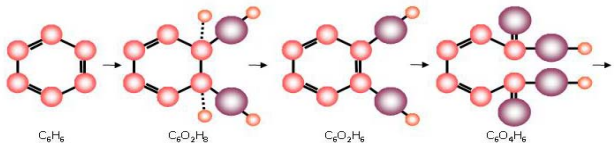
BIOREMEDIATION CRIB SHEET #2

How do microbes remediate petroleum hydrocarbons?

The driving force behind BIOREMEDIATION is to provide energy for the cell to carry out functions necessary for cell growth and reproduction. The abundant energy that petroleum hydrocarbons store in the carbon and hydrogen bonds is released and stored by the cell during cellular metabolism.

METABOLISM OF PETROLEUM HYDROCARBONS

Petroleum consists of a large number of compounds that are formed predominantly by carbon to hydrogen bonds. Petroleum constituents can be grouped into alkanes (straight and branched) , cycloalkanes, and aromatic hydrocarbons. Straight-chain alkanes are degraded by oxidation of a terminal hydrocarbon forming a long-chain carboxylic acid. Branched alkanes are resistant to metabolism under most conditions. Aromatic compounds include the monoaromatic BTEX compounds and polynuclear compounds with multiple ring structures. The metabolism of aromatics involves oxidative attack on the ring structure, formation of a diol intermediate followed by ring cleavage and the formation of organic acids. The common product of the different metabolism pathways is an organic acid that can enter the β-oxidation and tricarboxylic acid cycle.



The initial steps in the metabolism of benzene.

THE SOLUBILITY PROBLEM

Petroleum is relatively insoluble in water, but petroleum is attracted by lipids of the outer cell wall. Enzymes in the phospholipid layer initiate the metabolism of the petroleum molecule eventually converting the petroleum molecule into a form that can yield storable energy for the cell. The gene *alkL* is thought to be involved in the initial uptake of alkanes through the outer cell wall.

PETROLEUM-METABOLIZING ORGANISMS

Petroleum is a naturally-occurring substance, so it is not surprising that many organisms have evolved the capability of metabolizing components of petroleum. The most common is *Pseudomonas sp.,* which the most common group found in contaminated soil and ground water. Petrox ® is a consortium of strains of *Pseudomonas sp.* Other common petroleum metabolizing organisms are *Achromobacter*, *Arthrobacter*, *Micrococcus*, *Nocardia*, *Vibrio*, *Acinetobacter*, *Brevibacterium*, *Corynebacterium*, *Flavobacterium*, *Candida*, *Rhodotorula*, and S*porobolmyces*.

IT ' S ALL IN THE DNA

Genetic information for petroleum metabolism in encoded in both chromosomal and plasmid genes. Genes responsible for the production of the oxygenase and hydroxylase enzymes involved in the initial steps of petroleum metabolism have been identified. Advanced genetic techniques can be used to determine the metabolic capabilities of organisms and the active processes during bioremediation.

WWW.CL-Solutions.com