

Bioremediation of Polycyclic Aromatic Hydrocarbons in Soil at Former Manufactured Gas Plant Sites

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Outline

Manufactured Gas Plants

Hydrocarbons and PAH

Methods of Bioremediation

Microorganisms and Uptake

Enhancing Bioavailability

Effectiveness of Bioremediation

Future Directions

MGPs

Produced coal gas in late 19th, early 20th centuries

Waste – coal tar

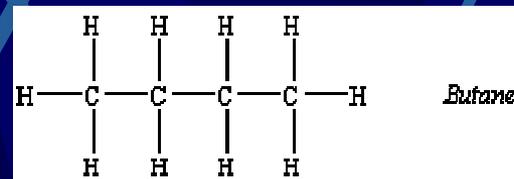
Improper disposal

Pollutants leach into groundwater

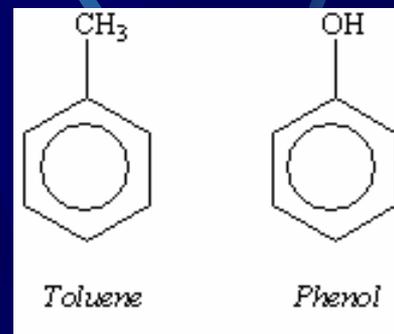
Prevalence of problem

Hydrocarbons

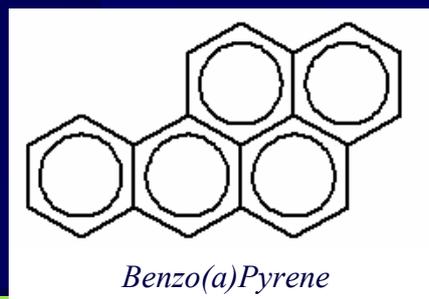
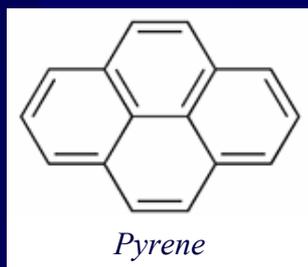
Chain hydrocarbons



