Secretary

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FOREWORD

The mission of the U.S. Geological Survey (USGS) is to assess the quantity and quality of the earth resources of the Nation and to provide information that will assist resource managers and policy-makers at Federal, State, and local levels in making sound decisions. Assessment of water-quality conditions and trends is an important part of this overall mission.

One of the greatest challenges faced by water-resources scientists is acquiring reliable information that will guide the use and protection of the Nation's water resources. That challenge is being addressed by Federal, State, interstate, and local water-resource agencies and by many academic institutions. These organizations are collecting water-quality data for a host of purposes that include: compliance with permits and water-supply standards; development of remediation plans for a specific contamination problem; operational decisions on industrial, wastewater, or water-supply facilities; and research on factors that affect water quality. An additional need for water-quality information is to provide a basis on which regional and national-level policy decisions can be based. Wise decisions must be based on sound information. As a society we need to know whether certain types of water-quality problems are isolated or ubiquitous, whether there are significant differences in conditions among regions, whether the conditions are changing over time, and why these conditions change from place to place and over time. The information can be used to help determine the efficacy of existing water-quality policies and to help analysts determine the need for and likely consequences of new policies.

To address these needs, the Congress appropriated funds in 1986 for the USGS to begin a pilot program in seven project areas to develop and refine the National Water-Quality Assessment (NAWQA) Program. In 1991, the USGS began full implementation of the program. The NAWQA Program builds upon an existing base of water-quality studies of the USGS, as well as those of other Federal, State, and local agencies. The objectives of the NAWQA Program are to:

- Describe current water-quality conditions for a large part of the Nation's freshwater streams, rivers, and aquifers.

- Describe how water quality is changing over time.

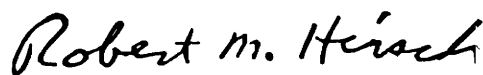
- Improve understanding of the primary natural and human factors that affect water-quality conditions.

This information will help support the development and evaluation of management, regulatory, and monitoring decisions by other Federal, State, and local agencies to protect, use, and enhance water resources.

The goals of the NAWQA Program are being achieved through ongoing and proposed investigations of 59 of the Nation's most important river basins and aquifer systems, which are referred to as Study Units. These Study Units are distributed throughout the Nation and cover a diversity of hydrogeologic settings. More than two-thirds of the Nation's freshwater use occurs within the 59 Study Units and more than two-thirds of the people served by public water-supply systems live within their boundaries.

National synthesis of data analysis, based on aggregation of comparable information obtained from the Study Units, is a major component of the program. This effort focuses on selected water-quality topics using nationally consistent information. Comparative studies will explain differences and similarities in observed water-quality conditions among study areas and will identify changes and trends and their causes. The first topics addressed by the national synthesis are pesticides, nutrients, volatile organic compounds, and aquatic biology. Discussions on these and other water-quality topics will be published in periodic summaries of the quality of the Nation's ground and surface water as the information becomes available.

This report is an element of the comprehensive body of information developed as part of the NAWQA Program. The program depends heavily on the advice, cooperation, and information from many Federal, State, interstate, Tribal, and local agencies and the public. The assistance and suggestions of all are greatly appreciated.



Robert M. Hirsch
Chief Hydrologist

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Selected Bibliography of the Fuel Oxygenate Methyl *tert*-Butyl Ether (MTBE) with Emphasis on Water Quality

By Elise V. Brachtel, Curtis V. Price, and Rick M. Clawges

ABSTRACT

A selected bibliography of scientific literature on the fuel oxygenate methyl *tert*-butyl ether (MTBE) is presented in this report. The primary focus of the bibliography is on the water-quality aspects of MTBE. The bibliography includes 268 references. Each reference has been assigned a keyword(s) on the basis of its subject matter. Bibliographic entries are listed alphabetically by principal author, either individual(s) or organization(s), and by date (most recent entry last for multiple entries by the same principal author). Entries are numbered consecutively and include their assigned keyword(s). The keyword index is grouped by six major topical categories. Within each major category, associated keywords are listed alphabetically. The keyword index identifies those references (via their reference number) associated with each keyword. The bibliography also is available in searchable form on the Internet using Internet browser software. Instructions are given within the report on how to access the Internet version of the bibliography, which will be updated periodically as long as funding permits.

