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EDUCATION, PUBLICATION, COMMUNICATION, AND COMMERCIALIZATION

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Project Description

The CATM Program continues to provide scientific and technical information on trace metals to interested parties and stakeholders in research organizations; federal, state, and local agencies; the energy sector; industrial partners; and environmental groups. In addition, CATM encourages and supports activities that provide training and educational opportunities for students, professionals, and outreach to the general public.

The CATM Program continues to provide improved educational courses and materials that make students and the public more aware of environmental issues and serve as reference documents to the scientific community (1–15). With respect to education, the goals of the CATM Program are consistent with EPA goals which state that “increased information exchange between scientists, public health officials, businesses, citizens, and all levels of government will foster greater knowledge about the environment and what can be done to protect it” (16, 17). As one of the Centers of Excellence within the EERC, CATM continues to be instrumental in focusing attention on these issues in various public forums, both domestically and abroad.

Additionally, CATM strives to develop and demonstrate products and technologies that aid in emission characterization, measurement, prevention, and/or control. As concepts evolve, CATM works with partners to commercialize these technologies in the marketplace. To ensure that these goals, as well as the overall goals of CATM, are met, EPA has conducted on-site peer review of the CATM Program. The outcome of these reviews has been very positive, with the most recent review complimenting CATM as “one of EPA’s best centers” (18).

Goal

Specific goals for CATM are as follows:

- Prepare, publish, and present information regarding issues related to air toxic metals and CATM research at conferences and workshops and in peer-reviewed journals and conference proceedings for the benefit of stakeholders and the general research community.

- Provide educational opportunities for students through CATM research.
- Promote technology development and commercialization.
- Promote positive attitudes, adopt changes, and apply best practices for environmental stewardship.

Rationale

Because of increasing global environmental concerns, timely training, education, and dissemination of up-to-date information to stakeholders in government agencies (especially EPA and the U.S. Department of Energy [DOE]), research and educational institutions, and industry are critical. Sharing and transferring cutting-edge research findings to industry, environmental groups, state agencies, and EPA have been instrumental in establishing scientifically based regulatory standards. CATM will continue to provide valid and timely information to those decision makers who must implement policy, evaluate environmental and health impacts, and determine the most judicious course of action in light of the most recent information. In a time when environmental transparency is becoming more important to the general public, it is critical that valid, well-established research is available in order for an informed public to contribute to the ongoing dialogue concerning energy and the environment. CATM strives to provide that information in a way that can be understood by the affected sector of the public.

Approach

Despite the U.S. Court of Appeals decision to vacate EPA's Clean Air Mercury Rule (CAMR), mercury control issues will continue to be part of the larger picture of emission control, especially for trace metals. Stakeholders have become even more eager to obtain research that addresses characterization, measurement, and control of trace metal emissions. Regulations to control particulate matter, SO₂, NO₂, and other pollutants will always be related to trace metal emissions. As states and regions forge regulations of their own, stakeholders are seeking scientifically sound solutions to these challenges. In addition, this regulation has served to heighten the public's awareness of other pollutants. In order to address an audience with varying levels of knowledge and sophistication, several vehicles of communication are necessary to ensure that this critical information reaches those who need it most.

To facilitate the transfer of information to government, research organizations, academia, industry, and the general public, CATM continues to support efforts to transfer timely scientific knowledge including the following venues: 1) coordination of the CATM annual meeting; 2) coordination and sponsorship of the Air Quality VI Conference: Mercury, Trace Elements, SO₃, Particulate Matter, and Greenhouse Gases (AQVI) and the Western Fuels Symposium, as well as participation and presentation at other conferences or forums that are directed to stakeholders; 3) distribution of the CATM Newsletter; 4) updating and maintaining the CATM Web page; 5) serving on environmental advisory committees; 6) education through various publications and workshops; 7) outreach through other international forums to address trace metal concerns from a global perspective; and 8) overall administration of the CATM Program.

