INFICON

APPLICATION NOTE

Low Level PPB Detection of MTBE in Groundwater Using the CMS5000 Monitoring System

INTRODUCTION

Since the late 1970s, methyl tert-butyl ether (MTBE), a synthetic, volatile, colorless ether has been used as an additive in reformulated gasoline (RFG) in the United States. The purpose of this additive was to promote more thorough combustion of gasoline by an engine in order to reduce carbon monoxide and ozone emissions. As a result of the Federal Clean Air Act of 1990, many areas of the country with the worst ozone or smog problems were required to use RFG with MTBE. Unfortunately, leaks in petroleum storage tanks and pipelines contaminated many groundwater supplies used by communities as a source of drinking water. MTBE-contaminated drinking water is easily recognizable by its unpleasant turpentine-like taste and odor. To make matters worse, because of its small molecular size and high solubility in water, MTBE moves into groundwater at a much faster rate and is more difficult to remove than other gasoline components such as benzene, toluene and xylene. Therefore, many states have banned the use of MTBE in reformulated gasoline replacing it with ethanol.

At numerous locations across the country, remediation efforts are underway to reduce MTBE contamination from groundwater down to permissible concentration levels. During the remediation process, groundwater samples are usually collected on a regular basis and sent to a commercial analytical laboratory for gas chromatographic analysis. The results of these analyses are used to assess the progress and effectiveness of the MTBE removal process. Since the remediation process can take months or even years to complete, total sample analysis costs can become quite significant. An alternative to manual groundwater sampling, followed by commercial laboratory analysis for MTBE, can be found in a system designed to automatically collect water samples and analyze them right at the site of contamination. The CMS5000 Gas Chromatography Monitoring System developed by INFICON has been designed to operate in an automated mode right on site, eliminating the need for manual sampling and lab analysis. The system can be set up to automatically collect, analyze and transmit MTBE concentration data over the course of days, weeks or months. The software allows an operator to extract and consolidate concentration and time data from multiple files with minimal effort. As a result, the time required to create concentration versus time trend plots, an important tool for determining the direction of future remediation efforts, can be minimized. This application note illustrates the effectiveness of the CMS5000 system in detecting and accurately quantifying low levels of MTBE contamination in groundwater.

EXPERIMENTAL

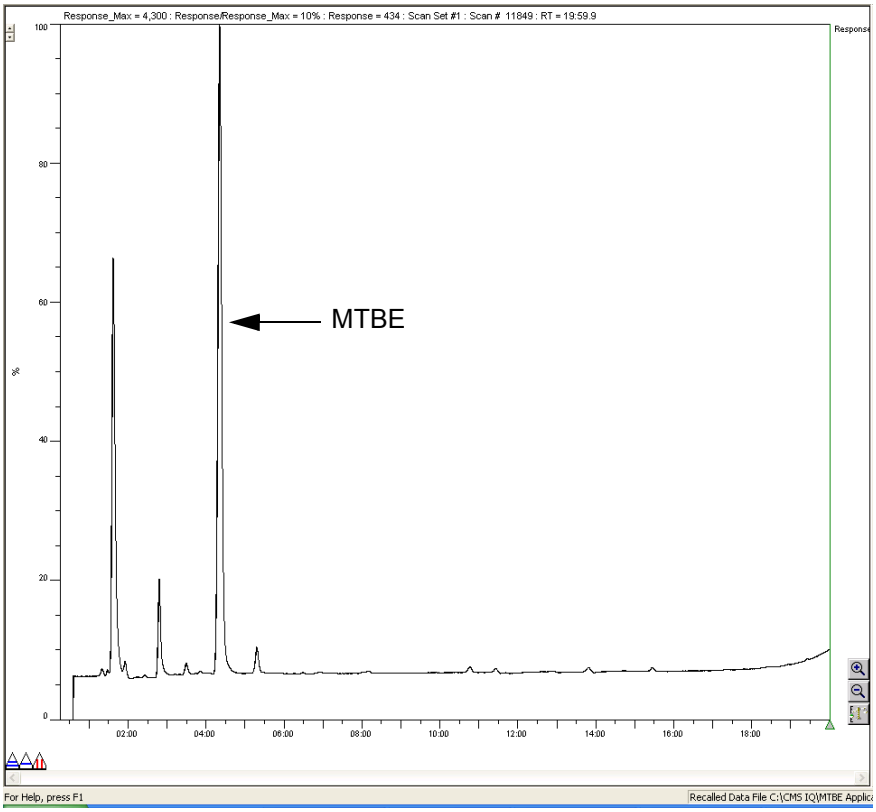
MTBE calibration standards were prepared at 1.0, 5.0 and 10.0 ppb by spiking 2 liters of VOC-free water with 1.0, 5.0 and 10.0 µL of a 2000 ppm MTBE standard. MTBE calibration standards dissolved in water were purged with argon and a 3 mL gaseous sample was collected on the installed Tri-Bed concentrator. The MTBE was thermally desorbed from the concentrator and separated on a capillary column using a 20 minute method with column temperature programming. A three-point calibration curve with quadratic fit forced through the origin was generated from the data.

Calibration accuracy was measured by analyzing a 5.0 ppb MTBE verification standard and calculating the percent recovery. Figure 1 shows a chromatogram of the 5.0 ppb MTBE standard. The percent recovery was found to be 97%.

CONCLUSION

MTBE is a persistent groundwater contaminant found in many municipal drinking water supplies. The CMS5000 Monitoring System was designed specifically for applications requiring on site and unattended monitoring of contaminants in water over short time intervals and/or extended periods of time. It has been shown to be an extremely useful tool for accurate detection of MTBE contamination in water down to sub-ppb levels. Over the course of months, a CMS5000 operator can remotely monitor and track day-to-day changes in MTBE concentration, and thus alleviate the need for personnel to travel to and from the site on a regular basis. Therefore, the expensive and time-consuming process of collecting groundwater samples, sending them to a commercial analytical laboratory for analysis, and waiting for results is no longer necessary.

Figure 1 Chromatogram of MTBE at a Concentration of 5.0 ppb



Column: HP-1MS, 30 m, 0.32 mm id, 4.0 µm df, Conc. Fill: 1 min.
Temperature Profile: 60°C (hold 1 min.) to 90°C at 4°C/min., to 135°C at 6°C/min., to 200°C at 20°C/min. (hold 45 sec)