C-8 BIODEGRADATION IN GROUND WATER

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GEOLOGICAL CROSS SECTION

SAMPLING LOCATIONS

SITE CONCEPTUAL MODEL

Source Areas

- Former anaerobic digestion ponds (sludges removed)
- C-8 up to 614 mg/kg @ 8 - 10 foot depth
- Ground water at 30'

SITE CONCEPTUAL MODEL - 2

Hydrogeology

- Sand and gravel 65 - 100 feet deep
- Yields up to 300 GPM
- Production wells influence GW flow paths
- Linear velocity 1 ft/day K= 1oo ft/day

LUBECK WELL FIELD

- Travel time from anaerobic ponds is about 5 years
- 2 ppb discharge concentration

WHY STUDY C-8 DEGRADATION IN GROUND WATER?

- Long exposure to C-8
- Long residence times
- Available
- Relatively simple

Converting Biodegradation Rate Constants to Half-lives

- $C = C_0 e^{-kt}$, where k is the rate constant
- If you solve the equation $C = C_0 e^{-kt}$, for k and t when $C = 0.5C_0$ than $t = -0.693/k$ where t is half-life in days and k is the rate constant
- For example: $k = 0.0019$ = a half-life of 365 days or 1 year

METHOD REQUIREMENTS

- GW velocity and direction
- Wells along a single flow line
- Analyses of parent and daughters
- Sorption information

C-8 IN GROUNDWATER

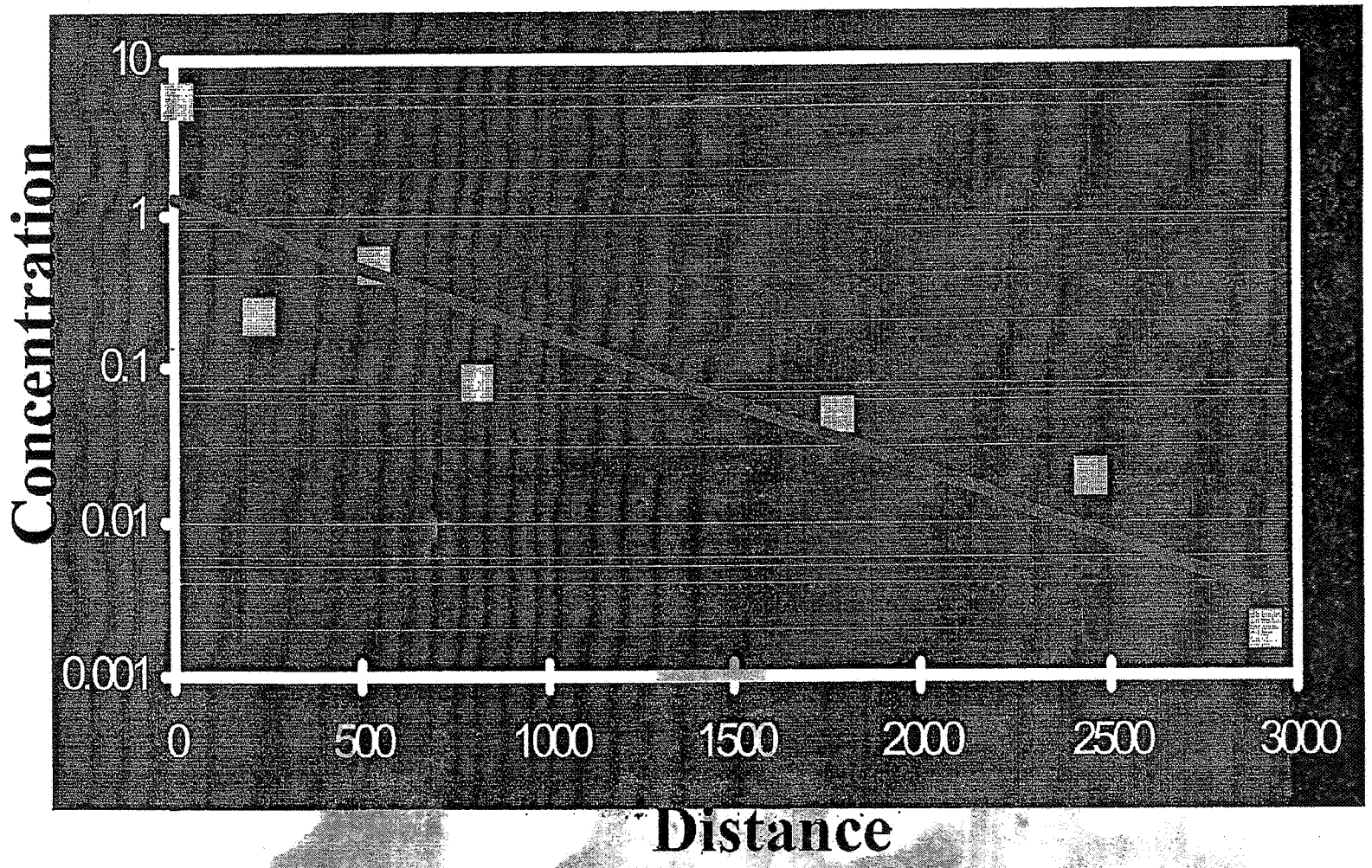
	Distance	c-8 ppm
MW-1	0	5.64
MW-2	220	0.234
MW-3	520	0.487
MW-4	800	0.0842
MW-5	1770	0.05
MW-6	2440	0.02
Lubeck	2900	0.002

DETECTION LIMITS

- PQL = 0.051
  MDL = 0.0255

- We use the MDL if concentration is below method detection limit

APPARENT LOSS RATE



Distance

INTERPRETATION

$$Y = 1.2344e^{-0.002X}$$

$$SLOPE = 0.002 = k$$

$$R^2 = 0.8401$$

INTERPRETATION

$$t = 0.693/(k*v)$$

However, k must be corrected for GW velocity using the "retardation factor".

$$t = 0.693/(k*v*R_f)$$

SORPTION/RETARDATION

$$R_f = 1 + (\rho_b/n) * (K_{oc} * F_{oc})$$

For C-8, $K_{oc} = 5000$

$F_{oc} = 0.0005$ $\rho_b = 1.8$ $n = 0.35$

$$R_f = 13.8$$

IMPACT OF RETARDATION

Velocity	Slope*v	Half Life
365 ft/yr	0.73	0.95 years
100 ft/yr	0.20	3.5 years
	Retarded	
365 ft/yr	0.0145	13.1 years
100 ft/yr	0.053	47.7 years

SENSITIVITES

- Aquifer organic carbon content determines retardation factor - big impact on T1/2
- GW velocity - big impact on T 1/2
- Intermediate source appears to exist.
  Changes ability to fit data.
  3M was not able to find either fluoride or C-7 daughter products.

CONCLUSIONS

- C-8 half life appears to be slow: half life from 13 to 48 years
- No biodegradation products found by 3M
- Rate estimate sensitive to TOC and V
- Rate estimate very sensitive to K_{OC}