SKB SV-018

# THE OCCURRENCE OF METHYL TERT-BUTYLETHER (MBTE) in the Netherlands

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**Abstract**

The aim of this project has been to find out to what extend MTBE is present in Dutch soil and groundwater, and what the effect will be if it is detected. MTBE is found in groundwater in countries around us, and its presence in ground water resources in the US is causing big problems.

In this project, a limited number of groundwater samples were taken and analysed for MTBE. In some, MTBE was detected in significant levels. Thus, MTBE may also cause similar problems in the Netherlands. Furthermore, a workshop has been held at the Dutch Soil Conference “Bodem Breed 1999”, to give information to interested people in the soil quality management field about MTBE and to check for the opinions that live among people working at institutes, agencies, government, companies etc., regarding MTBE.

One of the conclusions of this project is that the awareness of authorities and regulators has to be improved. A national inventory on MTBE occurrence in Dutch groundwater is recommended to further investigate MTBE pollution. With this information, the implications of MTBE use can be discussed and addressed.



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## PREFACE

This is the final report of a definition study “The occurrence of methyl tert-butylether (MBTE) in the Netherlands”. This project has been performed in collaboration with the Dutch foundation SKB (Stichting Kennisontwikkeling en Kennisoverdracht Bodem).

This report is ment to put MTBE ground water contamination on the agenda of regulators and problem holders. MTBE has been demonstrated to be a serious threat and too long the problem has been ignored in many countries. In the Netherlands, no attention has been paid to MTBE until now. We’d better wake up and tackle the problem seriously.

March 2000

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## ABSTRACT

The occurrence of methyl tert-butylether (MBTE) in the Netherlands

The aim of this project has been to find out to what extend MTBE is present in Dutch soil and groundwater, and what the effect will be if it is detected. MTBE is found in groundwater in countries around us, and its presence in ground water resources in the US is causing big problems.
In this project, a limited number of groundwater samples were taken and analysed for MTBE. In some, MTBE was detected in significant levels. Thus, MTBE may also cause similar problems in the Netherlands. Furthermore, a workshop has been held at the Dutch Soil Conference “Bodem Breed 1999”, to give information to interested people in the soil quality management field about MTBE and to check for the opinions that live among people working at institutes, agencies, government, companies etc., regarding MTBE.

One of the conclusions of this project is that the awareness of authorities and regulators has to be improved. A national inventory on MTBE occurrence in Dutch groundwater is recommended to further investigate MTBE pollution. With this information, the implications of MTBE use can be discussed and addressed.

# CHAPTER 1

# INTRODUCTION

Methyl tertiary-butyl ether (MTBE) is one of several fuel oxygenates added to petrol to both increase the octane content of petrol and to increase oxygen content. This results in improved fuel combustion and reduces the resulting concentrations of carbon monoxide and unburned hydrocarbons, a quality highly approved by oil companies, government and even several environmental organisations. MTBE is relatively inexpensive, easy to produce and blends well with gasoline without phase separation and is therefore by far the most commonly used oxygenate. Other fuel oxygenates include ethanol (no. 2), methanol, ethyl tertiary-butyl ether (ETBE), tertiary-butyl ether (TBA), *tert*-amyl methyl ether, and di-isopropyl ether. The “California Air Resources Board” has predicted a decrease in ozone precursors of 15%, benzene emission of 50%, and CO emission of 11% with the addition of oxygenates or the exhaust of 15 million cars [11].

Since the 1970s, MTBE has been used in the United States. Its oxygenating effects have resulted in more extensive usage in recent years as a result of legislation on air quality, e.g. 1990 Clean Air Act Amendments in the US. According to these amendments oxygenates have to be added at least during winter (when CO concentrations in the air are at their highest) in concentrations varying from 15 to 30% (vol/vol). In 2000, it is expected that MTBE is added to approximately 70% of American petrol [35]. In the Netherlands, the used concentrations of MTBE are maximum 1.5%, much lower than in the US.

However, the enthusiasm about the use of MTBE is declining. MTBE is highly soluble, which makes it extremely mobile in groundwater, thus making it an important groundwater pollutant. A leaking petrol station in the vicinity of a drinking water well will cause drinking water of unacceptable quality in terms of taste and odour in no time. Concentrations as low as 20–50 µg/l can already cause this effect. At the moment, MTBE is the second most persistent contaminant in urban aquifers in the US [36]. Diffusion from the gas phase is less important. The USEPA (US Environmental Protection Agency) has classified MTBE as a possible human carcinogen, and has a provisional drinking water advisory of 20 to 200 µg/l, based on a life time intake and non-human carcinogenity. The advisory value coincides with the taste and smell threshold of MTBE (20 to 40 (µg/l) [35].

In Canada, MTBE is not at the list of toxic compounds. In Europe, the international Agency for Research on Cancer (IARC) in Lyon is performing an inventory of the available data and studies on MTBE toxicity. Toxicity studies with animals have shown that MTBE can be classified as carcinogenic for animals.

Due to the discussions about the possible health risks associated with MTBE, some states in the US (California and Maine) are about to ignore the 1990 Clean Air Act Amendments and refuse to add MTBE to their petrol [26]. A study to evaluate the effect of the better combustion of petrol versus the effect of ground- and drinking water will be started soon.