INTRODUCTION

Methyl *tert*-butyl ether (MTBE) is the most widely used fuel oxygenate in the United States. From 1984 to 1995, the production of MTBE has increased

by about 26 percent annually, with 8.0 billion kilograms produced in 1995 (Office of Science and Technology Policy, 1995, p. 2-5). Essentially all of the MTBE produced or imported in the United States is used in the oxygenation of gasoline. Recently, several concerns were raised by the public about MTBE. To address these concerns, a Federal interagency assessment on the United States' wintertime oxygenated-gasoline program was completed in 1996 and 1997. The assessment considered human health, air quality, fuel economy and engine performance, and ground water and drinking water. Scientific state-of-understanding chapters were prepared on each topic and combined in a final report (Office of Science and Technology Policy, 1995). The National Water-Quality Assessment (NAWQA) Volatile Organic Compound (VOC) National Synthesis Team of the U.S. Geological Survey has prepared this bibliography in support of the Interagency Oxygenated Fuel Assessment as a means of obtaining pertinent and current (1997) water-quality-related information on MTBE.

Purpose and Scope

This report describes and presents a bibliography of selected references concerning MTBE collected by the NAWQA VOC National Synthesis Team. The primary focus of the bibliography is on the water-quality aspects of MTBE. The bibliography contains 268 references received as of June 1997. New information will be added periodically to an online version of the bibliography (see section on "Using the Online Bibliography").

Sources of Bibliographic Information

This bibliography contains references from many sources, including journal articles, published reports and books, unpublished master's theses and doctoral dissertations, conference proceedings, book reviews, and approved in-press publications. Many of the references were obtained through the Chemical Abstracts¹ data base. The rest were compiled with the help of other interested parties, including several international research sources, industry and their commercial affiliates, research laboratories, and other governmental agencies.

Keywords

The references in the bibliography were categorized by topic and were assigned keywords after being read by a member of the NAWQA VOC National Synthesis Team. A keyword index was created in which keywords were placed under one of six major topical categories. These topical categories, as well as a complete list of keywords used in developing the bibliography, are listed in table 1.

Using the Bibliography and Keyword Index

Bibliographic entries are listed alphabetically by principal author, either individual(s) or organization(s), and by date (most recent entry last for multiple entries by the same principal author). Entries are numbered consecutively and are followed by their assigned keyword(s), which are contained within brackets. Entries in the Keyword Index section near the end of the report are grouped by the major topical categories listed in table 1, with keywords listed alphabetically within each major category. Following each keyword within brackets are the sequential numbers associated with individual references in the bibliography that were assigned to the keyword. A reference number can appear more than once in the Keyword Index section if more than one keyword was assigned to a particular reference. Topics of interest can be found by examining the major categories and associated keywords in the keyword index.

¹Use of trade, brand, or firm names in this report is for identification purposes only and does not constitute endorsement by the U.S. Geological Survey.

Table 1. Keywords assigned to references in this methyl *tert*-butyl ether (MTBE) bibliography

[Keywords are listed under six major topical categories]

Abiotic transformation processes
Dehydrogenation
Hydrolysis
Oxidation/reduction
Photolysis
Biotic transformation processes
Biochemical oxidation
Biodegradation
Biotransformation
Metabolic transformation
Transfer processes
Absorption
Adsorption
Air-water transfer
Bioaccumulation/bioconcentration factor
Degradation
Desorption
Sorption to humic materials
Sorption to resins
Sorption to sediments
Uptake by biota
Volatilization
Transport processes
Atmospheric
Dispersion/mixing
Precipitation scavenging
Environmental occurrences
Drinking water
Food
Gasoline
Ground water
Human tissue and fluids
Plant tissue/root
Precipitation
Soil
Storm water
Surface water
Miscellaneous
Analytical methods/quantification
Drinking-water standards/health advisories/action and cleanup levels
Economics/production
Human health
Laboratory experimentation
Physical/chemical properties
Remediation/cleanup technologies
Sampling and field-handling methods
Taste and odor properties
Toxicity to aquatic organisms

Using the Online Bibliography

This MTBE bibliography also is available on the Internet for simple searching using free-text input by the user or by the keywords included in this report. The free-text search looks for the text input by the user within the title and the keyword(s) associated with each reference. To access the online bibliography, an Internet connection and Internet browser software are required. The bibliography is accessed by using a browser to open an Internet document using the following Uniform Resource Locator (URL) address and following hypertext links presented there:

<http://www.sds.cr.usgs.gov/nawqa/vocns/mtbe/bib/>

The online bibliography will be updated periodically depending on the availability of new publications and funding. The top-level page of the online bibliography identifies a contact person who may be reached via electronic mail by users who want to make suggestions or share other references. Readers of this report who may not have access to Internet browser software may make suggestions by writing to:

Chief, VOC National Synthesis Team
U.S. Geological Survey
1608 Mt. View Rd.
Rapid City, SD 57702

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