CE 421/521 Environmental Biotechnology — Fall 2004

Biodegradation — Chapter 16

I. Introduction

point source:

non-point source:

II. Environmental Law

1970: C_____ A____ A_____ (CAA) — set national ambient air quality standards (NAAQS) for conventional air pollutants. Emissions standards for stationary and mobile sources

1972: C_____ W_____ A_____ (CWA) — mandates fishable/swimmable waters wherever possible. [1]Provided for construction grants program for POTW. Required secondary treatment at a minimum. [2]N_____ P_____D_____ E_____ S_____ (NPDES) permitting process established for point sources. [3]Area-wide water quality management to reduce non-point sources. [4]Wetlands protection, sludge disposal, and ocean discharges. [5]Regulation of oil spill cleanup.

1976: R_____ C_____ and R_____ A_____ (RCRA) — Management scheme for hazardous waste transportation, treatment, and disposal.

1976: T_____ S_____ Control Act (TSCA) Requires pre-market notification of EPA by manufacturer of a new chemical. Includes testing for biodegradability and toxicity. Prohibited all use of PCBs.

1980: Comprehensive environmental r_____ c_____ and l_____ act (CERCLA) also known as S_____

1986; S_____ amendments and re-authorization act (SARA). Provided for cleanup of "Superfund" sites.

1988: National C_____ Plan (NCP) Five step process to use in evaluating contaminated sites. Provided for ranking of contaminated sites called national priority list (NPL).

III. Biodegradation Processes

— cometabolism, mineralization, and biodegradation

biodegradation: b_____ of organic compounds by microorganisms

mineralization: c_____ biodegradation of organic compounds to CO_2 and water

cometabolism: breakdown of an organic compound where the degrading community derives no b_____ (i.e., carbon or energy) from degradation (requires a growth substrate) TCE degradation is a common example of cometabolism via methane monooxygenase

IV. Structure, Toxicity, and Biodegradability

Factors determining the rate and potential for biodegradation:

1. G_____ potential. Appropriate genes for transport and metabolism of substrate
2. B_____. Limited water solubility may limit biodegradation.
3. Contaminant s_____: steric and electronic effects.

   Steric effects include substituent groups h_____ recognition of active site for enzyme attachment and activity.

   Electronic effects include the extent to which the substituent group e_____ interferes with the interaction between the enzyme active site and the contaminant.

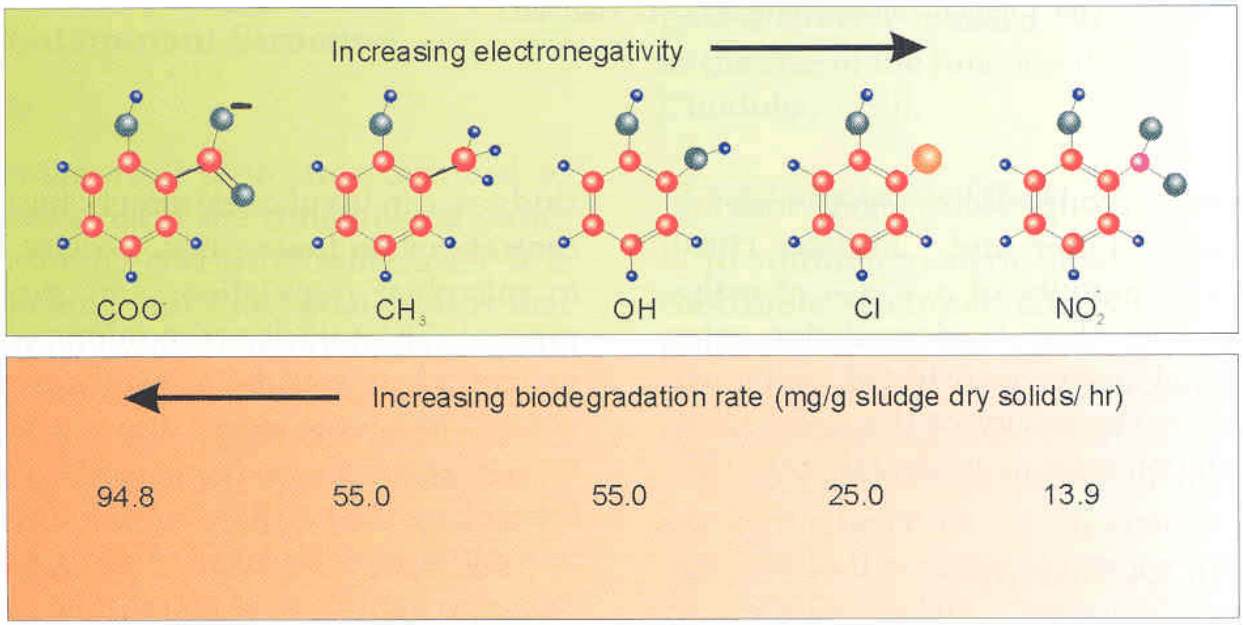

FIGURE 16.11 Various ortho-substituted phenols and their respective biodegradation rates. (Adapted from Pitter and Chudoba, 1990.)

4. T_____ or inhibitory effect of the contaminant on cellular metabolism (see Table)

V. Ten Growth Requirements for Microorganisms

1. _____ source
2. _____ source
3. Terminal _____ acceptor
4. _____nutrients: C, N, H, O, P, K, S
5. _____nutrients: Fe, Ni, Co, Mb, Zn, etc.
6. M_____
7. Appropriate t_____
8. Appropriate p_____
9. Absence of I_____
10. Mixing/c_____