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Book reviews

MTBE: Effects on Soil and Groundwater Resources
James Jacobs, Jacques Guertin, Christy Herron (Eds.), Lewis Publishers, Boca Raton, FL, 2000, 245 pp., $79.95, ISBN 1-56670-553-3

From hero to villain is a synoptic description of MTBEs fate. Methyl tertiary-butyl ether (MTBE) was thought to be a part of the solution to vehicle air pollution emissions. MTBE was added to gasoline (2.9 billion gallons in the U.S. in 1997) with a view to improving vehicle emissions and thereby improving ambient air quality. Unfortunately, its leakage to the ground and groundwater yielded 200,000 contaminated sites in the US.

An MTBE fact sheet as published in the first chapter of the book is found below.

"Some facts about the nature of MTBE and MTBE contamination of groundwater in the U.S. can be stated clearly, and are listed below.

- TASTE AND ODOR: Water sources contaminated with very low levels of MTBE become unusable for human consumption because of the unpleasant, turpentine-like taste and odor of MTBE.
- HEALTH RISK: Although MTBE is considered a potential health risk, there is little to no evidence that MTBE causes cancer in humans. Fortunately, the strong, turpentine-like taste and odor of MTBE can be detected by humans at relatively low concentrations in water. The potential for the population at large to drink significant quantities of water highly contaminated with MTBE is therefore unlikely. MTBE is not listed as a human carcinogen by the U.S. National Toxicology Panel, the California Proposition 65 Committee, or the International Agency for Research on Cancer.
- FATE AND TRANSPORT: MTBE enters soil and groundwater systems through leaking underground storage tanks (USTs), surface spills of gasoline, and other sources. Due to its high solubility in water, MTBE tends to migrate much faster and further in groundwater than equal amounts of other gasoline compounds.
- REMEDIATION: Owing to the physical and chemical characteristics of MTBE, remediation (or cleanup) of MTBE in groundwater is expensive, time consuming, and technically challenging. New technologies might improve remediation efficiency and reduce cost.
- AIR POLLUTION: The source of the reductions in air pollution that have taken place over the last few years is still under debate. Part of the overall nationwide improvement in air quality can be attributed to newer and more efficient automobile engines, which produce fewer harmful emissions. Reformulated gasoline containing MTBE may be responsible for some of the improvement in air quality, as suggested by the U.S. EPA; however, there

is some disagreement among air quality studies as to how much the use of MTBE in gasoline reduces automobile air emissions.
- ALTERNATIVE OXYGENATES: If other oxygenates are added to gasoline in the place of MTBE to lower vehicle emissions, the cost and currently limited availability of these alternatives, such as ethanol, are likely to increase the cost of gasoline. In addition, replacements for MTBE must be evaluated carefully for their potential health effects and their fate and transport characteristics in the subsurface."

This introductory material is followed by seven more chapters entitled as follows:

- History and overview of fuel oxygenates and MTBE
- Physical and chemical properties of MTBE
- Toxicity, health effects, and taste and odor thresholds of MTBE
- Transport and fate of MTBE in the environment
- Detection and treatment of MTBE in soil and groundwater
- MTBE: a perspective on environmental policy
- Conclusions and recommendations

The main sources of MTBE in the environment are leaking (gasoline) underground storage tanks (USTs), pipelines, and refueling facilities. Such leaks can seriously contaminate drinking water sources. For example, MTBE contamination from several leaking USTs has resulted in the shutdown of Santa Monica's (California) water supply wells and caused high cleanup costs.

The chapter that interested me most was the sixth chapter, entitled "Detection and treatment of MTBE in soil and groundwater." Analytical methods for detecting MTBE in (drinking) water, (ambient) air, body fluids and soil vapor are described.

Following this chapter's analytical section is the "Treatment of MTBE in groundwater." Discussed are MTBEs removed by activated carbon adsorption, air stripping, and chemical oxidation using Fenton's reagent. The final paragraph of this chapter is not encouraging (lending examples to the conclusion that MTBEs use should be avoided): "The results of the treatability studies indicate that MTBE is difficult and costly to remove from groundwater, when compared to the traditional treatment costs and difficulties experienced with the removal of hydrocarbons found in gasoline, such as benzene. If cost were no object, there appears to be potential for use of oxidants, air strippers, and carbon adsorption for the aboveground treatment."

The bulk of the book (130 pages) is given to Appendices:

- Appendix A: Glossary of technical terms and acronyms used in this book
- Appendix B: Conversions for international system (SI metric) and United States units
- Appendix C: Material safety data sheets: MTBE and gasoline
- Appendix D: Summary of MTBE state-by-state cleanup standards
- Appendix E: Geologic principles and MTBE
- Appendix F: MTBE: subsurface investigation and cleanup
- Appendix G: Synthesis, properties, and environmental fate of MTBE and oxygenate chemicals
- Appendix H: Plume geometries for subsurface concentrations of MTBE
- Appendix I: Toxicity of MTBE: human health risk calculations

- Appendix J: MTBE web sites
- Appendix K: Summary of MTBE remediation technologies

The final section is a 22 page (300 item) list of papers, books, etc.

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Trace Elements in Soil: Bioavailability, Flux, and Transfer
I.K. Iskandar, M.B. Kirkham (Eds.), Lewis Publishers, Boca Raton, FL, USA, 2000, 287 pp., US$ 89.95, ISBN 1-56670-507-X

Trace elements in soil, the topic of this excellent research report, have taken a new importance in recent years as chemicals, sewage sludge and past disposal activities have focused attention on them. It is a topic in which I have a personal interest, having done research on sewage sludge metal availability myself.

It thus is no surprise that I quote from Chapter 8, "Accumulation, Redistribution, Transport and Bioavailability of Heavy Metals in Waste-Amended Soils," where researchers F.X. Han, W.L. Kingery and H.M. Selim of Mississippi State University wrote:

> Heavy metals accumulate in agricultural soils amended with various agricultural and industrial wastes. There is some evidence of metal transport in long-term waste-amended soils, but most data show limited mobility of heavy metals in waste-amended soil profiles. The bioavailability of heavy metals and their mobility in soils are largely determined by their distribution among various solid-phase components. Heavy metals in soils amended with various wastes are redistributed and transferred with time from the labile forms to the more stable forms, and the redistribution processes are dependent upon the source and process of waste, level of waste input, nature of metal, time scale, and soil properties, such as pH, Eh, texture, and moisture regime.

The above quote is from only one chapter of 14 in the text written by 45 contributors from 11 different countries. The material focuses on the impact of industrial development and past disposal practices on the concentrations and fate of trace elements as important environmental contaminants in the atmosphere and aquatic and terrestrial systems.

The book is divided into two sections:

1. Bioavailability of trace elements; five chapters; 87 pages.
2. Fluxes and Transfer Partitioning of Trace Elements; nine chapters; 190 pages.

Regarding bioavailability, the editor wrote

> Bioavailability is a fundamental aspect in organisms for assimilation of nutrients and contaminant compounds, both inorganic and organic. Yet, it has remained a complex process to understand for nutritionists, toxicologists, environmental scientists, policy makers, and regulators. The parameters that measure or predict bioavailability remain diffused, inconsistent, and, at times, unreliable due to variations in organisms (i.e. species,