COAL MODIFICATION TO REDUCE MERCURY EMISSIONS

K. Thomas Klasson
Oak Ridge National Laboratory

INTRODUCTION

Mercury emissions from coal burning or reforming will be an issue in the future. The objective of this project is to address this issue utilizing biological coal modification, removing a large fraction of the mercury trapped in the coal prior to thermal processing. Sulfur oxidizing bacteria can release sulfur an iron from coal in a process called bioleaching. We expect the majority of the mercury to be released by the same process. This is a novel approach that has a high probability of succeeding because of the following:

1. High-sulfur coal contains high mercury concentrations.
2. Mercury-sulfur compounds are likely to be the main form of mercury in coal.
3. Biological leaching of coal has been shown to remove sulfur from coal.
4. Thus, we hypothesize that mercury will fortuitously be removed with the sulfur during bioleaching.

The project focuses on:

- quantifying the amount of mercury removed by bioleaching along with the sulfur and iron;
- characterizing speciation of mercury during this process;
- in the case of native organisms, identify bacterial genus capable of performing the biomodification;
- assess if mercury, along with sulfur and iron removal, increases attractiveness of bioleaching technology through larger-scale testing and rate modeling based on earlier sulfur bioleaching; and
- demonstrating a method of mercury removal from the leachate so it can be recycled.

The project was started in the fall of 2002. During the first two quarters, work was initiated with well-defined species of bacteria and coal for proof of concept tests. In the second year, work will be performed with environmental culture samples from which indigenous bacteria will be enriched and identified. Larger-scale testing, together with mercury dissolution rate determinations and technology assessment, will progress in the third year of this project with the best performing organisms.

TECHNICAL PROGRESS

Five different coals were obtained from the Penn State Coal Bank (PSOC). The coals obtained were PSOC-275 (Ohio #6A, Lower Freeport Seam) with a reported mercury content of 0.57 mg/kg, PSOC-

1286 (Ohio #5, Lower Kittanning Seam), PSOC-1296 (Pennsylvania B, Lower Kittanning Seam), PSOC-1368P (Weir-Pittsburg/Cherokee Seam, Missouri), PSOC-1479 (Pratt Seam, Alabama) with a high pyritic sulfur content and possibly high mercury levels based on coal seam data. The pyritic, total sulfur, total mercury content of these coals are shown below. The sulfur concentrations were provided with the coals from PSOC and the mercury analysis was performed according to the procedure developed by the U.S. Geological Survey (O'Leary, R.M. in USGS Bulletin 2144).

Coal	Pyritic Sulfur (%)	Total Sulfur (%)	Total Mercury (mg/kg)
PSOC-275	1.51	2.3	0.26
PSOC-1286	8.38	10.4	0.37
PSOC-1296	4.87	6.2	0.22
PSOC-1368P	8.83	12.5	0.27
PSOC-1470	2.37	3.15	0.29

Microorganisms (*At. ferrooxidans*, *L. ferrooxidans*, *At. thiooxidans*, and *A. caldus*) were obtained from American Type Culture Collection and are grown in the recommended media.