

## ***Ex Situ* Air Stripping at LaCrosse, Kansas**

**Site Name:** LaCrosse

**Site Location:** LaCrosse, Kansas

**Contaminants:** MTBE, BTEX, TPH

**Media:** Drinking Water

**Technology:** Air stripping

**Technology Scale:** Full

**Type of Cleanup:** State regulated

**Period of Operation:** 1997 to present

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**Site History [1,4,5]:**

The city of LaCrosse operates a drinking water treatment plant that provides water for the city's residents. Water from two public water supply (PWS) wells (Well #4 and Well #5) is pumped to the

treatment plant where it is softened (using hydrated lime) and disinfected (using chlorine) prior to distribution. The plant treats approximately 300 gallons per minute (gpm) in the winter and 450 gpm in the summer.

In April 1997, the two LaCrosse PWS wells were found to be contaminated with MTBE, BTEX, and other petroleum hydrocarbons. The source of the contamination was determined to be leaking underground storage tanks (UST) at three gasoline service stations located about 0.8 miles to the west of PWS Well #5. Contamination from the USTs at each of the service stations resulted in a commingled plume of total petroleum hydrocarbons (TPH), benzene, toluene, ethylbenzene, and xylene (BTEX), and methyl tert-butyl ether (MTBE). As of February 1999, the MTBE plume had migrated almost a mile east, resulting in contamination of PWS Wells #4 and #5, with MTBE concentrations as high as 1,050 ug/L found in the wells.

In April 1997, as an emergency response measure, a temporary air stripping system for treating MTBE was installed to allow the wells to continue to be used as the city's water supply source. In addition, the State of Kansas has installed and is maintaining carbon adsorption treatment systems (two carbon canisters in series) at several homes not served by the treatment plant. In September 1997, a permanent air stripping system (packed towers) was installed at the LaCrosse drinking water treatment plant and is still in operation. In addition, remediation efforts are underway to treat MTBE and other contamination in the groundwater migrating from the three UST source areas. The remediation is being conducted in the area known as Rush Center. These efforts include excavation of contaminated soil, soil vapor extraction and air sparging, and injection of oxygen release compound. This case study report focuses on the treatment of MTBE at the LaCrosse drinking water treatment plant.

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

#### Temporary Shallow Tray Strippers

The temporary air stripping system was installed in April 1997 and operated as an emergency response measure until the permanent system was completed. An existing five-tray air stripper that was being used as part of the pump and treat system at Rush Center was relocated to the LaCrosse treatment plant. The tray stripper was designed to extract water from the clear well at one end and put treated water back in at the opposite end. The flow rate for this system was 250 gallons per minute (gpm).

#### Permanent Packed Stripping Towers

The permanent air stripping system was installed in September 1997 and is still in operation. The system includes two packed air stripping towers, each 33 feet tall by 6 feet in diameter, operated in series. Both towers are packed with 2-inch Jaeger Tri-pack filled to 21 feet and have a design air to water ratio of 150:1. The design flow rate is 480 gpm for MTBE influent concentrations of up to 1,000 ug/L. The first tower is designed to remove MTBE to levels below 20 ug/L, with the second tower used to polish the water. Each tower is equipped with a blower designed to circulate 10,000 cubic feet per minute (cfm) of air. Influent water from the PWS wells is pumped to the water treatment facility, where it is first softened with lime, and routed into a settling basin for flocculation before being pumped into the first air stripper tower. The effluent from the second tower is pumped through a sand and anthracite filter into a 200,000 gallon underground clear well. Water is then put into distribution from the clear well.

## Technology Performance [1,2,3,4]

The treatment goal for MTBE is 10 ug/L in the effluent from the air stripping system. The objective of the temporary shallow tray stripping system, installed as an emergency measure, was to remove as much MTBE as possible prior to distribution.

