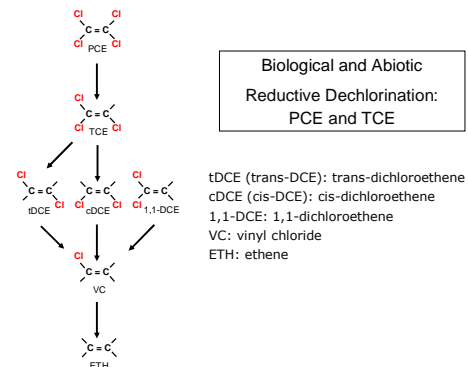


# Abiotic and Biotic Transformation of TCE under Sulfate Reducing Conditions: the Role of Spatial Heterogeneity)

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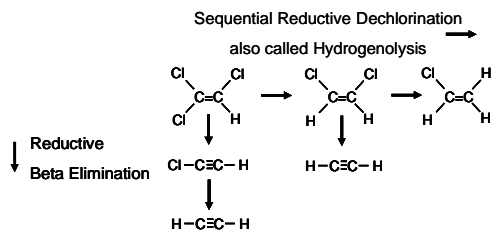
Seventh International Conference: Remediation of Chlorinated and Recalcitrant Compounds  
May 24-27, 2010, Monterey, California

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## Abiotic Transformations



For reactions with Iron(II) Sulfide see Butler and Hayes, *Environmental Science & Technology*, 35(19):3884-3891. 2001.

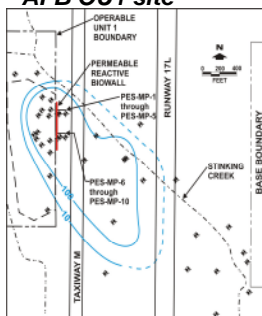
For reactions with Magnetite see Lee and Batchelor, *Environmental Science & Technology*, 36(23):5147-5154. 2002.

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Biotic and abiotic degradation of TCE at field scale in the OU-1 Mulch Biowall at Altus AFB.

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## Pilot-Scale Biowall at Altus AFB OU1 site



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Constructed June 2002

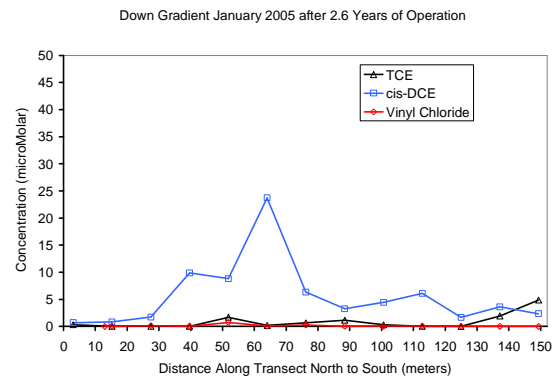
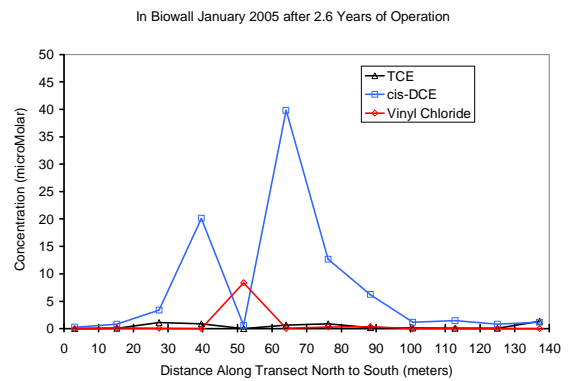
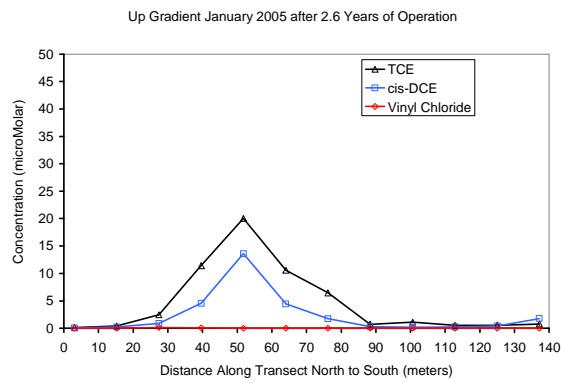
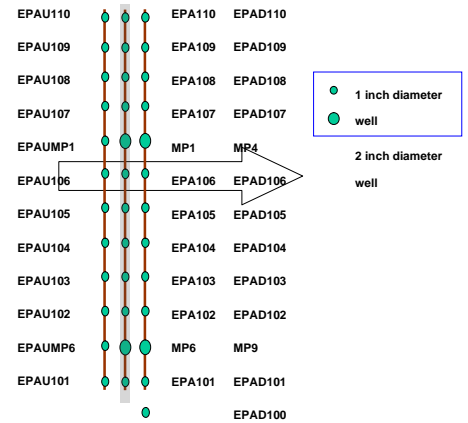
455 feet long, 24 feet deep, 1.5 feet wide

