



*Ronald C. Timpe  
Principal Investigator*

## MERCURY IN ALTERNATIVE FUELS

**Key Personnel:** Ronald C. Timpe (EERC), Michael J. Holmes (EERC), and Carolyn M. Nyberg (EERC)

### ***Project Description***

The emphasis on domestic sources of fuel for energy production is increasing as a result of the most recent events in the Middle East. President Bush has expressed the need for developing alternative energy sources as one means of reducing our dependence on foreign oil [1, 2].

This project is focused on expanding CATM research to include air toxic metal information on additional alternative fuels. The list of candidate fuel sources reflects the expected level of concern for mercury based on information available. In addition, samples were collected from selected alternative fuels and analyzed for mercury concentration. Appropriate analytical techniques were identified for each fuel type, and mercury measurements were performed to prioritize the fuels of interest and concern.

### ***Goal***

The primary goal of the project is to develop a list of alternative fuel sources that require additional attention regarding the measurement and control of mercury. This is directly aligned with the CATM goal of exploring issues that are not mainstream or that may arise in the future. The specific objectives include the following:

- Provide a list of fuels with the potential for significant mercury emissions, and perform an initial prioritization of the fuel sources on the list.
- Acquire samples, determine appropriate analytical methods, and make initial measurements of the levels of mercury in the highest-priority fuel sources.

### ***Rationale***

Fossil fuel supplies are being exhausted rapidly as the demand for energy increases annually. Efforts to extend the lifetime of these natural reserves involve supplementing with biomass, oil/tar sands, coalbed methane, municipal solid waste, and other plentiful previously ignored energy sources, collectively classed as alternative energy sources. Alternative sources of fuel have the potential to be significant sources of mercury emissions because of the low energy density associated with them. Although most are expected to be significantly lower than coal and also are likely lower than oil in terms of mercury concentrations on a

mass basis, the levels are potentially comparable on a Btu basis. As an example, the Canadian oil sands require roughly an order of magnitude more mass as a starting point for oil production. If the mercury concentration is determined to be even one-tenth of that for coal, emissions might be equivalent for the two fuel sources. Similarly, the relatively low energy density of some biomass fuel options could cause a similar effect. Other fuel sources to consider include the oil/tar sands, oil shale, coalbed methane, underground gasification, and biomass.

### ***Approach***

Candidate fuel sources that are either in use or under consideration as alternatives to coal, oil, and natural gas were evaluated to identify their potential for significant mercury emissions.

The project consisted of several activities. A list of candidate fuel sources were prioritized to reflect the expected level of concern for mercury issues. Samples were collected and analyzed from selected alternative fuels of highest priority. Some of these fuel sources are being considered for use in the production of oil or synthesis gas, and others will be used directly. Samples of 13 fuels were analyzed to validate their mercury concentration. Analytical techniques were identified, and mercury measurements were performed.

Samples of the biomass were obtained from producers and users of the commodity. Most of the samples were originally grown for other uses, e.g., wheat, corn, and soybeans for human and animal feed and bromgrass and switchgrass for animal feed. The samples were analyzed by the Energy & Environmental Research Center (EERC) Analytical Research Laboratory (ARL). The ARL uses documented methods for calibration, quality control, and quality assurance.

### ***Progress***

The biomass samples to be analyzed for Hg have been gathered from the producers and have been analyzed. The Hg and moisture data for the 13 samples have been recorded in Table 1. Only one sample had a higher than expected Hg content, that being common cattail (*Typhus*) harvested from beside a man-made water reservoir. The agricultural products and residues and wood samples had much lower Hg concentrations. In general, biomass is generally lower in mercury concentrations by 3× as compared to oil and 10× lower as compared to coal. Common cattail, however, is similar to coal.

### ***Status***

The data set consisting of the moisture and Hg content of the 13 biomass samples is complete. The final report is in preparation.

### ***Quality Assurance/Quality Control***

The EERC maintains a wide range of analytical and testing laboratories that follow nationally recognized or approved standards and methods put forth by the U.S. Environmental Protection Agency, the American Society for Testing and Materials, the National Institute of Standards and Technology, and other agencies. These standard methods were used to measure mercury in a number of different samples. The accuracy of these methods is expected to yield results  $\pm 5\%$ .

**Table 1.** Mercury Content in Biomass

Alternative Fuels – Biomass	Sample	Moisture, wt%	As Recd Hg, $\mu\text{g}/\text{gram}$	H <sub>2</sub> O-Free Hg, $\mu\text{g}/\text{gram}$
Wheat 1	Kernel only	10.83	<0.0004	<0.0004
Sunflower Hulls	Hull only	6.88	0.0009	0.0010
Sunflower Stover	Stover	16.04	0.0016	0.0019
Soybeans	Bean only	4.84	<0.0004	<0.0004
Corn	Kernel only	8.09	0.0010	0.0011
Minnesota Hybrid Poplar	Wood without leaves	4.54	0.0040	0.0042
Switchgrass	Stover	5.64	0.0040	0.0042
LaCrosse Hybrid Willow	Wood only	5.54	<0.0006	<0.0006
Sugar Beet Pulp	Beet waste	8.27	<0.0004	<0.0004
Cattails (Typha)	Stalk w/o fruit	8.09	0.0836	0.0910
Flax straw	Plant	6.24	0.0060	0.0064
Bromgrass	Plant	5.91	0.0091	0.0097
Rice Hulls	Hulls	6.04	0.0020	0.0021
National Institute of Standards and Technology 1547 Peach Leaves (0.8)	Leaves	4.23	0.0253	0.0264

### *Potential Users/Technology Transfer*

The data obtained by this project will contribute to the growing database for biomass and other alternative fuels. As the use of biomass in supplementing fuel supplies increases, producers, consumers, and regulatory agencies will use the information to evaluate alternative fuel options.

### *References*

1. Cable News Network. Transcript of President Bush's Energy Speech. [www.cnn.com/2001/ALLPOLITICS/05/17/bush.transcript/index.html](http://www.cnn.com/2001/ALLPOLITICS/05/17/bush.transcript/index.html) (accessed Dec 2001).
2. National Corn Growers Association (NCGA). *Alternative Fuels Today*. **2001**, Dec.