The presence of MTBE in the Netherlands and Europe and related ground water problems is to our knowledge underestimated, and in some countries even unknown. One of the given reasons for the lack of attention is that the added MTBE concentration in European petrol are much lower compared to the concentrations that are used in the US. Furthermore, the facilities at petrol stations in Europe vary from the American facilities. In Europe, double sided containers are used to store the petrol, and these containers are less likely to cause underground leakage. However,

the accident in 1998, when an MTBE tank exploded during cleaning and MTBE was released in the environment, shows that not only petrol stations are important when preventing MTBE leakage [1]. Emphasising on the facilities at petrol stations only (to prevent leakage from underground storage tanks and associated piping) will not prevent MTBE leakage. Besides, MTBE is used widespread, making it very difficult to prevent worldwide MTBE leakage.

Up to day it is uncertain whether MTBE will give similar problems in Europe. It can be expected that MTBE can cause health problems in Europe, will affect the taste and odour of drinking water already at low concentrations. To our knowledge, MTBE is not a part of routine analyses.

This report will give a state of the art about MTBE. The situation in the Netherlands will be described and a short report and conclusions of a Dutch workshop, titled “Who’s afraid of MTBE” (Bodem Breed 1999) will be presented.

# CHAPTER 2

# STATE OF THE ART

## 2.1 Introduction

Methyl tertiary-butyl ether (MTBE), Figure 1, is one of several fuel oxygenates added to petrol to improve fuel combustion and reduce the resulting concentrations of carbon monoxide and unburned hydrocarbons. Since the 1970s, MTBE has been used in the United States, and since 1988 in Europe. Its oxygenating effects have resulted in more extensive usage in recent years as a result of legislation on air quality (e.g. 1990 Clean Air Act Amendments in the USA).

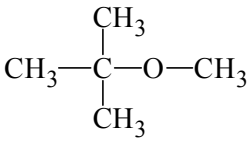

*Figure 1* Chemical structure of methyl tertiary-butyl ether (MTBE).

Other fuel oxygenates include ethanol, methanol, ethyl tertiary-butyl ether (ETBE), and tertiary-butyl ether (TBA). MTBE, however, is by far the most commonly used fuel additive. It is relatively inexpensive, easy to produce and blends well with petrol without phase separation. In the United States, oxygenated petrol must contain at least 2.7% oxygen by weight, which is equal to 15% MTBE by volume. Generally, MTBE concentrations in petrol vary from 15 to 30% [35]. In Europe, the used concentrations of MTBE vary from 1.5% to 15%.

The massive production and use of MTBE, combined with its high mobility due to its solubility, poor sorption properties and very low rates of intrinsic degradation, makes MTBE an important groundwater pollutant. Compared to the benzene, toluene, ethylbenzene and xylene (BTEX) components of petrol, MTBE is much more soluble and is less likely to adsorb to soil organic matter (low $K_{ow}$ values), see Table 1.
In fact, field scale observations indicate that MTBE moves as fast as a conservative tracer [2, 5].

*Table 1 Physical and chemical properties of MTBE compared to BTEXs [35].*

| Compound | MW | Solubility (g/l) | Vapour Pressure (mm Hg) | log $K_{ow}$ | H * $10^3$ (atm.$m^3$/mol) |
|---|---|---|---|---|---|
| MTBE | 88 | 48 | 245 | 0.94 - 1.16 | 0.55 |
| Benzene | 78 | 1.78 | 95 | 2.12 | 5.66 |
| Toluene | 92 | 0.52 | 22 | 2.73 | 6.71 |
| Ethylbenzene | 106 | 0.15 | 7 | 3.15 | 8.46 |
| Xylene (average) | 106 | 0.19 | 10 | 3.15 | 7.58 |

## 2.2 MTBE in the United States

The occurrence of MTBE in the US has been reported since the early eighties, and since then it received a lot of attention. The average annual production of MTBE in the US increased by approximately 25% between 1984 and 1994 [12].
An initial analysis of 20 sites showed that MTBE was the second most frequently detected chemicals in shallow groundwater [36]. Based on these results, a number of sites has been analysed for the occurrence of MTBE and were found to have contaminated groundwater [41]. Of the 1000 sites tested, more than 80 % were contaminated with MTBE, and concentrations as

high as 23 mg/l have been measured. As a result, MTBE was placed on the 1998 Contaminant Candidate List (CCL), published by the EPA, and identified as a contaminant with specific data gaps in the areas of health effects, occurrence data, and treatment technologies [40]. These data gaps should be filled in order for EPA to decide whether MTBE should be regulated or not.

### 2.3 MTBE in Europe

In Europe, the use of MTBE has started since 1988, when a Directive on the use of fuel oxygenates of the European Commission came into force. The only restrictions are that the level of oxygenates in petrol will not be more than 10 % (vol/vol) when transported over borders, and no more than 15 % (vol/vol) when used in the different countries.

Although several sites are reported to be contaminated with MTBE in several EU member states (e.g. Denmark, United Kingdom, France), a complete EU inventory on MTBE groundwater contamination is not available.

Air quality, particularly urban air quality, is also an important issue in Europe at the moment. However, even though the MTBE demand in Europe is growing, the octane problem is not as great as in the USA. This is because the restrictions on blending components are not as severe, but this is set to change with a new EU directive on fuel quality and vehicle emissions. The draft directive stems from the Auto/Oil programme, a tri-partite initiative between the European Commission and the oil and car industries designed to secure cost-effective compliance with air quality standard by 2010. The European Parliament modified the directive to require tighter fuel quality standards by 2000 and binding vehicle emission and fuel quality standards by 2005. Negotiations are still continuing, but once the directive has been finalised it will be for member states to determine how to achieve these new standards and the greater use of oxygenates such as MTBE may be one of the options considered.
If the use of MTBE in Europe increases, it is necessary to understand the impact of MTBE on the European environment.

