

# Unexpected Compounds: Where They Can Come From

Have you ever sent samples to a laboratory expecting to find one compound but find several others along with it? The answer to this mystery is really quite simple - biodegradation. When biodegradation is used as a tool for bioremediation, it can be very useful. Reasons for this are varied, but usually boil down to reductions in cost and the possibility of fewer future liabilities (landfill failures, accidental releases, etc.). However, when biodegradation is not expected, it can further confuse an already complex site investigation. Therefore, it is incumbent upon environmental professionals to be aware of possible metabolites associated with the compounds in question.

One area where biodegradation can really effect chemical composition is in the anaerobic transformations of chlorinated aliphatic hydrocarbons in aquifer systems. Many professionals have seen ground water systems where contaminants change over a gradient from the source. These systems seem to "clean" themselves gradually. What some people are not aware of is that the transformations observed are not chemically but microbially mediated.

For some time, the academic world has been aware that if indigenous populations of bacteria are given the correct conditions (i.e., sufficient nitrogen and phosphorus, optimal temperatures, etc.) they are usually capable of degrading pollutants without any other technological aids. Many bacteria can completely degrade a wide array of normally recalcitrant chemicals, but some chemicals are extremely hard to break down, leading to the existence of metabolites with exceedingly long half lives.

This "partial" degradation creates a new set of problems. Metabolites associated with the parent compounds initially released into the ground water or soil may appear. This is especially important if the metabolite is more toxic, carcinogenic or recalcitrant than the original compound.

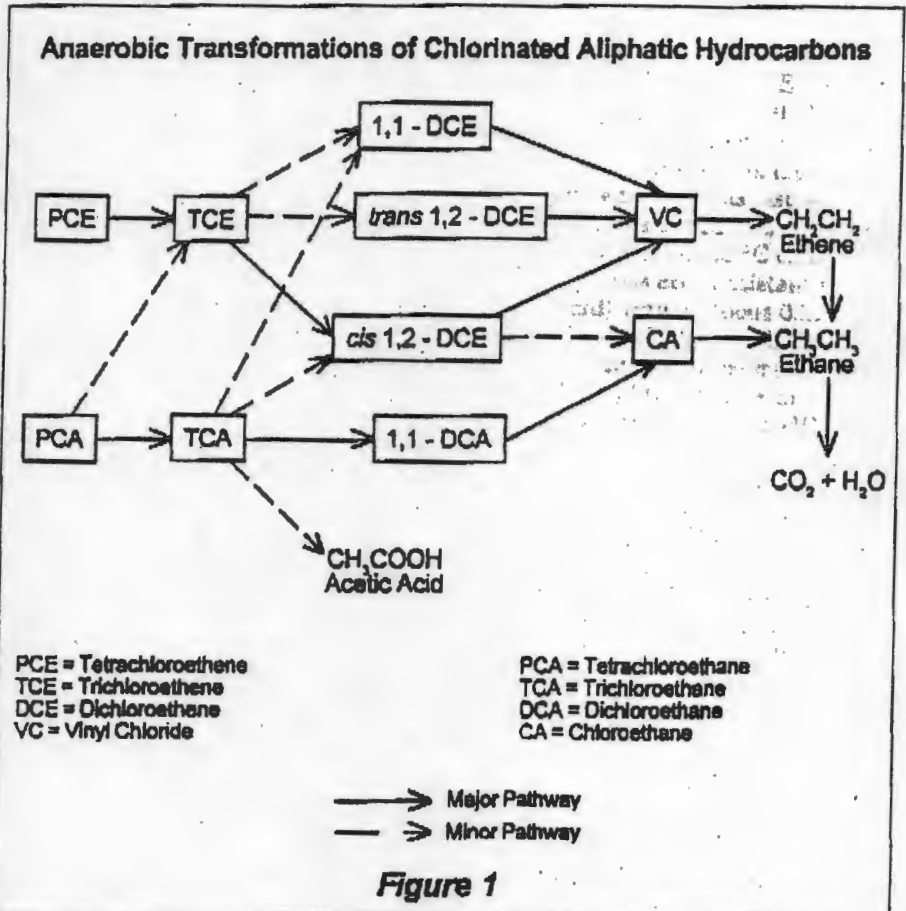
Compounds commonly found as aquifer contaminants which have this problem are tetrachloroethene (PCE) and trichloroethene (TCE) as well as tetrachloroethane (PCA) and trichloroethane (TCA). PCE and TCE, when metabolized by indigenous bacteria in an aquifer, go first from PCE to TCE, then to dichloroethene (DCE), and finally to vinyl chloride (VC). This process is outlined in Figure 1.