Cyclic hydrocarbons



Polycyclic hydrocarbons



Methods of Bioremediation

In-situ

- Lower cost

- Reduced chance of spreading pollution

Ex-situ

- Higher cost

- More control over parameters

Microorganisms

Bacteria

Geobacter

Many others

Fungi

Phanerochaete

Aspergillus

Methods of Uptake

Bacterial degradation

Hydrolysis of aromatic ring

Dioxygenase enzymes

Non-lygnolytic – cytochrome
monooxygenase enzymes

Major products – CO₂, water, benign
byproducts

Methods of Uptake

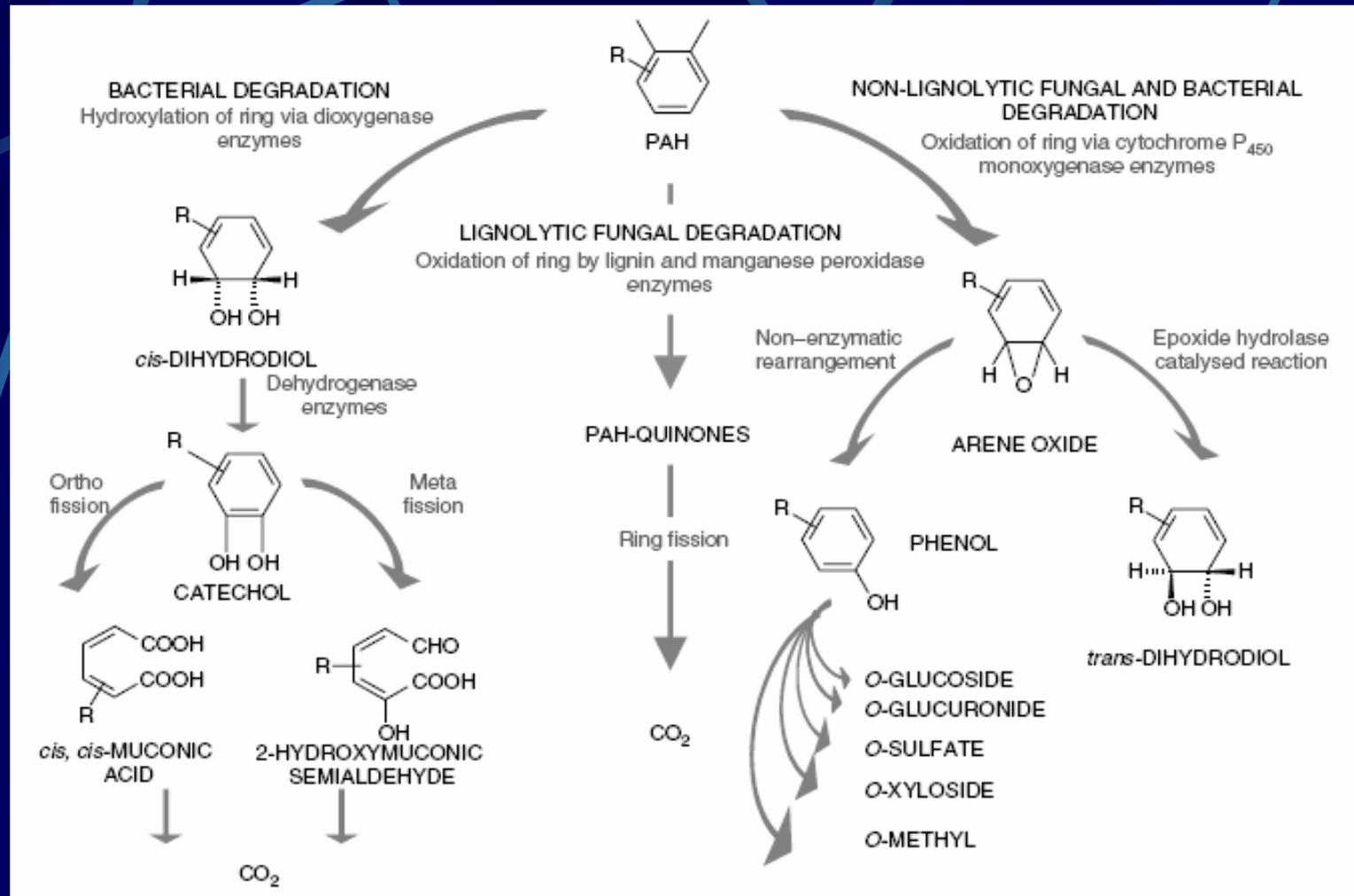
