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| **Environmental Enlightenment #192**By Ami Adini - Re-issued July 2, 2016

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| This is a SHORT, LIGHT and SIMPLE newsletter. Its purpose is to rekindle in the initiated terminology they have once learned, and enlighten the uninitiated on terms they may have heard but never known the meaning of. |
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| **MTBE 101**

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| This is a short essay on MTBE, a pursued culprit that has already cost California in excess of two billion dollars and more to come. This justifies a few words in “honor” of a once protagonist turned antagonist.The impact of MTBE on commercial and industrial real-estate transactions is huge. The one-time *wunderkind* solver for air pollution spouting from gasoline-powered engines has been decreed a turncoat villain tainting our groundwater resources, and war has been waged. It’s a multi-pronged offensive involving preventive measures such as hermetically tight underground storage facilities and a multibillion-dollar effort to contain and remedy the damage already inflicted. |   | http://amiadini.com/NewsletterArchive/160702-NL192NL/envEnl-192_clip_image002.jpg |
| Credit: Mac m 13[GFDL (www.gnu.org/copyleft/fdl.html) or CC-BY-SA-3.0-2.5-2.0-1.0 (www.creativecommons.org/licenses/by-sa/3.0)], via Wikimedia Commons |

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| The first thing we notice is that MTBE is a *chemical*, a man-made substance that can’t be found in nature.*Chemistry* is that area of human endeavor where substances are combined with other substances to create new substances. | http://amiadini.com/NewsletterArchive/160702-NL192NL/envEnl-192_clip_image004.jpg |

MTBE is a *compound,* a combination of substances put together. The word comes from Latin *componere,* *com-* (together) and *ponere* (to put).MTBE is an *organic* compound, a substance that contains carbon. Not all carbon-containing compounds are organic, but all organic compounds contain carbon.

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| Molecules are the tiniest parts a substance can be divided into without losing its characteristic qualities. If you take just one molecule of table salt, it will still act to cure meat. But if you break this molecule apart, it will be salt no more.Molecules are made of groups of atoms. Simple molecules have only a few atoms. Table salt has one atom of sodium and one of chlorine. On the other side of the spectrum we have huge molecules, such as protein, made up of thousands of atoms. |   | http://amiadini.com/NewsletterArchive/160702-NL192NL/envEnl-192_clip_image006.jpg |

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| Studying the building blocks of the material universe can be fascinating. Brick walls are real. If you should attempt to move your body through a wall, that wall would become painfully real in a hurry.The wall is made of tiny molecules clustered together, and the molecules are made of atoms holding hands. Atoms, in turn, are almost entirely space where a tiny mass (nucleus) is surrounded by electrons revolving far away. The electrons and the sub-particles of the nuclei are made of tiny motions. It means that our very solidly “real” matter is just a space made of highly rarified tiny motions that obey some basic rules of conduct. The reason your body doesn’t go through the nothingness which is the wall is that the body is constructed on the same order of nothingness as the wall and made to obey the same rules. Is the wall real? Yes, but only to such “real” things that were created to obey the rules of a game called *physical universe* |   | http://amiadini.com/NewsletterArchive/160702-NL192NL/envEnl-192_clip_image008.jpg |

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| MTBE is an organic chemical that belongs in the family of the *ether*. (*Ether* originates from a Greek word meaning *ignite*, *to blaze*.)An ether molecule is an organic compound built of three connecting blocks: a middle block that is an atom of oxygen holding two other compounds, one on each side. We designate the oxygen by “O” and each of the other compounds by “R.” The “R” compounds are not necessarily identical.  Diagrammatically we show it:The “O” stretches out two “hands.” Each hand clasps the hand of an “R.” | http://amiadini.com/NewsletterArchive/160702-NL192NL/envEnl-192_clip_image010.jpg |

The lighter-weight ethers, of which MTBE is a member, are fire and explosion hazards, and they are soluble in water. This high degree of solubility makes MTBE detrimental to groundwater, because it dissolves fast into the water and moves with it and through it. Gasoline compounds, such as benzene, toluene, ethyl benzene and xylenes are not as soluble as MTBE. This accounts for the phenomenon where MTBE is found in areas that have no traces of petroleum.

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| The image across depicts an analogy of solution where the red particles of a soluble substance (solute) hover within a medium of another substance (solvent). The solute particles have free range to move about and they “flee” from the high density zones to zones of little or no presence. | http://amiadini.com/NewsletterArchive/160702-NL192NL/envEnl-192_clip_image012.jpg |
| Credit: Hagmann, P., Cammoun, L., Gigandet, X., Meuli, R., Honey, C.J., Wedeen, V.J., Sporns, O., Friston, K.J. (2008). *Mapping the Structural Core of Human Cerebral Cortex*. PLoS Biology, 6(7), e159. DOI:10.1371/journal.pbio.0060159 |

 In the case of the MTBE molecule, an oxygen atom is interposed between and connects to the two compounds of *methyl* and *butyl*. These esoteric names should not dishearten you; they are simply names, not unlike Jon and Mary.http://amiadini.com/NewsletterArchive/160702-NL192NL/envEnl-192_clip_image013.gif

