**MTBE Case Study**
***Ex Situ* Air Stripping and GAC Treatment of Drinking Water at the Rockaway Township Site, Rockaway, New Jersey**

**Site Name:** Rockaway Township

**Site Location:** Rockaway Township, New Jersey

**Contaminants:** MTBE, TCE, diisopropyl ether (DIPE), other VOCs, TBA

**Media:** Drinking Water

**Technology:** Air stripping followed by granular activated carbon (GAC)

**Technology Scale:** Full

**Type of Cleanup:** NJDEP Administrative Consent Order

**Period of Operation:** 1980 to present

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**Site History [1,3,5]:**

The Rockaway Township, located in northern New Jersey, owns and operates a water supply system that provides drinking water to about half of the township's population. The system supplies groundwater from two wells (wells 6 and 7) ranging in depth from 100 to 200 feet that are located in an unconsolidated glacial deposit. Individual well flows are 450 gpm (well 6) and 850 gpm (well 7), with the total system capacity of two million gallons per day (MGD) as a result of head (pressure) constraints in the wells. An additional well (well 4) was removed from service in 1988, and sealed in 1994.

The supply wells were found to be contaminated with trichloroethene (TCE), detected in November 1979, and with MTBE and diisopropyl ether (DIPE), detected in October 1980. Concentrations of MTBE were found in the supply wells at levels ranging from 25 to 40 ug/L, and DIPE at levels ranging from 70 to 100 ug/L. In response to resident complaints about odor and taste of the water, the township provided alternative supplies of drinking water as an interim measure. The source of the contamination was identified as a gasoline service station (Shell Oil).

To treat the drinking water from the supply wells, a GAC system was initially installed. However, during operation, breakthrough of MTBE and DIPE occurred relatively quickly. As a result, the carbon had to be replaced once every four to six weeks, rather than the six to eight months that had been expected. Pilot-scale tests were then conducted to evaluate the effectiveness of aeration (air stripping) as a pretreatment step prior to the GAC system. Air stripping was found to lower levels of the ethers in the water and prolong the life of the carbon. In December 1981, air stripping (packed column) was added to the system and began operating in February 1982.

**Technology Description [1,4,5]:**

From October 1980 to February 1982, the drinking water treatment system at the Rockaway Township site was GAC only. Since February 1982, the drinking water treatment system at the site has included air stripping followed by GAC. During this time, there have been modifications to the design and operation of the air stripping and GAC components of the system, as described below.

*GAC*

The GAC system consists of two downflow pressure contactors that are operated in parallel. Each contactor is 20 feet high and 10 feet in diameter and contains 20,000 pounds of Calgon F-300 carbon (bituminous coal-based granular carbon, 8 by 30 mesh). The system has a rated capacity of 1,000 gpm with a surface loading rate of 6.3 gpm/sq ft and a contact time of 12 minutes. Treated water from the GAC system is pumped directly into the distribution system.

In July 1983, the GAC system was taken offline, because the air stripping system was achieving MTBE concentrations of less than 1 ug/L, and reduced concentrations of MTBE and DIPE in the influent to the air stripper. To avoid bacteria buildup in the carbon while offline, a small amount of water (20 gpm) was pumped through the GAC system on a continuous basis. However, in response to complaints by residents about scaling in their hot water heaters caused by the change in water chemistry during stripping, the GAC system was placed back into service.

*Air Stripping*

The original air stripping system was constructed of aluminum and was a countercurrent packed column 35 feet high and 9 feet in diameter with a design capacity of 1400 gpm (2 MGD). The column was packed with 1640 cubic feet of 3-inch polyethylene telerettes, with a packing height of 25 feet. The design air flow rate was 37,500 cubic feet per minute (cfm) with an air-to-water ratio of 200:1. Well water was pumped into the top of the column and flowed by gravity through the packed media. Air was blown upward through the column using two centrifugal blowers (each rated at 27,500 cfm at 16 inches of water). Treated water was collected in an aluminum clear well located under the column. Water from the clear well was then pumped to the GAC system using two booster pumps (each rated at 700 gpm at 114 psi).

In 1993, the aluminum column was found to be corroded and was replaced with a fiberglass air stripper of the same height and dimensions as the aluminum column. In addition, because MTBE was no longer observed in the supply wells, the fiberglass air stripper was redesigned to focus on the removal of TCE and DIPE, rather than MTBE. The new design uses a 30 hp blower and 20,000 cfm of air flow. The flow of supply well water through the aeration system is the same as described above for the aluminum column.

**Technology Performance [1,2,4,5]:**

No specific treatment goals for MTBE were provided.