### 2.4 Health risks associated with MTBE

Because the perception of MTBE as an environmental problem is a relatively new, studying the health effects of MTBE has only recently become a major item. Various studies have been performed to test the carcinogenity of MTBE to animals, and have shown MTBE to be carcinogenic to experimental animals [3, 4]. In a review of these studies, the International Agency for Research on Cancer in Lyon describe these and other studies to be of limited evidence of carcinogenity of MTBE to experimental animals. The highly variable organ site distributions of tumours in treated animals in the various studies left uncertainty about the reproducibility of the data [18]. They classified MTBE as a Group 3 compound, which means not classifiable as carcinogenic to humans, which is not the same as non-carcinogenic [27]. This lack of supported data involving the health effects of MTBE creates difficulties in developing regulatory guidelines for exposure to MTBE, e.g. in The Netherlands.
The USEPA however has classified MTBE as a possible human carcinogen, and has a provisional drinking water advisory that coincides with the taste and smell threshold of MTBE (20 to 40 μg/l). It appears that the threshold taste and odour concentration of MTBE is likely to be lower than any future human health-related guideline value.
In Canada, MTBE was found to be carcinogenic to animals under conditions that are not relevant to human exposure (at relative high doses or by non-relevant routes of exposure). Therefore, the Canadian Comity on Occasional Health and Safety removed MTBE from the list with chemicals that are carcinogenic to humans [8].

## 2.5 Mobility of MTBE in groundwater

Release of MTBE in the air and water occurs during manufacturing, distribution, storage, and use. Most of the MTBE release occur in the air and MTBE is degraded with a half-life as short as 3 days through photo-oxidation [33, 42]. However, MTBE is soluble in water and partitions readily from air to rainfall and snowfall. This results in deposition to land surface and subsequent contamination of surface and groundwater. Direct releases of MTBE to surface and groundwater occur as well, e.g. at petroleum product facilities, petrol stations, etc.

In a mixed composition contaminant source such as petrol, each individual compound will travel at a rate depending on its water solubility and sorption properties. Compared to the benzene, toluene, ethylbenzene and xylene (BTEX) components of petrol, MTBE is much more soluble and is less likely to adsorb to soil organic matter (low $K_{ow}$ values), see Table 1. MTBE moves through aquifers as fast as a conservative tracer, and is expected to travel at nearly the same velocity as the groundwater [2, 5]. Consequently, MTBE is expected to be at the leading edge of the plume, given sufficient time and distance.
Generally, the contamination of an aquifer can be predicted by modelling. The required parameters for these models are hydrologic, geologic, and contaminant specific. The latter include the transformation rates of the compounds in the soil, which are hardly known for MTBE. The first reports show that MTBE is very recalcitrant towards degradation. In many petroleum hydrocarbon plumes in the USA, MTBE replaced benzene as the risk determining contaminant [35]. The same accounts for the photolysis rate, and air-water exchange rates, making it very difficult to predict the transport of MTBE in contaminated aquifers [41].

A comparison between the transport of benzene and MTBE plumes is demonstrated in Figure 2. It shows that each component in a plume travels at a rate depending on its individual properties and that MTBE is at the leading edge of the plume after a certain time period.

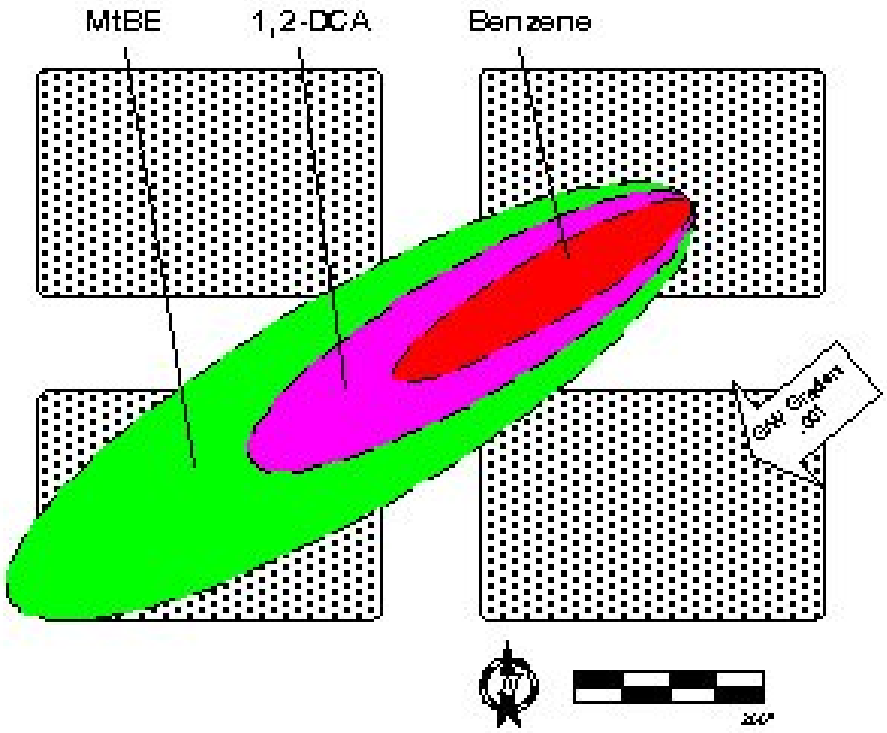


*Figure 2 Modelling of a plume with benzene, 1,2-DCA and MTBE*

## 2.6 Biological degradation, a literature review

Biological treatment of soil and water contaminated with MTBE may offer a simpler, less expensive alternative compared to chemical and physical processes. MTBE may not be as recalcitrant as previously thought. Several studies have found evidence of MTBE degradation in the laboratory and field under a variety of conditions [5, 16, 22-24, 28, 37].