Fungal degradation

Lignolytic – woody material

Non-Lignolytic – soils

Common mechanism – oxidation of aromatic ring

Methods of Uptake



Enhancing Biodegradation

Surfactants – mixed results

Solvents – shown to be effective in desorbing PAH from soil

Enhancing Biodegradation

Fenton's reaction – hydrolyzes PAH
enhancing microbial action

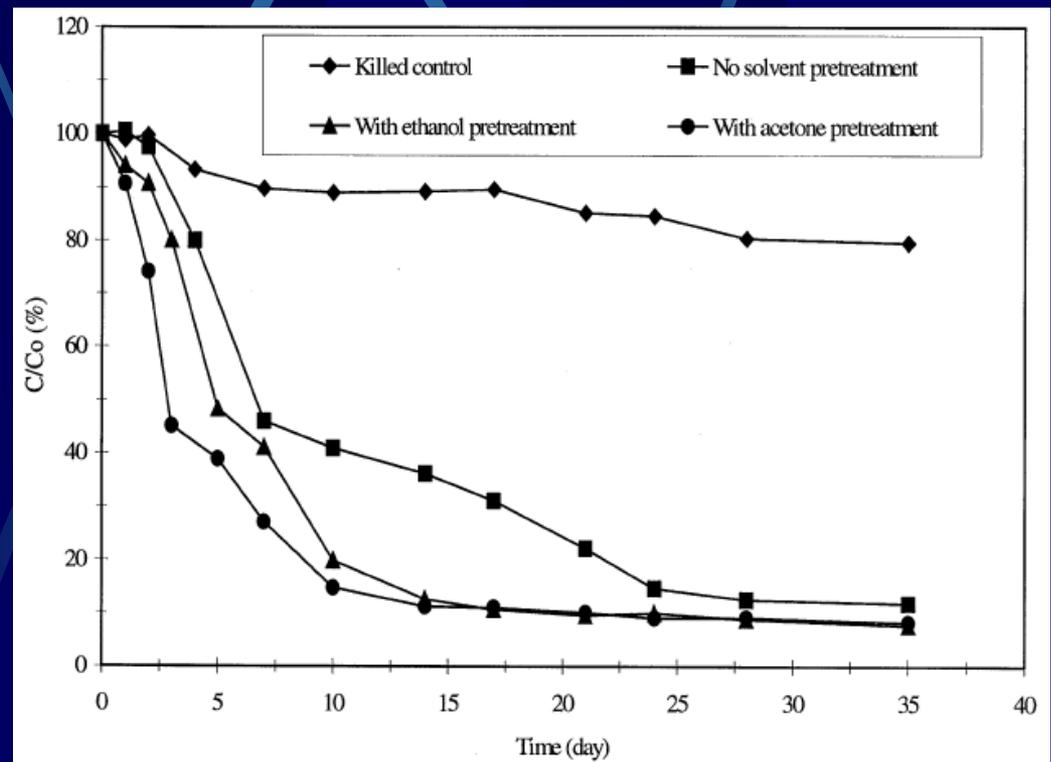
Temperature and pH – tend to be
situation and microbe specific

Nutrients – limiting component

Effectiveness

Case Study: Lee *et al* (2000)

