

Removal of mercury from coal via microbial bioleaching

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Abstract:

A biological process for removal of mercury from coal is under investigation. Iron and sulfur oxidizing bacteria have previously been used for desulfurization of coal. We have shown that removal of mercury is also possible via the same principles. Two pure cultures, *Leptospirillum ferrooxidans* and *Acidithiobacillus ferrooxidans* and four environmental consortium samples obtained from acid mine drainage were studied for mercury removal from coal. Four different coal samples were examined. The results have shown that up to 20% of the mercury can be removed in batch cultures compared to control. Additional parameters such as media composition, pH and inoculum size were also studied.

Goal:

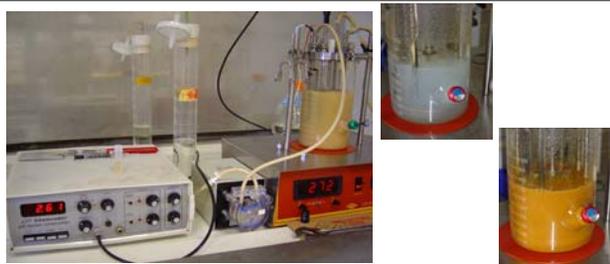
- To investigate the potential of microbial bioleaching for removal of mercury from coal

Problem:

- Coal contains 0.2 mg/g of mercury
- Associated with inorganic sulfur and iron.

How:

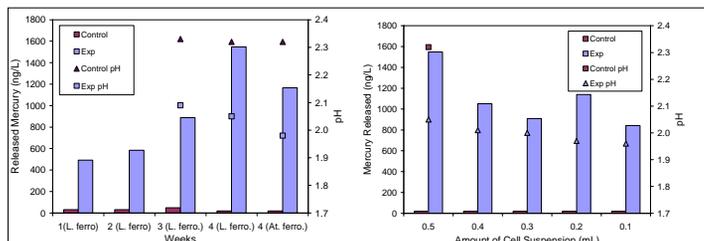
- Iron and sulfur oxidizing-bacteria can oxidize the metal-binding sulfides
- Release of mercury into leachate
- Trap mercury using resins



Growth of *At. ferrooxidans* in stirred tank reactor at time zero (middle) and after 48 h (right). Iron(II) oxidation is evident.

Batch experiments for coal biomodification using microorganisms

- Contacting of coal and aqueous microbial culture in test tubes



- Results: Removal of mercury from coal PSOC 1470 using pure cultures at 30°C in batch experiments.

- Up to 20% mercury removal has been observed in batch expts.

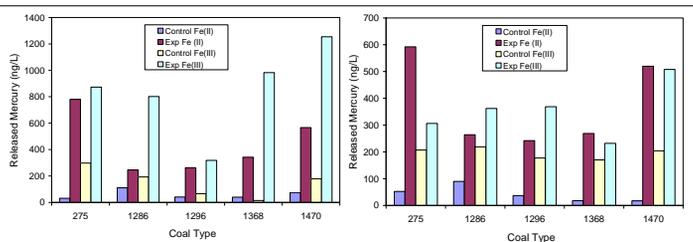
- Effect of inoculum size on mercury removal (right panel)

Environmental samples for acquiring microbial consortiums

An acid mine drainage site near the mine where samples of microorganisms were collected.



Abandoned Valzinca mine in Spotsylvania county, Virginia.



Removal of mercury from various coals by environmental culture enrichment VA#2 (left) and VA#3 (right) with different species of iron augmentation.

Conclusion: A biological process for removal of mercury from coal was investigated. Iron and sulfur-oxidizing organisms were tested for their potential to modify coal to release mercury. It was demonstrated that *L. ferrooxidans* and *A. ferrooxidans* are able to modify the coal and release up to 20% of the total mercury from coal into the liquid phase in batch experiments. Semi-continuous experiments showed up to 50% removal of mercury (under non-optimized conditions). Environmental enrichments from acid mine drainage site were also investigated for their potential to solubilize mercury and were found to perform similar to the pure cultures. A continuous process with optimized conditions is expected to remove higher levels of mercury from coal.

Future work: A continuous process for mercury removal and separation is currently under investigation.

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