A laboratory-based study reported complete MTBE degradation under aerobic conditions with an acclimated enrichment culture [28]. In experiments with cell suspensions, the production of tertiary-butyl ether (TBA) was demonstrated, and $^{14}C$ labelled MTBE was used to demonstrate the production of $^{14}C$-CO2. In further experiments, this culture (BC-1) has been used in a bioaugmentation field test and the MTBE concentration in this pilot was demonstrated to decrease faster compared to a non-augmented site [29]. Additional evidence with enrichment cultures that degrade MTBE aerobically, supports the aerobic degradation potential of MTBE [7, 17, 22, 31]. However, some reports have been published in which only limited [5] or no degradation of MTBE at all [19] occurred under aerobic conditions. This was possibly due to the presence of easier degradable substrates, like BTEX.
Degradation of MTBE under aerobic conditions has also been demonstrated with a variety of aerobic alkane degrading bacteria and fungi, They can either degrade MTBE co-metabolic when grown on e.g. pentane or butane [13, 15] or after growth on pentane or butane [37]. As the occurrence of MTBE usually coincides with the occurrence of alkanes, this might promote the degradation of MTBE.

Laboratory experiments under anaerobic conditions with methanogenic sediment and groundwater did not show any degradation of MTBE after 182 to 249 days of incubation [39]. In further experiments in which various soil samples and redox conditions were tested was concluded that MTBE resist anaerobic decay and must be considered recalcitrant [23]. However, Mormile and co-workers demonstrated that a decrease in MTBE were related to a stoichiometric increase in TBA concentrations, but this was only evident in a single replicate after a lengthy (152 days) acclimation period. In other anaerobic studies, the co-existence of other easier degradable substrates in microcosm studies with material from an MTBE plume is thought to be the cause of the recalcitrance of MTBE for microbial attack under anaerobic conditions [43].

In both the aerobic and anaerobic experiments, the degradation of MTBE is demonstrated to proceed via tertiary-butyl ether (TBA), which can be degraded via both aerobic and anaerobic conditions [6, 20, 24, 37]. Anaerobic degradation rates of TBA are higher than anaerobic degradation rates of MTBE.

So far, a few field studies have been performed. A site has been monitored for several years, showing a decrease in MTBE concentration over time [20]. However, the abiotic natural attenuation processes of dilution and dispersion in the direction of the groundwater flow are thought to play an important part in reducing the MTBE concentration.
A more extensive study has been performed in which the MTBE impacts on groundwater resources in California were evaluated [14]. They used the 1995-1996 data from 63 sites to define concentration contours of dissolved MTBE and benzene plumes using action levels of 20 and 1 mg/l. They concluded that MTBE is generally recalcitrant, that MTBE plumes are more mobile than benzene plumes, and that the primary attenuation mechanism is dispersion.
The same conclusion was drawn from a study in Texas [21]. They also observed that MTBE plumes are longer than their companion benzene plumes at the majority (56 %) of the investigated sites. However, they also traced sites where data indicate plume stability, which may be a direct evidence of natural attenuation. Other studies indicate that biodegradation played a major role in MTBE mass loss, although laboratory data did not always match the field results [5, 30].

A site at which MTBE was not degraded under the natural field conditions, a bioaugmentation field test has been performed. An acclimated enrichment culture (BC-1), capable of MTBE degradation, was injected in the field and the MTBE concentration in this pilot was demonstrated to decrease faster compared to a non-augmented site [29].

In addition, the potential for plants to take up, metabolise, and transpire MTBE has been studied. Poplar cells were able to oxidise 0.03% of the dosed MTBE to CO2, while 0.05% was fixed in cell tissue over a 3 day testing period [38]. In a field test, these percentages were a hundred times higher.

The laboratory and field studies show that the number temporal data is still limited. As the number of available data will increase, a clearer picture of the behaviour of MTBE in nature will emerge and information about plume formation will become available in future.

## 2.7 Practical applications / Field experiments

Various techniques are possible for the removal of MTBE, but not all of them have been used or tested.
Wastewater treatment is a common technique, but has not really been tested for MTBE contaminated groundwater.

In situ biological treatment depends on the presence of micro-organisms that are capable of degrading the pollutant, the biodegradation rate, and the environmental characteristics of a site. A sufficient permeability of the soil is needed to transmit fluids, and a uniformity of the subsurface is important to predict chemical transport and fate of the contaminant, and to characterise the site [25].

To date, several bioremediation field studies have been reported, but conflicting results have been found, making it difficult to predict the possibility of biological clean-up of a MTBE contaminated site. Bioaugmentation of a site with an acclimated enrichment culture (BC-1), capable of MTBE degradation, was demonstrated to be successful [29].