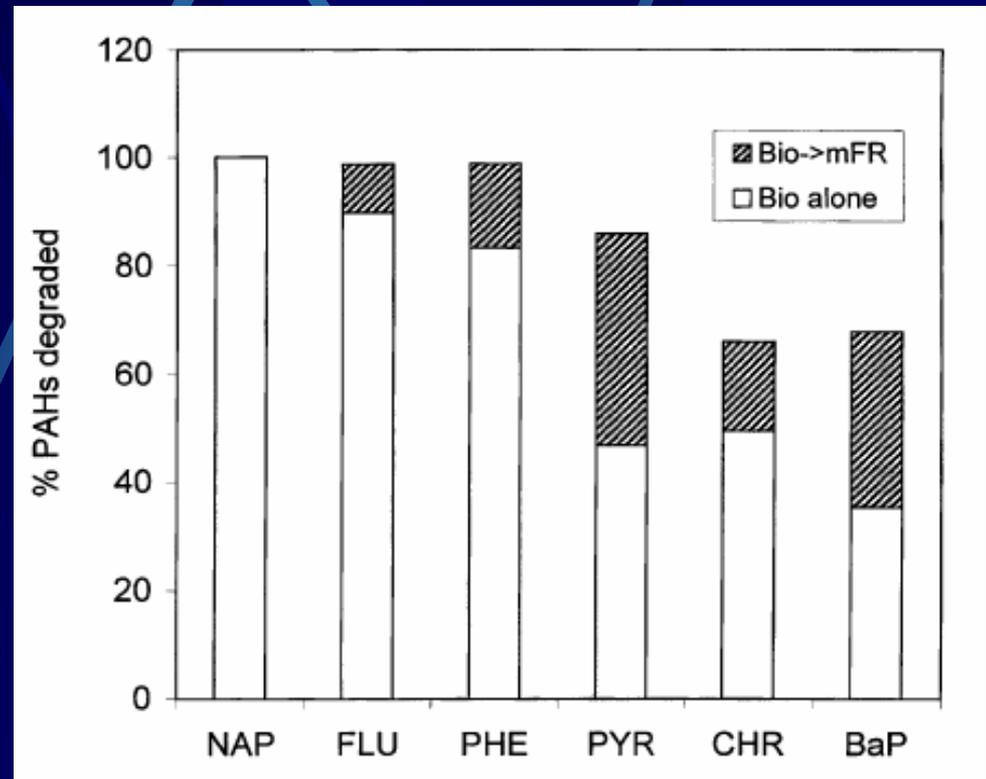
Solvents
improved
availability



Effectiveness

Case Study: Nam *et al* (2000)

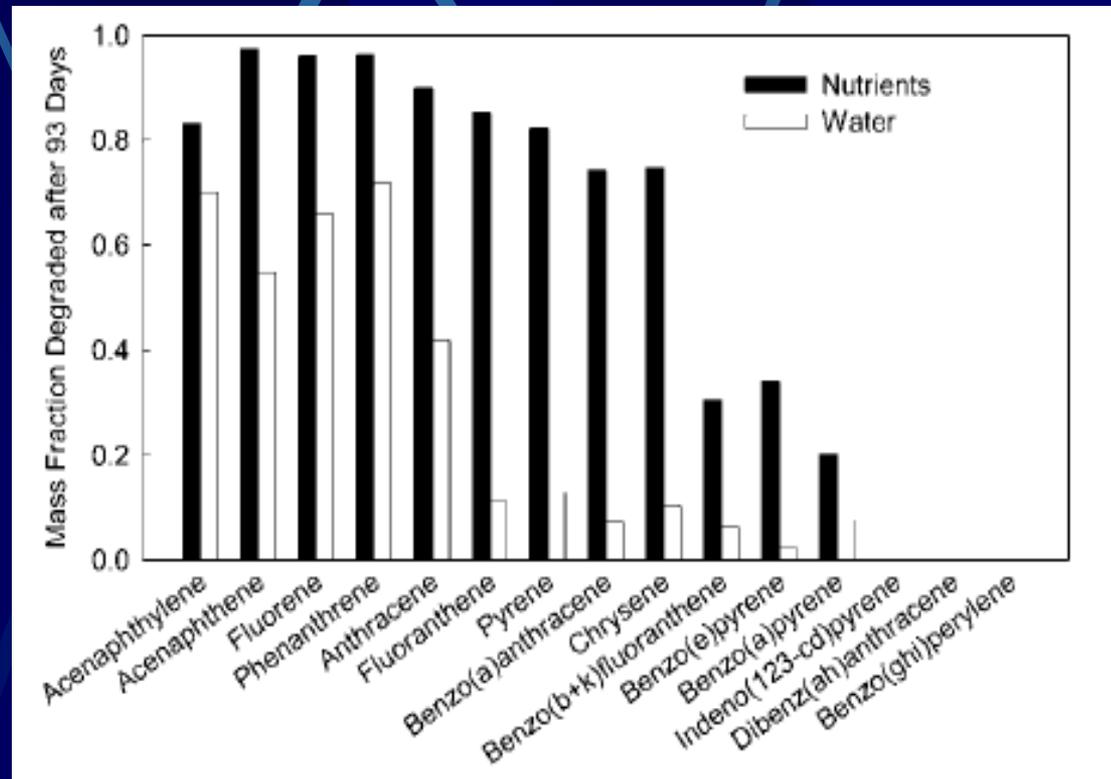
Bio + Fenton's
improved
% removal



Effectiveness

Case Study: Li *et al* (2004)

Nutrients
improved
availability



Future Directions

Renewed use of MGPs

Enhancing effectiveness and bio-
availability

Engineering microbes

Questions?