300 cubic yards tree mulch

60 cubic yards composed cotton gin trash

265 cubic yards sand

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TCE 2004-2006

Location	Up Gradient	In Biowall	Down Gradient	Fraction Remaining
Meters North to South on Transect	ug/L	ug/L	ug/L	
64	1273	52	110	0.086
51	1171	17	101	0.086
39	1197	8	132	0.11

Biotic and abiotic degradation of TCE at field scale in the OU-1 Mulch Biowall at Altus AFB.

The biowall degraded TCE to *cis*-DCE.

Approximately 10% of the TCE was not degraded.



The mulch averages 71% solids and 29% water filled porosity.

At a Darcy Flow of 0.044 feet per day, the seepage velocity would be 0.15 feet per day.

The biowall is 1.5 feet wide.

The residence time is 10 days.



$$C / C_o = e^{-kt}$$

$$k = -\ln(C / C_o) / t$$

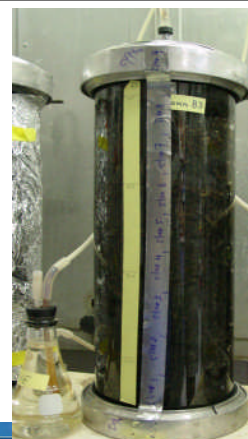
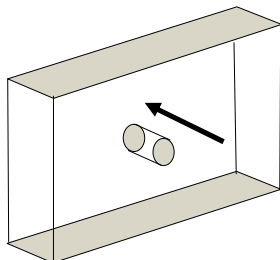
$$C/C_o = 0.11$$

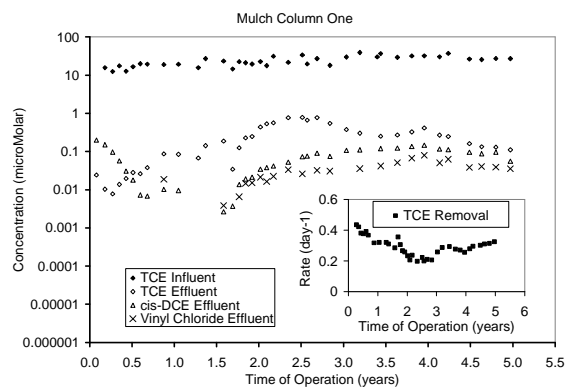
$$t = 10 \text{ days}$$

$$k = 0.2 \text{ per day}$$



Degradation of TCE in a Laboratory Column that Simulates the Mulch Biowalls.





Biotic and abiotic degradation of TCE at field scale in the OU-1 Mulch Biowall at Altus AFB.