Chemical techniques, like air sparging, have been tested at sites. Air is injected below the water table, and either stripping, or aerobic degradation removes MTBE. This has been demonstrated in down-gradient wells, where initially 99% of the MTBE was removed by air stripping, followed by mainly aerobic degradation [9]. Adsorption on Granular Activated Carbon (GAC) is expected to be less effective, as the adsorption capacity of GAC for MTBE is very low [34].

Soil vapour extraction, which is commonly used to remove petrol contaminants, is theoretically applicable for MTBE as well, as MTBE has a high vapour pressure and low sorption capacity. In a computer simulation to predict the rate of MTBE removal, MTBE was predicted to be removed very quickly, and faster than the other components of petrol [10].

Chemical transformation of MTBE in aquifer material has been studied as well, and it was found that the addition of $H_2O_2$ resulted in the oxidation of MTBE to TBA and acetone [44]. A comparable transformation was found in aqueous phase with the addition of $H_2O_2$ and $Fe^{2+}$ (formation of Fentons reagents).

## 2.8 Conclusions

### *2.8.1 Is MTBE a problem?*

As a result of widespread use, leakage and spillage of petrol, MTBE will contaminate soil and groundwater. Due to its high mobility in the subsurface and most probably low biodegradation potential, MTBE arrives ahead of the hydrocarbon plume in contaminated soils. Up to date, there is a poor knowledge and network in European member states on spillage and groundwater

pollution occurrence, making the extent of the problem unknown. In the United States, MTBE is the second most frequently detected chemical in shallow groundwater, and concentrations as high as 23 mg/l have been measured (US EPA). As a result of consumer complaints about the acute health problems from inhalation of MTBE fumes and concerns about groundwater contamination, environmental groups and lawmakers in California and Main have called on EPA to phase out the additive. Its use is now banned in both states [26].

### *2.8.2 Recommendations for further actions*

The Danish EPA has raised the issue of MTBE a few years ago, and has already made an "action plan" to deal with the occurrence and persistence of MTBE in the environment. The Danish EPA Action Plan on MTBE encompasses the following elements:

- Comprehensive assessment of the preliminary limit level for MTBE;
- Monitoring developments with respect to the possibilities for finding suitable substitutes for MTBE;
- Preparation of regulations for the operation of existing filling stations, including more stringent control of the petrol storage tanks;
- Preparation of more stringent regulations governing the establishment of new filling stations;
- Enhanced monitoring;
- Ensuring analysis quality;
- Initiatives aimed at reducing unnecessary use of 98 octane petrol by motorists;
- Investigation of the possibilities to differentiate the petrol levy according to its MTBE content.

Management of MTBE

- Information and education;
- Pro-active stance;
- Focus on spill prevention and spill monitoring;
- Rapid response once release is detected;
- Manage groundwater issues.

# CHAPTER 3

# MTBE IN THE NETHERLANDS

At present, there are insufficient data to make an accurate assessment of the current risks posed by MTBE to Dutch groundwater resources. The presence of MTBE in Dutch ground water and soil is unknown, and might be underestimated. MTBE is being used in Europe since the late eighties, and as the used concentrations of MTBE in Europe and the Netherlands are much lower than in the United States, it is generally believed that MTBE will not cause any problems in the Netherlands. Another argument is the construction of the petrol tanks, which have to be double-sided in the Netherlands, thus causing less underground leakage [1]. A recent accident in 1998 when a MTBE tank exploded during cleaning and the soil was contaminated with MTBE, demonstrates that care should be taken with such statements [32]. Furthermore, the use of petrol is widespread making it nearly impossible to prevent leakage and spilling of petrol.

As MTBE is a hot topic in the US, it is difficult to believe that MTBE will be harmless in the Netherlands. It is very likely that MTBE will affect Dutch ground- and surface water in one way or the other. MTBE is not part of a routine analysis; this could be helpful to generate information about the existence of MTBE in the Netherlands.
In this project, groundwater from a few petrol stations has been analysed on MTBE, and the results are presented in Table 2.

*Table 2 MTBE concentrations at various locations.*

| Location / Well | Depth | Distance from petrol station | MTBE (µg/l) |
|---|---|---|---|
| Location 1 | | | |
| 120* | 2.0 - 4.0 | 1.0 | < 1,0 |
| 127 | 1.7 - 2.7 | 1.0 | ** |
| 128* | 2.5 - 4.5 | 1.0 | 1,7 |
| Location 2 | | | |
| 14 | 1.2 - 2.2 | 1.5 | ** |
| 15* | 0.9 - 1.9 | 1.0 | 16 |
| 200* | 2.0 - 3.0 | 2.5 | 120 |
| Location 3 | | | |
| 1 | 2.5 - 4.5 | 0.5 | ** |
| 22* | 2.5 - 4.5 | 8.0 | < 1,0 |
| 15 | 2.5 - 4.5 | 2.5 | ** |
| Location 4 | | | |
| PB2 | ? | ? | 47 |

* MTBE analysed with GC-MS analyse.
** MTBE could not be quantified, due to the presence of various other peaks in the chromatogram. A GC-MS analyse has not been performed on these samples.

In two out of ten samples, MTBE contamination ranging between 50 and 150 µg/l was found. Thus, in 20% of the samples, MTBE may form serious ground water contamination. Extrapolation is not recommended, but a further investigation is required.
This also has an impact in terms of prevention. Petrol stations should be safe!