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| Methyl is an organic compound built of one carbon atom clasping hands with three hydrogen atoms, like this:This formation is given a formula CH3, where “C” designates carbon, “H” designates hydrogen, and the "3" designates the number of hydrogen atoms.The carbon atom has four hands to offer. The hydrogen atom has only one hand to offer. Thus, when joining hands with hydrogen atoms in the methyl group, the carbon atom has one hand left stretching and is actively seeking one more mate. |   | http://amiadini.com/NewsletterArchive/160702-NL192NL/envEnl-192_clip_image015.gif |

Butyl is an organic compound made of four carbon atoms clasping hands with nine hydrogen atoms—its symbol is C4H9. This is a sizable group of 13 members, which gives them opportunity to arrange in various formations. Although the number of carbon and hydrogen atoms is same in all formations, each formation presents different characteristics to the outside world.http://amiadini.com/NewsletterArchive/160702-NL192NL/envEnl-192_clip_image017.jpgCredit: U.S Navy photo by Photographers Mate 2nd Class Summer M. Anderson. (RELEASED) (Photo courtesy of U.S. Navy)An analogy could be a naval fleet of four destroyers and nine missile boats. Various formations can be formed, and each would present a different problem to an opponent.

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| In the MTBE party, the butyl group appears in its *tertiary*form:It is *tertiary* because *three* CH3 groups clasp hands with the carbon. | http://amiadini.com/NewsletterArchive/160702-NL192NL/envEnl-192_clip_image019.gif |

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| We position the *tertiary*butyl on the left with an oxygen atom in the middle and the methyl on the right, and we get the ether compound called MTBE: |   | http://amiadini.com/NewsletterArchive/160702-NL192NL/envEnl-192_clip_image022.jpg |

The association is now complete, no hand left stretching out. This is a stable association. We name it *methyl tert-butyl ether*, where *tert* is short for *tertiary,*and we shorten it to MTBE.

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| In March 2000, the California State Water Resources Control Board issued *Guidelines for Investigation and Cleanup of MTBE.* The following quotes pertain to the nature of MTBE:"…the standard approach for dealing with petroleum releases… will not suffice for MTBE, because unlike traditional petroleum constituents such as benzene, MTBE moves quickly to pollute water and is slow to degrade in the subsurface environment. Response time is critical for MTBE.""MTBE has been added to gasoline to enhance octane and to comply with clean air mandates. It was approved by the USEPA for use in 1979 and was added to gasoline during the 1980s at approximately 2-5% by volume as an octane booster. In 1992, it was blended at 10-15% by volume for use in some areas in the wintertime oxygenated fuel program. In 1996, it began to be used year round at 11% by volume in the statewide reformulated gasoline program." |   | http://amiadini.com/NewsletterArchive/160702-NL192NL/envEnl-192_clip_image024.jpg |

“Relative to other fuel hydrocarbons, MTBE has high solubility in water. The compound has low retardation in groundwater aquifers, and is slow to biodegrade. These properties, combined with a high percentage in gasoline, cause the potential for high source area concentrations, long plumes in groundwater, and long residence times in the subsurface. It also has taste and odor characteristics that can impair water supplies at very low concentrations.”“There have been impacts on drinking water wells at dozens of sites in California…. In addition, there are thousands of underground storage tank sites with MTBE detected in the groundwater. Other sources of MTBE release to the environment include above ground storage tanks, spills, pipelines, etc.”http://amiadini.com/NewsletterArchive/160702-NL192NL/envEnl-192_clip_image001.jpg |
| You can find past issues of our "Environmental Enlightenment" at [amiadini.com](http://www.amiadini.com/) Wealth of information about environmental site assessments in the real estate transactions and issues concerning assessment and cleanup of contamination in the subsurface soil and groundwater. |

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| Call me if you have any questions. There are **no obligations.**Ami Adini Environmental Services, Inc.Environmental Consultants & General Engineering ContractorsCalifornia Lic. #1009513 A B HAZ ASB**818-824-8102**; **mail@amiadini.com**[www.amiadini.com](http://amiadini.com/)Ami Adini is a veteran environmental practitioner with over 40 years of experience. He carries a Bachelor of Science degree (B.Sc.) in Mechanical Engineering including academic credits in Nuclear and Chemical Engineering and postgraduate education in these fields. His career includes design and construction of nuclear plant facilities, chemical processing plants and hazardous wastewater treatment systems. He is a former California Registered Environmental Assessor Levels I & II in the 1988-2012 registry that certified environmental professionals in the assessment and remediation of environmentally impacted land, and a Registered Environmental Professional (REP) since 1989 with the National Registry of Environmental Professionals (NREP). He is a California Business & Professions Code Qualifying Responsible Managing Officer (RMO) in the General Engineering Contractor classification with Hazardous Substance Removal and Asbestos certifications, and president of AMI ADINI ENVIRONMENTAL SERVICES, INC. (AAES), a general engineering contractor and consulting firm specializing in environmental site assessments, rehabilitation of contaminated sites and removal of environmental risks from real-estate transactions. (Contact Ami for a complete resume.) **AAES provides practical solutions to environmental concerns using the highest standards of ethics and integrity while providing its clients with maximum return on their investments.** |

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