Most PCA is converted to chloroethane and acetic acid which are not considered genotoxic compounds. However, some of the bacteria which break-down PCA and TCA do produce undesirable VC by hydrolyzing TCA and

producing cis 1,2-DCE and 1,1-DCE which then makes VC.

The primary reaction of concern in ground water systems seems to be one of reductive dehalogenation. Under the highly reduced conditions found in many aquifers, anaerobic bacteria "make a living" from Carbon-Chlorine bond energy. Unfortunately, as the bacteria rids the compound of each successive Chlorine atom, the other Carbon-Chlorine bonds become stronger, making it more difficult for the bacteria to break them.

The VC limit has challenged many researchers to try to overcome this barrier. Recent studies suggest that VC metabolism is possible under relatively short times in mixed batch cultures. VC metabolism is also very quickly achieved aerobically. In order for the environmental professional to design the appropriate treatment, it is essential that they are aware of contaminant metabolites. ■



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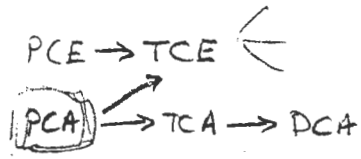
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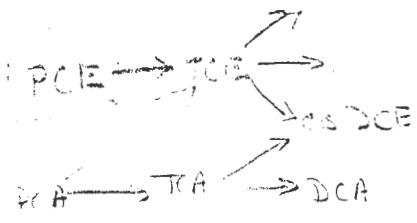
POUND RIDGE Sampling Summary  
 SCOTTS CORNERS  
 Sampling Results Available as of 3-9-95

16 Westchester Avenue Nina Scuderl	3-7-95		No Contamination Found
22 Westchester Avenue Stewart Simon	2-14-95		No Contamination Found
34 Westchester Avenue Curry And Hovis	2-14-95		No Contamination Found
35 Westchester Avenue Pound Ridge Vet	2-14-95		No Contamination Found
54 Westchester Avenue Hunter Travel Service	2-14-95	19ppb	MTBE
56 Westchester Avenue J. Brown Interiors	2-14-95	21ppb	MTBE
57 Westchester Avenue U. S. Post Office	1-26-95	4.9ppb	MTBE
Trinity Corners Shopping Center	2-14-95	2.5ppb	MTBE
60 Westchester Avenue Country Treasures	8-18-94	6.6ppb	MTBE
65 Westchester Avenue Antiques and Tools Joan Silbersher	8-18-94	34ppb .59ppb	MTBE 1,1-Dichloroethane
	2-8-95	.57ppb 300ppb	1,1-Dichloroethane MTBE Other Purgeable Compounds
	2-14-95	.84ppb 330ppb	1,1-Dichloroethane MTBE Other Purgeable Compounds