# CHAPTER 4

# WORKSHOP "WHO'S AFRAID OF MTBE".

## 4.1 Introduction

A workshop entitled "Who's afraid of MTBE" has been organised at the Dutch soil conference *Bodem Breed 1999*.
Mainly people from research institutes and consultants were present at this workshop, along with a few representatives from advisory boards and the government.

## 4.2 Discussion

The discussion between the participants was started after a general introduction about the topic (presented slides are given in Appendix A). The 30 participants were divided in 2 groups, pro's and cons of the statement: "MTBE is a problem in the Netherlands". The participants were not free to choose there opinion, but were forced into a role, depending on their position in the room.
The discussion was started with blunt statements, to get a real discussion started.

### Statement 1: MTBE ruins our ground- and drinking water

Arguments "MTBE is not a problem"
- We have modern cars, that do not need MTBE. They need MTBE in the US as they drive old pick-ups and MTBE is needed to keep their engines running.
- The question is whether MTBE will cause problems in drinking water, as hardly any drinking water wells are in the vicinity of petrol stations. Therefore, MTBE will not be found in drinking water. As a matter of fact, their will be a number of other compounds that will cause larger effects than MTBE, e.g. nitrate. And MTBE can not be compared to these compounds, as it will be present in minor amounts only. MTBE might be a problem, but certainly not for drinking water quality.

Arguments "MTBE is a problem"
- When looking at the chemical properties of MTBE, it is justified to consider this a harmful compound. This is a valid reason why MTBE should be routinely analysed for, especially when high concentrations of benzene are found in the water.
- The argument that MTBE will not be found in Dutch groundwater is easily made, as this has never been sorted out. In the Netherlands, groundwater is a "receptor" and has to be protected.

### Statement 2: MTBE is a threat to human health

Arguments "MTBE is a problem":
- Up to date it is stated that MTBE is a carcinogen or potential carcinogenic compound. Whether a compound is carcinogenic or not, might not be the most important question here. The idea that a compound might be carcinogenic can already have a big impact on the public reaction. This might be the explanation for the reaction of the American people on the environmental impact of MTBE.
- If it is not a health problem, it will at least be a communication problem. If the media state that MTBE is not good for our health, then the public will feel it that way. Therefore it is necessary to get insight in the size of the potential MTBE problem in the Netherlands.

- In the Netherlands, a few labs analyse for MTBE, and MTBE has been analysed regularly (anonymously) in a Dutch bioremediation project. The outcome of this project was that MTBE is present in Dutch groundwater. A routine analyses for MTBE is not standardised in the Netherlands, whereas some other European countries do analyse for MTBE regularly.

Arguments “MTBE is not a problem”:
- MTBE will not be a threat to human health. How can MTBE be a threat, if we are all using petrol stations when filling our tanks without wearing a gas mask, and MTBE will be present 20 m deep in the soil? You need a very good media specialist to make a hype out of this so-called problem!

After these 2 statements it was clear that it was very difficult for the participants of the workshop to stick to their forced role, especially the ones that were supposed to be in favour of “MTBE is not a problem”. As said: “It will be a coincidence if Denmark, America and some other countries measure MTBE in their groundwater, and we stick to the opinion that we can’t smell it, don’t measure it, so there will be no MTBE problem!”

It was clear that everyone agreed with the statement “People dealing with soil contamination and bioremediation in the Netherlands should pay attention to possible MTBE contamination in the Netherlands”.

The other statements were not discussed like the previous ones, but the workshop was continued with a general discussion about the presence and prevention of MTBE in the Netherlands. A few questions and points were raised in this matter.

1. Is MTBE still present in the soil and groundwater after previous performed bioremediation projects?
2. A lot of petrol stations have been cleaned-up, but MTBE was already present at these stations before the clean-up process had started. How effective were these clean-ups for MTBE, as these projects and monitoring plans were focused at mineral oil and petrol contamination in hot spots. Possible larger contaminated plumes, caused by MTBE, are most likely left out in these clean-ups.
3. At the moment, not all petrol stations have been cleaned-up. Less than 60% of the petrol stations in the Netherlands do not have proper facilities. In the year 2005 the companies should properly equip all stations.
4. Are the newly planned facilities good enough to prevent leaking of compounds like MTBE, or will the facilities only be useful during incidental accidents.
   MTBE as an indicator for contamination at a site.
   MTBE can be used to give information about the level of contamination at a site. According to the Dutch protocol, all contaminants younger than 1987 have to be removed. Since MTBE is only present in Dutch petrol since 1988, MTBE can be used as a marker. If MTBE is found in the soil or groundwater, the site has to be cleaned-up. The only question is whether site-owners will be pleased with the possible use of MTBE as a marker, to see whether they have to clean their site or not?

A survey that was made under the participants of the workshop is presented in Appendix B.

### 4.3 Conclusion Workshop

The result of the workshop and discussion was that attention has to be paid to possible contamination of Dutch soil and groundwater with MTBE. Of course, this is slightly coloured as no representatives of the industry and site-owners were present at the workshop. Mainly people

from research and consultant companies were present at this workshop, along with a few representatives from advisory boards and the government.

The most important action steps, according to the people at the workshop are listed below:

1. An **inventory** of the presence of MTBE in the Netherlands;
2. Decide whether MTBE can cause a **problem** in the Netherlands and further action is needed;.
3. Lay down a **standard value** for MTBE, to get national attention for MTBE and the consequences of the use of MTBE.