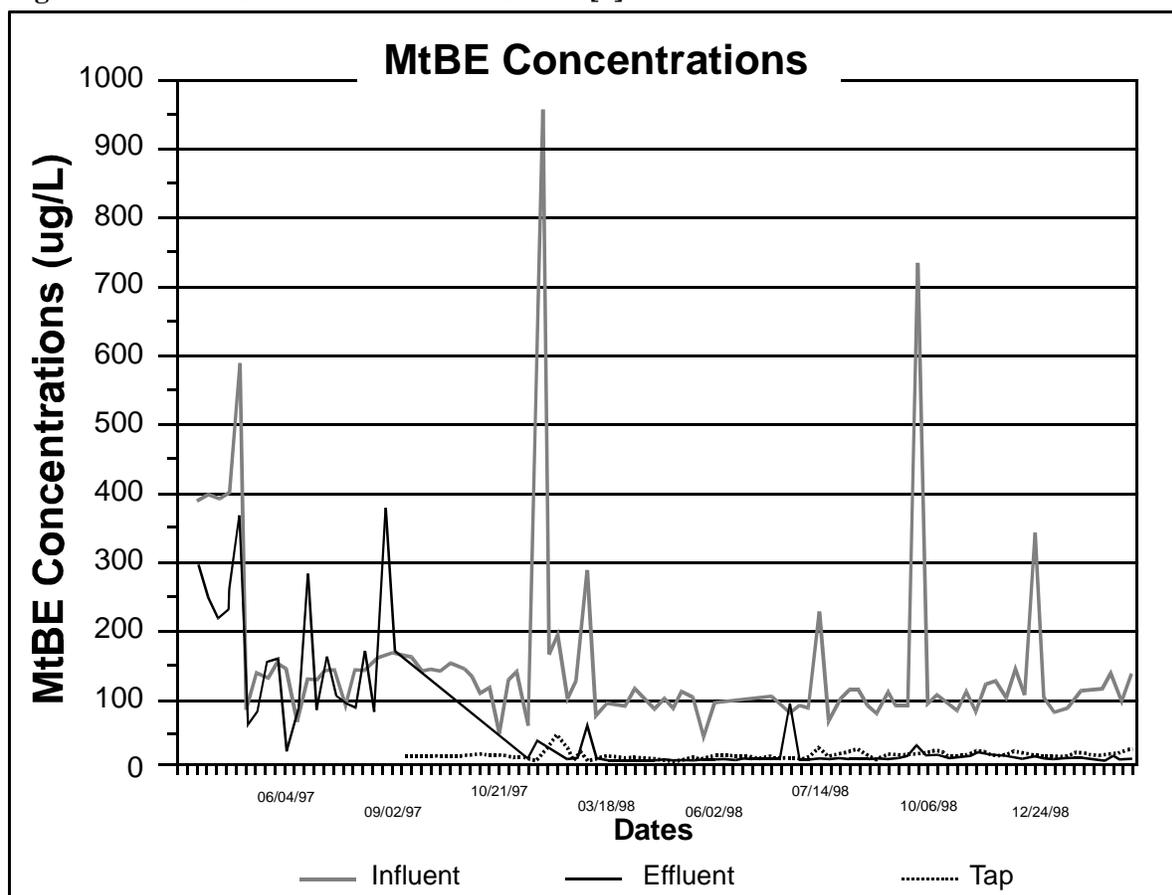
### Temporary Shallow Tray Strippers

The five-tray air stripper operated for a total of five months until the permanent air stripping system came on line. During that time, MTBE influent levels of 200-600 ug/L were reduced to concentrations ranging from 17-375 ug/L, an average reduction of 40 percent.

### Permanent Packed Stripping Towers

The permanent packed tower air stripping system at LaCrosse has been operating since September 16, 1997, and performance data for MTBE treatment are available through September 1999. Table 1 (included at the end of the report) provides a detailed summary of MTBE data from September 1997 through September 1999, including data on influent and effluent concentrations and percent reductions in each tower. Figure 1 presents a summary of MTBE concentrations in influent, effluent, and tap water samples collected during this timeframe.

**Figure 1: MTBE Concentrations at LaCrosse [1]**



As shown in Table 1, MTBE effluent concentrations from the packed tower air stripping system were consistently below the treatment goal of 10 ug/L (about 93% of the time), and were below the detection limit of 0.2 ug/L almost 30 percent of the time. Of the 69 effluent samples collected between September 16, 1997 and September 1, 1999, 64 of the samples were below the cleanup goal. The five exceedances ranged in concentration from 19 to 74 ug/L, with the last exceedance observed in September 1998.

Data on percent reduction in MTBE concentrations presented in Table 1 shows that the average percent reduction after the first stripper tower was 83% and 95% after the second stripper tower. The average percent reduction in the tap water samples was 92%. Influent MTBE concentrations were generally less than 200 ug/L during this period of operation. As illustrated in Figure 1, occasional spikes in influent MTBE concentrations were observed during this period of operation. The spikes appeared to correspond to the treatment of water from PWS Well #5, which contained higher MTBE concentrations than Well #4. PWS #4 is pumped five days a week (Monday-Friday), while PWS #5 is pumped on Saturdays to maintain operational conditions for backup purposes when PWS #4 is down. As a result of discussions with KDHE, pumping of Well #5 has been reduced from about 21 hours per month to 5-10 hours per month.

No significant operation or maintenance problems have been reported and there have been no problems with fouling or scaling to date.