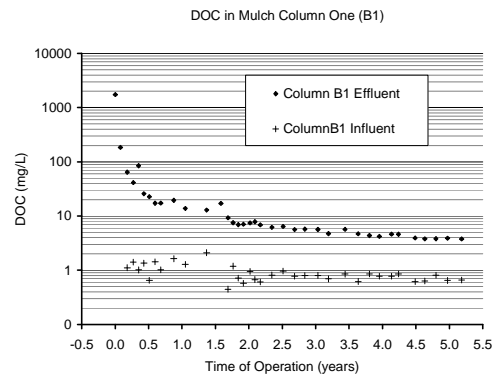
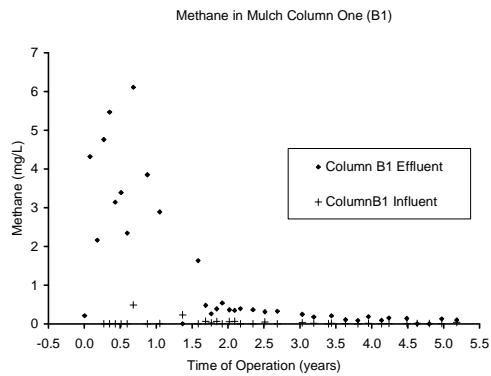
The biowall degraded TCE to *cis*-DCE.

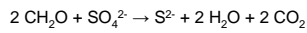
Approximately 10% of the TCE was not degraded.

Biotic and abiotic degradation of TCE at field scale in the laboratory Column

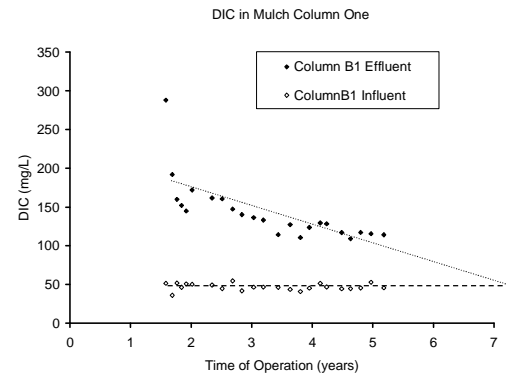
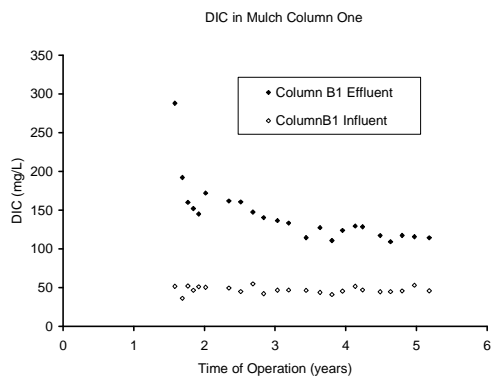
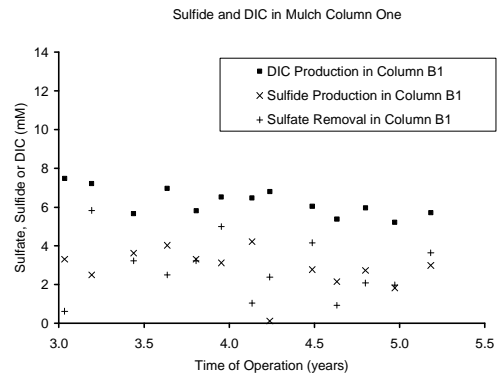
The column degraded TCE to methane and carbon dioxide, not *cis*-DCE.

Approximately 0.1% to 1% of the TCE was not degraded.





Under sulfate reducing conditions, expect two moles of carbon dioxide (DIC) for every mole of sulfate removed and sulfide produced.



Based on behavior in the laboratory, TCE degradation has been sustained for at least five years, and might last for a few more years. After two years, most of biodegradation is sulfate reduction. This is important because the sulfide that is produced can produce or sustain iron sulfide minerals (FeS) in the biowall, which will provide an abiotic component of TCE removal.



Biotic and abiotic degradation of TCE at field scale in the OU-1 Mulch Biowall at Altus AFB.

The biowall degraded TCE to cis-DCE.