PCA → TCA → DCA



66 Westchester Avenue Shell Station	8-18-94	13ppb	MTBE	
		1.2ppb	1,1-Dichloroethane	
		1.3ppb	Toluene	
	2-8-95	120ppb	MTBE	
		1.8ppb	1,1-Dichloroethane	
		.63ppb	1,1,1-Trichloroethene	
			Other Purgeable Compounds	
67 Westchester Avenue The Country Shopper	8-18-94	15ppb	MTBE	
		.54ppb	Chloroform	
	2-8-95	560ppb	MTBE	
	2-14-95	450ppb	MTBE	
			Other Purgeable Compounds	
68 Westchester Avenue Chubby's Hardware	8-18-94	3300ppb	MTBE	
		52ppb	Benzene	
		2ppb	Chlorobenzene	
		.68	1,4-Dichlorobenzene	
		.51	Naphthalene	
		3.8	1,1-Dichloroethane	
		1.3	Cis-1,2-Dichloroethene	
		1.5	Trichloroethene	
		.51	O-Xylene	
		2-1-95	3500ppb	MTBE
			2.6	1,1-Dichloroethane
		1.2	Tetrachloroethene	
			Other Purgeable compounds	
Prefilter	2-8-95	3500ppb	MTBE	
		1.4ppb	Benzene	
		.92ppb	Chlorobenzene	
		.60	1,3-Dichlorobenzene	
		.97	Tetrachloroethene	
		3.0	1,1-Dichloroethane	
		.54	Cis-1,2-Dichloroethene	
	.68	Trichloroethene		
			Other Purgeable Compounds	
Midfilter	2-8-95	No Contamination Found		
69 Westchester Avenue The Orange Cherry	8-18-94	25ppb	MTBE	



70 Westchester Avenue Di Nardo's Restaurant	2-18-94	1.5ppb	MTBE
Dora Landry Antiques	8-18-94	41ppb	MTBE
	2-8-95	29ppb	MTBE
71 Westchester Avenue The Wine Connection	2-3-94	No Contamination Found	
	8-18-94	10ppb	MTBE
	2-8-95	9.4ppb	MTBE
72 Westchester Avenue Pound Ridge Cleaners	7-1-93	1.3ppb 4.6ppb	Tetrachloroethene MTBE
Moreno's Residence Postfilter	2-3-94	6.8ppb 4.9ppb	Tetrachloroethene MTBE
	2-22-94	5.6ppb 4.3ppb	Tetrachloroethene MTBE
Prefilter	5-9-94	2.0ppb 250ppb	Tetrachloroethene MTBE
Midfilter		.55ppb 48ppb	Tetrachloroethene <u>Dichlorodifloromethane</u> <i>From 12</i>
Postfilter		No Contamination Found	
Prefilter	8-18-94	4.6ppb 530ppb 1.4ppb .5ppb	Tetrachloroethene MTBE Toluene Benzene
Midfilter		460ppb 7.7ppb	MTBE <u>Dichlorodifloromethane</u>
Postfilter		2.3ppb	<u>Dichlorodifloromethane</u>
Prefilter	2-1-95	3.0ppb 400ppb	Tetrachloroethene MTBE Other Purgeable Compounds
Postfilter	2-8-95	600ppb 44ppb	MTBE <u>Dichlorodifloromethane</u>
Prefilter	2-14-95	7.4ppb 320ppb	Tetrachloroethene MTBE Other Purgeable Compounds
Midfilter		600ppb	MTBE Other Purgeable Compounds
Postfilter		830ppb	MTBE Other Purgeable Compounds

73 Westchester Avenue	8-18-95	4.7ppb	MTBE
Kulhanek and Plan	2-8-95	6.3ppb	MTBE
NatWest Bank			
74 Westchester Avenue	2-8-95	120ppb	MTBE
Travel Agency			
77 Westchester Avenue	2-18-94	.6ppb	Toluene
Texaco Station		15.2ppb	MTBE
	8-18-94	1.8ppb	MTBE
	2-8-95	7.9ppb	MTBE
78 Westchester Avenue	2-3-94	10ppb	MTBE
The Deli	8-22-94	5.6ppb	MTBE
	2-8-95	8.4ppb	MTBE (Before/After)
		8.0ppb	MTBE (After)
79 Westchester Avenue	8-22-94	No Contamination Found	
Houlihan/Lawerence	2-8-95	No Contamination Found	
80 Westchester Avenue	2-3-94	No Contamination Found	
Scotts Corners	8-22-95	2.0ppb	1,4-Dichlorobenzene
Fire Station		1.1ppb	MTBE
	2-8-95	1.6ppb	MTBE
81 Westchester Avenue	8-22-94	No Contamination Found	
Tony Woolner Designer			
83 Westchester Avenue	8-22-94	No Contamination Found	
Preferred Realty	2-14-95	No Contamination Found	
The Corner Store			