#### **Technology Cost [4]**

The total capital cost for the packed tower system was \$185,000. The operation and maintenance costs are \$30,000 per year. The treatment system is operated by city personnel. No costs were provided for the temporary air stripping system.

#### **Observations and Lessons Learned:**

During the first two years of operation, the dual packed tower air stripping system at the LaCrosse treatment plant has consistently reduced MTBE concentrations in the source wells to below the cleanup goal of 10 ug/L. There have been no exceedances of the cleanup goal during the last 12 months of operation.

According to the State, the stripping system appears to be less efficient during extremely cold weather. Ambient air is pulled from outside the building into the air stripper blowers with no preliminary heating process.

#### **References**

1. MTBE Research Partnership. *Treatment Technologies for Removal of Methyl Tertiary Butyl Ether (MTBE) from Drinking Water*. Published by the National Water Research Institute, Fountain Valley, CA; (714) 378-3278. <<http://www.ocwd.com/nwri>>. December 1998.
2. Telephone call record. Conversation between Steve Michener, Tetra Tech EM Inc., and Bill Reetz, Kansas DHE. October 12, 1999.
3. E-mail from Bill Reetz, KDHE, to Linda Fiedler, EPA/TIO. "MTBE Case Study". December 16, 1999.

4. Bill Reetz, KDHE. State of Kansas Remediation Systems and Public Water Treatment System for MTBE Contaminated Sites. Presented at the Second International Conference on Remediation of Chlorinated and Recalcitrant Compounds, Monterey, CA. May 22-25, 2000.
5. Bill Reetz, KDHE. Telephone Call with Richard Weisman, Tetra Tech EM Inc., Additional Information About the LaCrosse Case Study. June 21, 2000.

**Table 1. Summary of MTBE Levels from the LaCrosse Treatment System [3]**

Date	Influent (ug/L)	Clear Well (ug/L)	Between Strippers (ug/L)	Effluent (ug/L)	Tap (ug/L)	Percent Reduction - 1 <sup>st</sup> Stripper	Percent Reduction - 2 <sup>nd</sup> Stripper	Percent Reduction to Tap
9/16/97	138	NA	13.8	<0.2	6.88	90.00	100.00	95.01
9/17/97	142	NA	12.6	<0.2	5.75	91.13	100.00	95.95
9/18/97	139	NA	14	<0.2	<0.2	89.93	100.00	100.00
9/23/97	151	NA	13.3	<0.2	<0.2	91.19	100.00	100.00
9/24/97	147	NA	14.1	<0.2	<0.2	90.41	100.00	100.00
9/30/97	136	NA	14.3	<0.2	3.87	89.49	100.00	97.15
10/8/97	107	NA	11.4	<0.2	<0.2	89.35	100.00	100.00
10/14/97	116	NA	<0.2	<0.2	<0.2	100.00	100.00	100.00
10/21/97	46.1	NA	14.9	<0.2	66.1	67.68	100.00	-43.38
10/29/97	129	NA	11	<0.2	3.96	91.47	100.00	96.93
11/18/97	140	NA	14	<0.2	58	90.00	100.00	58.57
12/16/97	52.6	NA	13.1	3.33	3.64	75.10	93.67	93.08
12/29/97	954	NA	168	29.4	48.9	82.39	96.92	94.87
1/13/98	159	NA	35.1	19.3	231	77.92	87.86	-45.28
1/26/98	197	NA	51.4	NA	71.2	73.91	100.00	63.86
2/11/98	93.9	NA	17.9	4.02	<.2	80.94	95.72	100.00
2/24/98	125	NA	23.9	5.01	38.1	80.88	95.99	69.52
3/3/98	290	NA	171	51.1	12.9	41.03	82.38	95.55
3/10/98	71.8	NA	15.8	3.92	6.07	77.99	94.54	91.55
3/18/98	93.2	NA	19	2.99	7.41	79.61	96.79	92.05
3/25/98	90	NA	17.1	4	3.78	81.00	95.56	95.80
4/1/98	88.4	NA	17.2	3.68	9.83	80.54	95.84	88.88
4/9/98	115	NA	18	3.1	17.3	84.35	97.30	84.96
4/15/98	99.7	NA	>.2	<.2	<.2	100.00	100.00	100.00
4/21/98	84	NA	13.9	<.2	<.2	83.45	100.00	100.00
4/28/98	97.6	NA	13.3	<.2	5.32	86.37	100.00	94.55
5/6/98	83	NA	8.4	<.2	11.4	89.88	100.00	86.27
5/13/98	110	NA	10	<.2	5.5	90.91	100.00	95.00
5/20/98	98	NA	15	2.6	16	84.69	97.35	83.67

