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2-Butanone and Tetrahydrofuran Contamination in the Water Supply[1]

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MEK (2-butanone) and THF (tetrahydrofuran) were found in high concentrations in our laboratory's water outlets 6 mo after PVC (polyvinyl chloride) pipe installation. Subsequent analysis confirmed that the solvents from the PVC pipe cement used to join the tubing were leaching into our water supply. Water samples were taken at various residence times in the pipe to observe the solvents' leaching kinetics.

MATERIALS AND METHODS

Before sample collection, the water was run for about 30 min to purge the contaminated water from the pipes. After flushing, the tap was closed for a predetermined time to establish a residence time for the water in the pipe. Twenty-five mL of water were collected and placed in a corning Midget bubbler unit (C); figure 1 shows the sample collection scheme: nitrogen gas (A), purified through charcoal and silica gel column (B), was then bubbled through the sample (C) to purge the volatile organics from the water onto the Tenax column (D). Nitrogen flowed at a rate of 35 cc/min for 15 min. The volatile organics were thus concentrated on the Tenax column (NOVOTNY 1974, PELLIZZARI 1975), a 13 cm x 6 mm ID stainless tubing packed with 0.2 g of 60/80 mesh Tenax and fitted with a Swagelok fitting on the inlet and a Luer-Lock syringe needle adapter on the outlet.

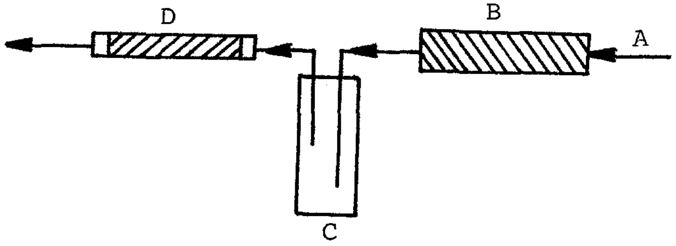

Figure 1. Sample Collection Scheme.

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After sample collection, the column (D) was removed from the bubbler unit (C), fitted with a No. 20 syringe (E) needle on one end and connected to the gas chromatograph nitrogen carrier gas line (A) on the other end as shown in Figure 2. With the carrier gas bypassing the Tenax column, a heating wire (K) was used to heat the column for 5 min to a final temperature of 165 C. The carrier gas was then switched using a three-way valve (L) to the column for 1.0 min, eluting the organic compounds from the Tenax column to the G.C. column (G).

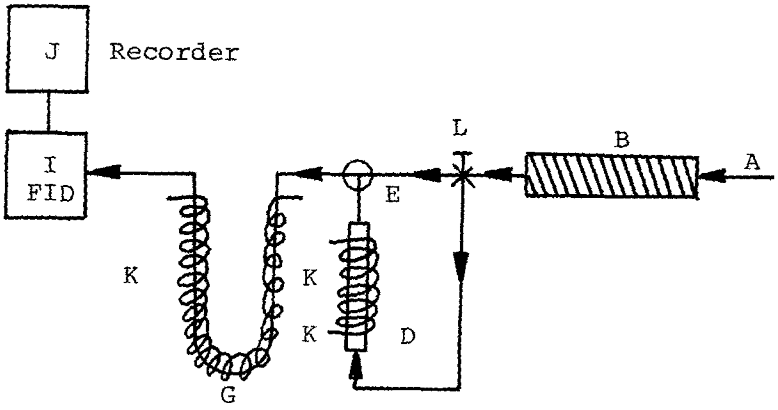

Figure 2. Sample Analysis.

Analysis was performed using a 1.2 m x 3 mm OD glass column packed with 0.2% Carbowax 1500 on 60/80 mesh Carbopak C; carrier gas low rate was 8 cc/min. Column temperature was maintained at 23.5 C for 5 min and then heated at a rate of 8 C/min to reach a final temperature of 60 C. The samples was measured by a flame ionization detector (I) and recorded on a strip chart recorder (J). The sample was also injected into a GC-mass spectrometer for positive confirmation.

Recovery. Distilled water (25 mL) fortified with 50 μL each of MEK and THF was preconcentrated and analyzed using the identical procedure as for sample analysis. A linear calibration curve was obtained for the range of samples analyzed. Average recovery efficiency was found to be 12 and 14% for MEK and THF, respectively. Results were corrected for the true values in the samples based on these values.

TABLE 1. Concentration (ppm) of MEK and THF in Water Samples at Various Residence Times in the PVC Pipe

Residence Time (h)	Samples taken 6 mo after pipe installation		Samples taken 8 mo after pipe installation	
	MEK	THF	MEK	THF
0	0	0	0	0
4	0.4	1.0	0.1	0.7
8	0.6	1.7	-	-
16	1.8	5.8	0.6	2.4
24	2.2	8.9	1.1	3.7
48	3.9	12	2.1	6.8
64	4.5	13	-	-
72	-	-	2.2	7.5
96	4.5	13	-	-

RESULTS AND DISCUSSION

Two sets of water samples were collected 6 and 8 mo after PVC pipe installation and usage in our laboratory. About 80 feet of 1.5 in. diameter PVC pipe was installed. Bond Tite^R (Pearsall Polymer Co.) PVC pipe cement was used for joint connection. About 40 gal of water were used daily in the laboratory. The water temperature was about 21 C. Seven water samples at different residence times in the PVC pipe were taken for analysis. After each sample taken, water in the PVC pipe was thoroughly flushed out and one sample was immediately taken and analyzed. This sample was reported as zero residence time in the pipe. Each sample was done in triplicate, average data were used (Table 1). Deviation of each experimental run was 0.8% for THF and 0.6% for MEK.

When the residence time was zero, there was no detectable MEK or THF found in the samples. Both MEK and THF concentration increased with a longer residence time and finally approached an equilibrium condition. The final equilibrium concentration for THF and MEK in the first set of samples was 13 and 4.5 ppm, respectively. The second set of water samples, taken at 8 mo after PVC pipe installation and use, reached a final equilibrium concentration for THF and MEK of 7.5 and 2.2 ppm, respectively. The results show that the residence time for MEK and THF compounds in both sets of samples reach equilibrium concentration in about 48 h.

A comparison of the data from the two sets of samples indicates that concentration of both MEK and THF in the second set were reduced to 1/2 of the concentration in the first set. About 2,400 gal of water was used during the period of samples taken between Set I and Set II. This water presumably removed some of the MEK and THF from PVC pipe cement in the pipe.

REFERENCES

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