85 Westchester Avenue Moon Struck Pizza	8-22-94	No Contamination Found	
87 Westchester Avenue Scotts Corner Service Station	8-22-94 2-8-95 2-21-95	No Contamination Found No Contamination Found No Contamination Found	
89 Westchester Avenue Ambulance Corp.	2-21-95	2.5ppb	<u>Dichlorodifloromethane</u> F-12 Presoftener
	2-21-95	2.9ppb	<u>Dichlorodifloromethane</u> Postsoftener
8 Trinity Lane Len	1-26-95 2-8-95	1.3ppb 2.4ppb	Chloroform Chloroform MTBE
10 Trinity Lane Santulli	1-26-95 2-8-95	4.2ppb 3.8ppb	MTBE MTBE
14 Trinity Lane Scofield	1-26-95 2-8-95 2-8-95	10ppb 7.6ppb 8.2ppb	MTBE MTBE (Before Softener) MTBE (After Softener)
18 Trinity Lane Laird	1-26-95	2.1ppb 1.2ppb 11ppb	1,1-Dichloroethane 1,1,1-Trichloroethnene MTBE

22 Trinity Lane  
Janiga

1-26-95	4.8ppb	1,1-Dichloroethane
	1.1ppb	1,1,1-Trichloroethene
	440ppb	MTBE
	.90ppb	Cis-1,2-Dichloroethene
2-1-95	4.1ppb	1,1-Dichloroethane
	1.2ppb	1,1,1-Trichloroethene
	410ppb	MTBE
	.97ppb	Cis-1,2-Dichloroethene
		Other Purgeable Compounds

Before Filter

2-8-95	4.1ppb	1,1-Dichloroethane
	1.1ppb	1,1,1-Trichloroethene
	460ppb	MTBE
	.89ppb	Cis-1,2-Dichloroethene
		Other Purgeable Compounds

Between Filters

2-8-95		No Contamination Found
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25 Trinity Lane  
Wade

1-26-95	4.6ppb	1,1-Dichloroethane
	260ppb	MTBE
2-1-95	6.2ppb	1,1-Dichloroethane
	1.3ppb	1,1,1-Trichloroethene
	310ppb	MTBE
		Other Purgeable Compounds

26 Trinity Lane  
Levine

1-26-95	8.4ppb	1,1-Dichloroethane
	2.0ppb	Cis-1,2-Dichloroethene
	.57ppb	Tetrachloroethene
	1.7ppb	Benzene
	.87ppb	Sec-Butyl Benzene
	1.0ppb	1,2-Dichlorobenzene
	1.0ppb	1,4-Dichlorobenzene
	7200ppb	MTBE
	4.9ppb	Chlorobenzene
		Other Purgeable Compounds