**Table 1. Summary of MTBE Levels from the LaCrosse Treatment System [3] (continued)**

Date	Influent (ug/L)	Clear Well (ug/L)	Between Strippers (ug/L)	Effluent (ug/L)	Tap (ug/L)	Percent Reduction - 1 <sup>st</sup> Stripper	Percent Reduction - 2 <sup>nd</sup> Stripper	Percent Reduction to Tap
5/27/98	39.6	NA	6.92	1.26	4.36	82.48	96.81	88.96
6/2/98	91	NA	16	2.5	5.6	82.42	97.25	93.85
6/9/98	100	NA	16	2.9	12	84.00	97.10	88.00
6/16/98	92	NA	16	2.6	3.7	82.61	97.17	95.98
6/24/98	73	NA	12	74	3.5	83.56	-1.37	95.21
7/1/98	87	NA	13	2	2.8	85.06	97.70	96.78
7/7/98	82.9	NA	11.4	1.2	1.17	86.25	98.55	98.59
7/14/98	227	NA	18.5	2.46	7.14	87.00	98.92	96.85
7/21/98	62.6	NA	10.5	<.2	2.85	83.23	100.00	95.45
7/28/98	94.9	NA	10.4	1.04	4.39	89.04	98.90	95.37
8/4/98	108	NA	12.7	2.08	20.8	88.24	98.07	80.74
8/11/98	110	NA	12.2	<.2	27.5	88.91	100.00	75.00
8/19/98	87.7	NA	11.2	1.34	10.7	87.23	98.47	87.80
8/26/98	70.4	NA	12.6	<.2	2.84	82.10	100.00	95.97
9/1/98	108	NA	15.2	3.03	23.6	85.93	97.19	78.15
9/9/98	86.1	NA	16.7	2.42	4.94	80.60	97.19	94.26
9/16/98	84.3	NA	15	2.55	5.01	82.42	97.01	94.13
9/30/98	731	NA	124	19.6	6.52	83.04	97.32	99.11
10/6/98	88.9	NA	16.5	4.32	3.78	81.44	95.14	95.75
10/14/98	101	NA	19.7	4.55	<.2	80.50	95.50	100.00
10/20/98	86.4	NA	12.4	2.37	7.02	85.65	97.26	91.88
10/28/98	77.7	NA	12.7	2.53	6.09	83.66	96.74	92.16
11/3/98	107	NA	11.7	3.19	2.83	89.07	97.02	97.36
11/12/98	73.3	NA	17.6	5.22	7.96	75.99	92.88	89.14
11/18/98	116	NA	15.1	7.41	14.8	86.98	93.61	87.24
11/24/98	121	NA	12.6	1.03	1.38	89.59	99.15	98.86
12/2/98	94	NA	9.86	0.58	1.63	89.51	99.38	98.27
12/8/98	143	NA	16.5	3.29	3.58	88.46	97.70	97.50
12/16/98	102	NA	16	3.05	4.85	84.31	97.01	95.25

**Table 1. Summary of MTBE Levels from the LaCrosse Treatment System [3] (continued)**

<b>Date</b>	<b>Influent (ug/L)</b>	<b>Clear Well (ug/L)</b>	<b>Between Strippers (ug/L)</b>	<b>Effluent (ug/L)</b>	<b>Tap (ug/L)</b>	<b>Percent Reduction - 1<sup>st</sup> Stripper</b>	<b>Percent Reduction - 2<sup>nd</sup> Stripper</b>	<b>Percent Reduction to Tap</b>
12/21/98	339	NA	52.6	9.82	2.9	84.48	97.10	99.14
12/28/98	93.3	NA	11.6	1.31	7.38	87.57	98.60	92.09
1/6/99	72.8	NA	8.9	1.45	2.93	87.77	98.01	95.98
1/12/99	76.7	NA	11.4	1.78	11	85.14	97.68	85.66
2/3/99	87.6	NA	11.8	1.29	2.52	86.53	98.53	97.12
3/3/99	108	NA	14.3	2.65	2.82	86.76	97.55	97.39
4/6/99	<.2	NA	<.2	<.2	<.2	NC	NC	NC
5/5/99	108	NA	4.9	0.28	35.8	95.46	99.74	66.85
6/1/99	134	NA	29.4	7.98	15.2	78.06	94.04	88.66
7/7/99	87.4	NA	12.2	2.53	13	86.04	97.11	85.13
8/3/99	132	NA	19.6	4.11	8.68	85.15	96.89	93.42
9/1/99	78	NA	11.5	1.62	1.28	85.26	97.92	98.36
<b>Average Removals</b>						<b>83%</b>	<b>95%</b>	<b>92%</b>

NA - not analyzed  
 NC - not calculated