Progress

Meetings

The annual CATM Research Advisory Council (RAC) meeting was held at the Marriott Crystal Gateway Hotel in Arlington, Virginia, on September 23, 2007, in conjunction with the AQVI Conference. This meeting provides a forum by which industry, government, and the research community can exchange information on CATM results and provide direction for future CATM research, development, and commercialization programs. Seventeen people participated, representing government (including EPA and DOE), industry, and other research organizations. Of particular interest was CATM research into trace metals, ongoing research into the health effects of mercury and implications of adequate dietary selenium, new methodologies for measurement of trace metals, and continued development of a model that explains the possible means by which activated carbon captures or oxidizes mercury and how flue gas interferences can reduce the capacity of the carbon. The group expressed appreciation for CATM's continued role in communicating to both the research community and general population appropriate technologies for emission control of various air pollutants. The group discussed the role that both global warming and advanced combustion systems will play in the future and urged support for CATM researchers to broaden their research to include these areas.

The group again underscored that dissemination of research findings through conferences and workshops is among the most important contributions that CATM researchers make, thereby presenting the most current information through venues that meet the needs of stakeholders in the most timely manner possible. CATM's staff has increasing visibility and enhanced standing in the international community by taking advantage of opportunities to present results of CATM and EERC air toxics research.

The Director of CATM and CATM staff have followed this direction to provide dissemination and outreach for these data at several conferences and workshops throughout the year.

In January 2007, CATM staff presented data at the Electric Utilities Environmental Conference & Expo on Clean Air, Mercury, Global Warming and Renewable Energy in Tucson, Arizona, from various studies showing the effects of activated carbon injection and other mercury control strategies on the environmental performance of several coal combustion by-products including fly ash from coal-fired utilities. This research shows, among other things, that an 18-hour synthetic groundwater leaching protocol may not accurately reflect trace metal releases over longer periods 30- or 60-day periods. This project clearly showed that most releases were very low but that activated carbon, in particular, does have a small but measurable effect on releases. Updated information related to this area of CATM study was also presented at the 2007 World of Coal Ash Annual Meeting in Covington, Kentucky, in May 2007.

In addition, CATM's Director presented data regarding past and ongoing mercury research data at the Minnesota Pollution Control Agency's Air, Water & Waste Conference in Bloomington, Minnesota, in February 2007. This was an opportunity to address stakeholders in a state that is requiring additional mercury controls over those that were called for under CAMR. Because the time frame for compliance was pushed up, timely data are an important part of assessing whether utilities are likely to meet limit as scheduled. Minnesota, like many other states, is considering mercury controls for several industrial users other than coal-fired utilities. In order to address mercury control from a broader context, the CATM Director also was instrumental in addressing another group of Minnesota stakeholders at the Minnesota Mercury Environmental Initiative in October 2007 in Minneapolis. The focus of this group is to evaluate releases to both the air and water and to determine possible courses of action to meet EPA's guidelines; the mining and power industries, wastewater treatment, environmental groups and the general public will

be engaged in this dialogue and will work together to reduce mercury and, in many cases, other trace metals, and we are proud that CATM has had a role to play in our immediate region.

At the national American Chemical Society (ACS) annual meeting in Chicago in March, a CATM chemist who is a past chair of the Fuels Division, and is involved in ongoing carbon research (especially for activated carbon) presented a paper entitled “The Effect of Selenite and Selenate on Mercury Capture on Carbon.” CATM research was presented to encourage the group of scientists and industrial chemists to evaluate possible differences in two species of selenium for mercury capture. At this same meeting, CATM research was presented regarding mercury control in fuel, especially from coal and petroleum products. At the ACS fall meeting, CATM was also represented in discussions regarding mercury interactions with flue gas constituents and activated carbon sorbents.

In June 2007, CATM’s Director and another CATM researcher traveled to Tokyo, Japan, as mercury and trace metal experts from the U.S. research community, serving on the international Mercury Emissions from Coal working group; in this capacity, they have been involved in the ongoing discussions with an international working group to evaluate and reduce mercury emissions worldwide. John Pavlish presented information from several mercury control projects that used activated carbon injection for mercury control in a facility configuration with an electrostatic precipitator followed by a fabric filter. Two large-scale projects were evaluated to look at balance-of-plant impacts in these plants. In both cases, serious concerns over bag life were shown during the projects; although these data come from only two plants combusting lignite, it demonstrates the difficulty that can be seen when activated carbon injection is used as a retrofit in units that are already experiencing challenges with dust loading or pressure drop issues.

In June 2007, the Area Manager for Transformation Mechanisms presented a paper at the Clearwater Conference in Tucson regarding the impact that mercury sorbents have on hazardous air pollutants, in particular mercury. Attendees were very interested in the subject matter showing that activated carbon and sorbent enhancement additives have the potential to enrich some trace metals in the finest fraction of fly ash. A paper was also prepared as a result of this conference.