*GAC-only system (October 1980 - February 1982):*

As discussed above, the original GAC-only system operated from October 1980 to February 1982. Initial contaminant influent concentrations were 25-35 ug/L MTBE, 70-80 ug/L DIPE, and 10 ug/L TCE. During the first two months of operation, effluent concentrations of contaminants were below detectable limits (detection limits not specified). However, by January 1981, MTBE and DIPE began to break through the GAC, with levels of MTBE as high as 23 ug/L and DIPE as high as 13 ug/L. In March 1981, the carbon was replaced and lasted about four months before breakthrough occurred; subsequent carbon replacement was required once every four to six weeks, until aeration was added as a pretreatment step.

*Air Stripping and GAC system (February 1982 to ongoing):*

For the first two weeks of operation of the air stripper, the concentrations of MTBE and DIPE in the effluent from the GAC system were less than 1 ug/L. However, MTBE and DIPE levels in the GAC effluent rose to 2-3 ug/L (higher than the influent concentration of 1 ug/L), indicating that MTBE and DIPE were desorbing from the carbon. By December 1982, MTBE and DIPE levels in the effluent fell to less than 1 ug/L, indicating that MTBE and DIPE had been sufficiently desorbed to no longer be found at elevated concentrations in the effluent from the GAC. In 1993, MTBE was no longer found in water from the supply wells, and the system was redesigned, as described above, to focus on the treatment of TCE and DIPE. Replacement of the carbon has not been required since the addition of the air stripper.

In 1997, the Shell Oil gasoline service station developed another leak, with MTBE entering the Rockaway Township drinking water supply wells. MTBE levels in the supply wells were found at concentrations ranging from 1 - 8 ug/L. Shell Oil installed an off site treatment plant which contained the MTBE to within minimal levels. In addition, TBA was also detected in the supply wells. According

to the Rockaway Township, as of July 2000, no MTBE or TBA are currently found in the supply wells. The air stripper/GAC treatment system is continuing to remove TCE and other VOCs (1,1-DCE, 1,1-DCA) from the supply wells.

**Technology Cost [1]:**

*Air Stripping*

The capital cost for the air stripping system was estimated to be $375,000 (1981$), including the column, packing media, blowers, piping, controls, site work, and booster pumps. The annual operating cost (primarily cost for power) was estimated to be $100,000, based on a cost for electricity of $0.09/kW-hr.

*GAC*

The capital cost for the GAC system was estimated to be $200,000 (1980$), including the contactors, GAC, piping, site work, and the building. The annual operating cost (primarily carbon replacement) was estimated to be $200,000 ($0.52/1,000 gallons of water treated, 1980$). Carbon usage rates were calculated based on measured influent levels and flow rates, with a breakthrough of 4 ug/L for ether compounds. Carbon usage without air stripping was calculated to be 1.0-2.0 lbs of GAC per 1,000 gallons of water treated. Carbon usage with air stripping was <0.01 lb of GAC per 1,000 gallons treated of water treated. The carbon has not been replaced since the air stripping system has been operating.

**Observations and Lessons Learned:**

The use of air stripping followed by GAC has been effective in treating MTBE in drinking water to levels of less than 1 ug/L. In addition, levels of DIPE, TCE, and other VOCs in the water from the supply wells have been reduced using this system.

At this site, the use of GAC alone was found to not be cost-effective. Carbon breakthrough of MTBE and DIPE occurred more quickly than expected (four to six weeks versus six to eight months), increasing the cost of carbon replacement.

The air stripping/GAC system is continuing to be used to treat TCE and other VOCs; however, no MTBE or TBA are currently found in the drinking water supply wells.

**References:**

1. McKinnon, Ronald J., and John E. Dyksen. *Removing Organics from Groundwater Through Aeration Plus GAC*. Journal of the American Water Works Association. May 1984.

2. U.S. Environmental Protection Agency, National Risk Management Research Laboratory (prepared by Dynamac Corporation). *Assessment of the Environmental Consequences of Oxygenated Fuels*. Draft, October 1997.

3. Record of Telephone Conversation between Steve Michener, Tetra Tech EM Inc., and Robert Sheard, Rockaway Township. Information on treatment technologies used at Rockaway Township. September 9, 1999.

4. Record of Telephone Conversation between Steve Michener, Tetra Tech EM Inc., and Fenton Purcell. Information on Rockaway Township, NJ site. October 13, 1999.

5. E-mail from Robert W. Sheard, Superintendent, Rockaway Township, to Richard Weisman, Tetra Tech EM Inc. Rockaway Township Airstripping Facility. July 10, 2000.