Step 1 is needed to open the spiral that is hard to break out of; *"MTBE is not measured, so MTBE is not a problem and we do not need to measure it in future*". At the moment it seems as if MTBE is not measured because of ignorance (conscious and unconscious). Problems are denied, before being addressed and accepted. When a problem is accepted sooner, the general costs that are associated with control and taking measures are usual much lower, in stead of denying it for a long time.

Research that has been performed by TNO-MEP had already shown that it is very difficult to demonstrate the MTBE issue, if there is no real need to do so. As a result of this workshop a few ideas have been generated and networking has been done to overcome this deadlock.

# CHAPTER 5

# FURTHER ACTIONS

## 5.1 National

- Mr. J. Vegter of the Technical Soil Protection Committee (TCB) will address the importance of MTBE to the Dutch ministry of health and will advise to discuss the MTBE issue. A copy of the letter of the TCB to the Dutch ministry of health is given in Appendix C.
- **A Dutch company has offered to ask each of their clients for permission to analyse their groundwater samples for MTBE (anonymously).**

## 5.2 International

- Mr. Rovers, chairman of the European committee of MTBE producing companies (EFOA), has been contacted. He is interested in the ideas that live in Europe and the Netherlands and is willing to talk to VROM, if needed. He has written a letter to the Dutch ministry of health as well, in addition to the letter of the TCB, see Appendix C;
- A German research group is planning to start a European project regarding a European inventory about the presence of MTBE. Collaboration with this group is under research at the moment;
- A workshop will be held at the European soil conference ConSoil 2000;
- Finally, invitations have been send to start an international network on MTBE, in collaboration with the Nicole network;
- An impression of European activities on MTBE is given in Appendix D.

# CHAPTER 6

# CONCLUSIONS

The fact that MTBE has been found in Dutch groundwater near petrol stations and in groundwater in other European countries shows that the issue of MTBE in the Netherlands could be underestimated. The presence and prevention of MTBE in the Netherlands is unknown. It is considered very important for both problem (site) owners as well as research centres to gain knowledge about the presence of MTBE in groundwater and soil, methods to analyse MTBE, biological degradation processes, intermediates of the degradation process, and the monitoring of in-situ degradation of MTBE. Further investigation into this area is therefore highly needed.

First of all should be clarified to what extent MTBE is present in Dutch groundwater. Up to date, no public data are available on the occurrence of MTBE in the Netherlands and there is no need for site owners to analyse for MTBE, in case it is not regarded as a serious threat to the environment. A general inventory could give a better insight in the occurrence of MTBE in the Netherlands. From our own experience we know that it is very difficult to make such an inventory. Therefore this inventory has to be made under the authority of local or national authorities. With this inventory the discussion can start whether MTBE needs national attention, if the consequences of the use of MTBE have to be examined, and how a possible problem of MTBE in groundwater can be tackled.

Finally, an official national standard for MTBE has to be determined. An official Dutch standard does not exist for MTBE, but some consultants use a guideline of a few mg/l, whereas concentrations as low as 20 - 40 µg/l have already a negative effect on the taste and odour of the water. Probably it is not possible to have an official standard of MTBE, as MTBE is a relatively new or young contaminant. As a result, MTBE does not fall under the “Wet Bodem Bescherming” (Law of Soil Protection) of 1987, but under the new so-called “zorgplicht” (responsibility to maintain the soil quality). The Danish EPA has a guideline value of 30 µg/l.

So far, a few ideas have been generated and discussions have started to overcome the deadlock where we are at the moment. But the main issue, the help and willingness of site owners to collaborate with research groups on an MTBE inventory and/or the need to do so under authority of local and national authorities will be a must.
Contact with several groups abroad (Denmark, England, Germany will be used for a wider network and a possible European collaboration.

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# APPENDIX A

## SHEETS PRESENTED AT THE WORKSHOP "WHO'S AFRAID OF MBTE?" AT THE DUTCH SOIL CONFERENCE BODEM BREED 1999

Translations are available with the author

# APPENDIX B

## RESULTS SURVEY "WHO'S AFRAID OF MTBE ?" HELD AT THE WORKSHOP "WHO'S AFRAID OF MTBE?", AT THE DUTCH SOIL CONFERENCE BODEM BREED 1999.

Translations are available with the author

# ENQUÊTE “WHO’S AFRAID OF MTBE ?”

Bent U bang voor MTBE?

| | |
|---|---|
| ja | 6 |
| nee | 14 |
| ? | 2 |

Wist U wat MTBE was voor deze workshop?

| | |
|---|---|
| ja | 14 |
| nee | 6 |
| ? | 2 |

Hoeveel locatie’s kent u waar MTBE is aangetroffen?

| | |
|---|---|
| 0 | 17 |
| 1 | 2 |
| 2 | 1 |
| veel | 1 |
| USA | 1 |

Laat U MTBE standaard analyseren?

| | |
|---|---|
| ja | 1 |
| nee | 13 |
| nvt | 8 |

Denkt/Vindt U dat de situatie in USA (MTBE problematiek) te vergelijken is met de situatie hier?

| | |
|---|---|
| ja | 8 |
| nee | 14 |

Denkt U dat MTBE een probleem in Nederland gaat opleveren voor:

- Grondwaterverontreinging?