CATM researchers again worked to assist in the coordination, planning, and delivery during the “Air Quality VI Conference: Mercury, Trace Elements, SO₃, Particulate Matter, and Greenhouse Gases.” Four preconference workshops were conducted, led by past and present CATM researchers. These workshops covered mercury sampling and measurement; mercury control; fine particulate and SO₃ aerosol control issues and approaches; and a new session was added on CO₂ issues: CO₂ Separation and Sequestration. The sessions were well attended, and feedback obtained indicated that the information was appropriate for the target audience, with good discussion afterward. Presentations were made for several projects that were wholly or partially funded by CATM or CATM Affiliates.

In 2007, CATM again took part in sponsoring a mercury measurement workshop. This miniconference includes lecture, presentations, and hand-on training in the use and operations of continuous mercury monitors (CMMs). Feedback for this miniconference has been very positive, especially in preparation for possible monitoring requirements for the future. Participants have also had a good opportunity to network to learn from others who are purchasing, installing, and operating at their facilities.

The CATM Director and other CATM researchers were honored to be part of the 4th Annual Canadian Clean Coal Symposium Mercury Workshop in Regina, Saskatchewan, Canada, where they presented a full-day conference workshop on current information and data regarding mercury—measurement, sampling, control, and effects on other trace metals. Feedback was again very favorable, and plans are being made for a future follow-on conference.

CATM Newsletter

CATM continues publication of the CATM Newsletter for distribution to industry and other interested parties throughout the United States and 47 countries. The newsletter is designed to inform interested parties on air toxic issues and CATM activities and to encourage further participation and collaboration between industry and government. Access increases continually for the newsletter through the Web site, providing a way for stakeholders to gain immediate access and notify others that it is available. Both domestic and foreign entities continue to find this an entry point to mercury experts who can help them and frequently follow up with questions and comments for the author(s) of newsletter articles.

The first issue of the 2007 newsletter provided an overview of a large, multiyear project cofunded by CATM that evaluated coal combustion by-products (CCBs) and the impacts that mercury control technologies, specifically sorbents and sorbent enhancement additives, had on management and utilization of CCBs. The second newsletter provided a concise overview of the Air Quality VI (AQVI) International Conference on Mercury, Trace Elements, SO₃, Particulate Matter, and Greenhouse Gases. Because of the breadth of AQVI, the newsletter focused on providing information specific to mercury and trace elements. Because the reference list for this issue is lengthy, it was noted as being available on the Web site. All CATM Newsletters, along with several topical reports and presentations, have been provided free of charge to the research community and are available for download at any time at www.undeerc.org/catm/newsletters.html.

CATM Web Page

The CATM Web page continues to serve as a vehicle for easy access to recent developments and results from the CATM Program. General information about CATM is also maintained and includes background; role and activities; accomplishments; key education and training activities: conferences, short courses, workshops, and academic programs; and CATM personnel. There has been a dramatic increase in Web activity over the years as the public seeks current, relevant information related to trace metals.

Committees

CATM researchers and managers continue to serve on several advisory committees to provide expert advice and technical guidance on a number of issues related to air toxics. Below are a few of the committees on which CATM researchers serve:

- Binational Strategy Utility Mercury Reduction Committee
- Air Quality Conference Planning Committee
- International Mercury Conference Planning Committee (International Conferences on Mercury as a Global Pollutant and Mercury Environmental Conferences)
- U.S. Representative, Mercury Emissions from Coal International Mercury Experts Working Group
- North Dakota Mercury Task Force
- Subbituminous Energy Coalition (SEC)

- Western Fuels Symposium Technical Director
- ACS 2004 Chair, Fuel Division
- ACS, Chair, Fuel Division
- American Society of Mechanical Engineers Committee on Corrosion and Deposition Resulting from Impurities in Gas Streams, Advisory Member
- Minnesota Pollution Control Agency Advisory Committee
- Elsevier Science, Fuel Processing Technology, Editorial Board Member

Education Through Publications

CATM disseminates information in several ways, and 2007 was a very productive year—ten refereed journal articles were published and several more were submitted for publication. In addition, two papers were submitted to the American Chemical Society Fuel Chemistry Division Preprints and the Electric Utilities Environmental Conference Journal, both well-respected journals that are not refereed. In addition, especially in the health area, CATM researchers contributed to several publications that were later published by other authors and research groups.