(Kitchen Tap)	2-1-95	14ppb 3.6ppb .91ppb 2.0ppb 1.4ppb 1.6ppb 1.6ppb 7200ppb 7.4ppb 1.2ppb	1,1-Dichloroethane Cis-1,2-Dichloroethene Tetrachloroethene Benzene Sec-Butyl Benzene 1,2-Dichlorobenzene 1,4-Dichlorobenzene MTBE Chlorobenzene 1,1,1-Trichloroethene Other Purgeable Compounds
(First tap after pump)	2-1-95	8.1ppb 2.1ppb .56ppb 1.4ppb .91ppb 1.0ppb 1.1ppb 6800ppb 5.0ppb .71ppb	1,1-Dichloroethane Cis-1,2-Dichloroethene Tetrachloroethene Benzene Sec-Butyl Benzene 1,2-Dichlorobenzene 1,4-Dichlorobenzene MTBE Chlorobenzene 1,1,1-Trichloroethene Other Purgeable Compounds
(Shower Hot Water) (NYSDOH)	2-2-95	5.9ppb 1.9ppb .7ppb .7ppb 3.4ppb .5ppb	1,1-Dichloroethane Cis-1,2-Dichloroethene 1,2-Dichlorobenzene 1,4-Dichlorobenzene Chlorobenzene 1,1,1-Trichloroethene
(Shower Basin Hot Water) (NYSDOH)	2-2-95	1.5ppb 0.6ppb 1.0ppb	1,1-Dichloroethane Cis-1,2-Dichloroethene Chlorobenzene
(Kitchen Hot Water) (NYSDOH)	2-2-95	7.3ppb 2.4ppb .8ppb .8ppb 4.3ppb .6ppb	1,1-Dichloroethane Cis-1,2-Dichloroethene 1,2-Dichlorobenzene 1,4-Dichlorobenzene Chlorobenzene 1,1,1-Trichloroethene
(Boiled Water) (NYSDOH)	2-2-95	2.4ppb 0.9ppb 1.5ppb	1,1-Dichloroethane Cis-1,2-Dichloroethene Chlorobenzene
(Kitchen Tap)	2-3-95	160ppb	MTBE
(PreSoftener)	2-3-95		No Contamination Found
(Kitchen Tap)	2-14-95	96ppb	MTBE



6 Lower Trinity Pass Brown, Charlie	1-26-95	26ppb	MTBE
10 Lower Trinity Pass Seymour	1-26-95	15ppb .76ppb	MTBE 1,1,1-Trichloroethene
Prefilter	2-14-95	7.4ppb .62ppb .73ppb	MTBE 1,1-Dichloroethene 1,1,1-Trichloroethene
Midfilter	2-14-95	No Contamination Found	
Postfilter	2-14-95	No Contamination Found	
15 Lower Trinity Pass Thom	12-20-95	3.5ppb .43ppb .47ppb	MTBE 12-20 Sampled by Thom 1,1,1-Trichloroethene 1,1-Dichloroethene
	1-26-95	4.3ppb	MTBE
	2-8-95	3.2ppb	MTBE
17 Lower Trinity Pass Dunne	1-26-95	2.2ppb	MTBE
	2-8-95	No Contamination Found	
22 Lower Trinity Pass Huges, Kit	2-24-95	No Contamination Found	
23 Lower Trinity Pass Tomaselli	1-26-95	No Contamination Found	
24 Lower Trinity Pass Post, Katherine	2-24-95	No Contamination Found	
27 Lower Trinity Pass Russell, Roberta	2-21-95	No Contamination Found	
46 Lower Trinity Pass Nieburg, Herb	3-7-95	No Contamination Found	

18 Pine Drive Paula Cappa	2-14-95	No Contamination Found	
44 Pine Drive Joe Peloso	2-14-95	No Contamination Found	
1 Sellecks Walk Edythe Harris	2-14-95	No Contamination Found	
4 Trinity Pass Sheldon Satin Inc	2-21-95	370ppb	MTBE .92ppb 1,1-Dichloroethene Other Purgeable Compounds
Resample	2-27-95	370ppb	MTBE .83ppb 1,1-Dichloroethene .62ppb Chlorobenzene
7 Trinity Pass Unknown Residence	2-21-95	No Contamination Found	
10 Trinity Pass A.C. & Son Excavations	2-21-95	1.1ppb	MTBE
15 Trinity Pass Murphy, Rita	2-27-95	1.5ppb	MTBE
16 Trinity Pass Hoffman, Jean	2-21-95	2.0ppb	MTBE
20 Trinity Pass Johnston, E.	3-7-95	No Contamination Found	
25 Trinity Pass Slivka, Mark	2-27-95	No Contamination Found	

26 Trinity Pass Healy	3-7-95	No Contamination Found
31 Trinity Pass Richmond	3-7-95	3.8ppb MTBE
15 Rolling Meadow Lane April, Laurie	3-7-95	.6ppb Toluene
27 Rolling Meadow Lane Fopeanon, James	3-7-95	No Contamination Found