Harnessing Nature's Diversity

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Coal Bioprocessing

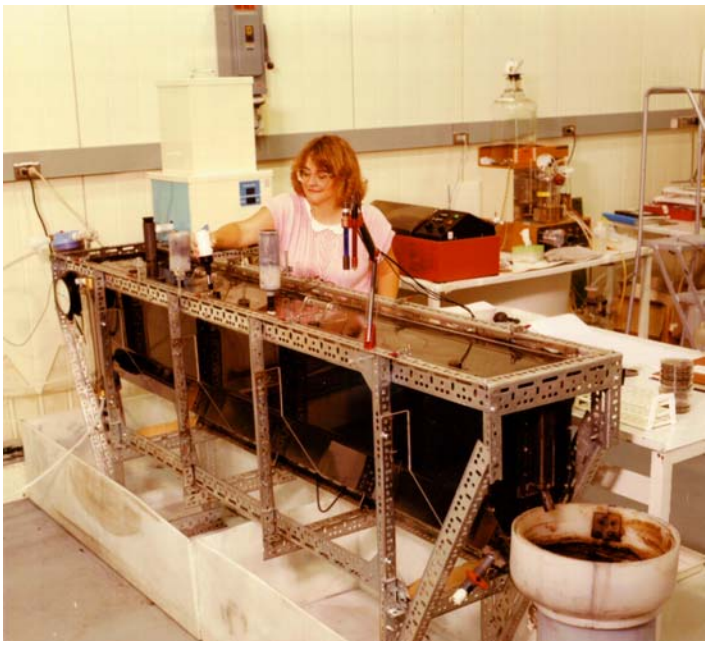
Coal is abundant—a natural resource throughout the world. INEEL research is developing bioprocessing technologies for cleaning and converting coal for both chemical and energy use. The goal is to exploit the diverse metabolic characteristics of naturally occurring microorganisms. Biological transformations may achieve many of the objectives of physical and chemical coal beneficiation and conversion processes, and can be used as alternatives or support to existing treatment technologies. A main objective of coal bioprocessing research is to remove inorganic and organic sulfur and associated hazardous metals. Another main objective is to produce chemicals from coal as a hydrocarbon feedstock. Enzymes produced by microbes may liquefy coal and function in organic solutions in ways not possible for conventional chemistry.

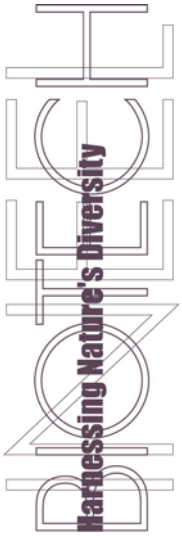
Progress

We have tested bacterial cultures for their ability to degrade aromatic and aliphatic organosulfur compounds and water-soluble materials derived from coal and lignite. Cultures examined were from a variety of sources (coal piles, oil-contaminated soil, thermal hot springs). Both aerobic and anaerobic microbes were tested. Microorganisms appear to remove sulfur from coal substrates by nonspecific mechanisms.

Design of large-scale trough, slurry column, and heap bioreactors for coal bioprocessing is ongoing. Finely ground coal particles have been processed in an airlift slurry reactor, which combined physical separation of large pyritic inclusions with oxidation of pyritic sulfur by bacteria of the genus *Acidithiobacillus*. The combined process resulted in removing 90% of the pyritic sulfur, 35% of the ash, and 70% of the hazardous air pollutants, with heating value retention of 90%.

We have tested a system in which an enzyme in 99% organic solvent functioned at 70% of its normal aqueous activity. This INEEL whole-cell catalytic system holds promise for deriving chemicals from coal and lignite versus deriving the same chemicals from crude oil. This catalytic system may also be used for converting methane to methanol without the polluting residuals.





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Selected Publications/Presentations/Patents

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