| | |
|---|---|
| ja | 17 |
| nee | 1 |
| beperkt | 4 |

- Bodemverontreiniging?

| | |
|---|---|
| ja | 10 |
| nee | 8 |
| beperkt | 3 |
| ? | 1 |

- Drinkwaterverontreiniging?

| | |
|---|---|
| ja | 8 |
| nee | 11 |
| beperkt | 1 |
| ? | 2 |

Denkt U dat er een correlatie te leggen is tussen benzeen pluimen, MTBE pluimen en mogelijke afbraak van benzeen?

| | |
|---|---|
| ja | 10 |
| nee | 9 |
| ? | 3 |

Denkt U dat MTBE een invloed hebben op het opstellen van het beslissing ondersteunend systeem voor de natuurlijke afbraak van verontreinigingen?

| | |
|---|---|
| ja | 14 |
| nee | 5 |
| ? | 3 |

Vindt U dat bodemreinigend Nederland aandacht moet besteden aan (mogelijke) MTBE verontreinigingen?

| | |
|---|---|
| ja | 22 |
| nee | 0 |

Vindt U dat er normen voor het voorkómen van MTBE moeten worden opgesteld?

| | |
|---|---|
| ja | 18 |
| nee | 4 |

Vindt U dat moet worden voorkómen dat MTBE in het milieu terecht komt?

| | |
|---|---|
| ja | 21 |
| nee | 0 |
| ? | 1 |

Moet het gebruik van MTBE worden voorkómen?

| | |
|---|---|
| ja | 9 |
| nee | 12 |
| ? | 1 |

Moet het gebruik van alternatieven voor MTBE worden onderzocht?

| | |
|---|---|
| ja | 18 |
| nee | 3 |
| evt. | 1 |

Is onderzoek in Nederland gewenst naar:

- Afbreekbaarheid MTBE onder verschillende condities (labschaal)?

| | |
|---|---|
| ja | 16 |
| nee | 1 |

- Afbreekbaarheid MTBE op verschillende locaties?

| | |
|---|---|
| ja | 18 |
| nee | 1 |

- Verspreidingsrisico's?

| | |
|---|---|
| ja | 19 |
| nee | |

Reuktest:
Wat is volgens U de volgorde van de flesjes met MTBE in oplopende concentratie (max. concentratie is 20 µg/l).

Ik ben verkouden
Ruikt allemaal naar rubber
De test is verder door niemand ingevuld, het flesje met 100 µg/l werd wel door de meeste aanwezigen als een vervelende geur waargenomen.

# OPMERKINGEN NAV DE ENQUÊTE "WHO'S AFRAID OF MTBE ?"

Denkt/Vindt U dat de situatie in USA (MTBE problematiek) te vergelijken is met de situatie hier?

Nee, want MTBE is in Nederland pas na 1988 toegepast (meer milieubewustzijn en bodembeschermende voorzieningen) en er wordt 'slechts' 1 a 2 % aan de benzine toegevoegd.

Denkt U dat MTBE een probleem in Nederland gaat opleveren voor:

- Bodemverontreiniging?

  Ja, maar mogelijk op locaties waar MTBE wordt geproduceerd, opgeslagen, vermengd enz.
- Drinkwaterverontreiniging?

  Ja, want uit de discussie bleek dat het moeilijk uit het drinkwater te verwijderen is.

Denkt U dat er een correlatie te leggen is tussen benzeen pluimen, MTBE pluimen en mogelijke afbraak van benzeen?

Wel tussen de verschillende pluimen, niet met de afbraak van benzeen

Nee, omdat benzeenverontreinigingen waarschijnlijk (veel) eerder dan 1988 zijn begonnen

Vindt U dat er normen voor het voorkómen van MTBE moeten worden opgesteld?

Nee, er moet eerst meer inzicht in het probleem komen en duidelijk worden of het een probleem is.

Vindt U dat moet worden voorkómen dat MTBE in het milieu terecht komt?

Nee, want ik denk dat dit al gedaan wordt.

Moet het gebruik van MTBE worden voorkómen?

Eerst MER op alternatieven

Moet het gebruik van alternatieven voor MTBE worden onderzocht?

Nee, want dat is al onderzocht.

Geen idee, zijn die er dan?

Elke toevoeging heeft voor- en nadelen

Is onderzoek in Nederland gewenst naar:

- Afbreekbaarheid MTBE onder verschillende condities (labschaal) en op verschillende locaties?

  Niet mee beginnen

Overig onderzoek:

In kaart brengen probleem

Eerst onderzoeken of het aanwezig is, en dan de specifieke eigenschappen

Overige opmerkingen

Toch een baseline studie om de verspreiding kwalitatief en kwantitatief in kaart te brengen.

Op basis van de gepresenteerde gegevens en discussie is er op dit moment geen genuanceerde uitspraak mogelijk over het MTBE probleem

MTBE is een bronprodukt en moet daarom in het analysepakket komen op die locaties waar benzeen ook een probleem is.

## APPENDIX C

## LETTERS TO THE DUTCH MINISTRY OF HEALTH, WRITTEN BY THE TCB AND EFOA.

Mr. J. Vegter of the Technical Soil Protection Committee (TCB) will address the importance of MTBE to the Dutch ministry of health and will advise to discuss the MTBE issue. A copy of the letter of the TCB to the Dutch ministry of health is given this .

# APPENDIX D

# AN IMPRESSION OF EUROPEAN ACTIVITIES ON MTBE