CATM staff continue to work on a critical review of mercury and mercury control options for coal-fired power plants. A well-cited CATM work was published in August 2003 by Elsevier in Fuel Processing Technology; the current work will update and broaden the focus presented in this status review. This document is presently in preparation.

In very late 2006, three CATM papers were included in bound proceedings that were not reported in the 2006 annual report; in 2007, there were eleven papers published in proceedings. In addition, two large reports were completed for projects that were cofunded by CATM.

CATM staff members also gave presentations at and participated in several conferences and workshops throughout the year; for several they also served in a planning capacity. In 2007, CATM researchers presented 18 papers at conferences (plus several workshops) around the world, with some noted above. In addition to attending workshops and conferences, CATM is also in the process of organizing and coordinating the AQVII Conference for September 2009.

Educational Opportunities for Students

Through CATM, numerous students have been involved in hands-on research into air toxic metal and related research. Not only does this provide access to research opportunities with key researchers in this area, but it provides a venue for students to be active participants while gaining valuable insights into the scientific and technical issues that face us on a local, regional, and global level. In addition to this benefit, these students enter the energy and environmental fields with real-world knowledge that increases their worth to employers. Last year's doctoral student, Alexander Azenkeng, has continued on at the EERC as a full-time researcher. CATM research also included two graduate students and twelve undergraduate students in various facets of research.

In 2007, CATM researchers expanded on a previous successful outreach program to middle school-aged students. This outreach underscores the fact that individual actions and decisions have direct impacts on the amount of pollution that is created. The program allowed teachers flexibility in how this material,

and a lecture, if requested, would be integrated into their current curriculum. By using a questionnaire on current behaviors and lifestyle choices as a launching pad into the thematic material, this outreach program empowers students to make lasting changes in their families' behaviors to reduce air pollution. Teachers who were involved in the 2006 outreach noted that several students have noted ways that they have adapted their choices toward more sustainable, lower-pollution actions. Outreach program materials are available year-round at no cost to educators.

Status

Educational and information-sharing activities will continue throughout the year. Involvement in community environmental activities will continue, as well as the programs in place to reach out to and help area schools in their efforts to educate students and teachers on energy and environmental issues.

In 2007, CATM continued building the capacity of University of North Dakota engineering students through delivery of workshops covering mercury. The feedback from the students indicated they found this real-world application of engineering concepts very valuable.

The newsletters and the CATM Web site have also become valuable outlets for disseminating information, and both will continue to provide valuable up-to-date information. The CATM Web page is regularly maintained throughout the year and can be accessed at www.undeerc.org/catm. Copies of the CATM Newsletter, topical reports, presentations, outreach materials, and other technical information related to trace metals are available for download to the general public via the CATM Web page.

Quality Assurance/Quality Control (QA/QC)

The EERC is committed to delivering consistent, high-quality research. An organizationwide quality management system (QMS), authorized and supported by EERC managers, is in effect and governs all programs within the organization. The EERC established and formalized a QMS in August 1988. A quality manual defines the requirements and the organizational responsibilities for each major element of the QMS and references the supporting documents needed to provide a comprehensive program. Compliance with this manual and its supporting documents ensures that the EERC adequately fulfills governmental and private client requirements relating to quality and compliance with applicable regulations, codes, and protocols. Additionally, the CATM Program at the EERC has a QA plan in effect that addresses trace metal research (19). The CATM QA plan has been reviewed and accepted by EPA. The project reported on herein has complied with the quality manual, the CATM QA plan, and all revisions. An independent QA auditor has reviewed all aspects of QA/QC associated with this project and report.

Potential Users/Technology Transfer

Stakeholders from industry, government agencies (specifically EPA and DOE), and the general scientific community will benefit from the results of the project, with information and data that will provide a much better understanding of air toxic issues and the control of air toxic emissions. Health effects research from CATM Area 4 is providing key information that has not been well studied regarding the impact of mercury-selenium interactions. This research provides fresh insights into the ways that mercury toxicity affects both vertebrate and invertebrates. The general public will continue to benefit

through the publication of refereed papers and documents, college courses, workshops, and numerous outreach programs initiated and supported by CATM.

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