

**Environment and Natural Resources Trust Fund
2020 Request for Proposals (RFP)**

Project Title:

ENRTF ID: 181-E

Pilot Scale Crematorium Mercury Filter

Category: E. Air Quality, Climate Change, and Renewable Energy

Sub-Category:

Total Project Budget: \$ 597,500

Proposed Project Time Period for the Funding Requested: June 30, 2022 (2 yrs)

Summary:

This project will develop a pilot-scale system to capture mercury from crematorium exhaust. Cremation in Minnesota emits 95 pounds of mercury from dental amalgam annually (~5% of state total).

Name: William Mitchell

Sponsoring Organization: Mertron, LLC

Job Title: _____

Department: _____

Address: 10204 Nesbitt Ave S
Bloomington MN 55437

Telephone Number: (510) 529-5658

Email wsmitchell3@gmail.com

Web Address: _____

Location:

Region: Statewide

County Name: Statewide

City / Township:

Alternate Text for Visual:

A graph shows cremations (and mercury emissions from fillings) are increasing, while another graph shows emissions targets for mercury are decreasing. Photo from Jay Cooke State Park.

_____ Funding Priorities	_____ Multiple Benefits	_____ Outcomes	_____ Knowledge Base
_____ Extent of Impact	_____ Innovation	_____ Scientific/Tech Basis	_____ Urgency
_____ Capacity Readiness	_____ Leverage	_____ TOTAL	_____ %



PROJECT TITLE: Pilot Scale Crematorium Mercury Filter

I. PROJECT STATEMENT

This project will develop a pilot-scale system that captures mercury from crematorium exhaust. Cremation in Minnesota puts 95 pounds of mercury from dental amalgam into the air each year—accounting for 4% of mercury release statewide in 2014—and the number of cremations is rising. Technology to reduce mercury emissions from crematoria is crucial to meet the Minnesota Pollution Control Agency’s target mercury emissions limit of 789 lb/year by 2025; without it, cremations will account for >10% of the state’s annual mercury budget.

In this project we will install a cremation chamber (retort) suitable for cremating dogs or other pets weighing up to 200 pounds. A retort of this size is capable of providing similar temperatures to a full-sized human retort but at a smaller scale for physical size and air flow. A custom exhaust stack with extra instrumentation (temperature, pressure, flow rate) capable of holding a replaceable ceramic mercury-sequestering filter (e.g. coated with selenium) will be designed and installed. Once built, several types of ceramic support and filter packages that seem promising from lab-scale testing will be tested in the pilot-scale system and evaluated on their efficacy, life expectancy, and ease of use.

Initial proof-of-concept testing on materials for mercury removal has been performed, and further development is the subject of a pending National Science Foundation Small Business Innovation Research grant. We are working to further refine the chemistry, material science, and fabrication portion of the technology by mid-2020.

While existing technologies used in coal-fired power plants are available today for use in crematorium retorts, the systems are very expensive (\$250K – 500K) and take up 100-200 square feet of space next to the retort. The Mertron design aims to meet demand for a lower-cost, smaller-footprint mercury abatement solution that could be put into operation at smaller crematoria across the state.

Mercury amalgam dental fillings are substantially cheaper than ceramic fillings, and are still widely used in American dentistry. With so many amalgam fillings in place and still being installed, the average per capita mercury load in teeth is unlikely to reduce much in the coming decades. While removing the teeth or fillings prior to cremation may seem like an obvious solution, rigor mortis, embalming, and other considerations such as possible mutilation of bodies make this impractical or illegal. Filtering the exhaust from the cremation retort is likely the simplest, most effective way to reduce mercury emissions from cremation.

II. PROJECT ACTIVITIES AND OUTCOMES

Activity 1: Install a custom, pet-sized retort

Install a new cremation chamber (retort) for pets weighing up to 200 pounds at an existing crematorium partner’s facility in the greater Twin Cities area, yielding a smaller-scale installation than a full human-sized retort. Using a new retort makes provides better access to the stack for modifications, and does not have prior contamination from mercury or other substances. The stack will be customized to hold test filter materials, as well as temperature, flow rate, and pressure sensors/controls. Upon completion of all product development activities, the retort will be sold to the crematorium partner and the proceeds returned to the ENRTF.

ENRTF BUDGET: \$460,000

Outcome	Completion Date
Installation of retort	September 30, 2020
Physical stack customization to hold filter	June 30, 2021
Instrumentation/Controls for stack installed	September 30, 2021



Activity 2: Prepare and test filters

A Research Assistant will synthesize pilot-scale filters using proprietary Mertron technology alongside facilities and expertise from the Minnesota Nano Center. These filters will be tested in the pilot-scale retort and an atomic-absorption spectrometer will measure mercury emissions under no-load and average-load mercury conditions in the retort. Following testing, samples from the filter will be characterized for mercury adsorption and to determine the level of degradation from use.

ENRTF BUDGET: \$112,500

Outcome	Completion Date
Synthesis of filters	June 30, 2021
Testing of filters	December 31, 2021
Characterization of filters	March 31, 2022

III. PROJECT PARTNERS AND COLLABORATORS:

Partners receiving ENRTF funding

Name	Title	Affiliation	Role
Dr. James Marti	Senior Scientist and Outreach Coordinator	Minnesota Nano Center, University of Minnesota	Advisor

Partners not receiving ENRTF funding

Name	Title	Affiliation	Role
Dr. David Poerschke	Assistant Professor	College of Science and Engineering, University of Minnesota	Advisor
Dr. Sandra Myers	Associate Professor	University of Minnesota School of Dentistry	Advisor
Tom Williams	Funeral industry consultant; CEO	Independent; Mertron, LLC	Advisor
Various partners in the funeral home and cremation industry	Stakeholder experts	Cremation Association of North America	Advisors

IV. LONG-TERM IMPLEMENTATION AND FUNDING:

This work will provide the basis for products that could be installed in crematoria across the state to achieve a 5–10% reduction in mercury toward the Minnesota Pollution Control Agency’s 2025 emissions targets. Additionally they could be installed at crematoria across the country, and around the world. Using the knowledge gained from this experiment and others, patents will be sought and the idea commercialized with an effort made to have the technology widely adopted: we all benefit from lower mercury emissions. Additional private funding is being sought, and will cover items such as the atomic absorption mercury analyzer. We intend to leverage the relationships formed in this project to begin production of full-scale filter systems that can retrofit onto existing retorts and stacks.

V. SEE ADDITIONAL PROPOSAL COMPONENTS:

- A. Proposal Budget Spreadsheet**
- B. Visual Component or Map**
- F. Project Manager Qualifications and Organization Description**
- H. Financial Capacity**

Attachment A: Project Budget Spreadsheet
 Environment and Natural Resources Trust Fund
 M.L. 2020 Budget Spreadsheet



Legal Citation:

Project Manager: William Mitchell

Project Title: Pilot Scale Crematorium Mercury Filter

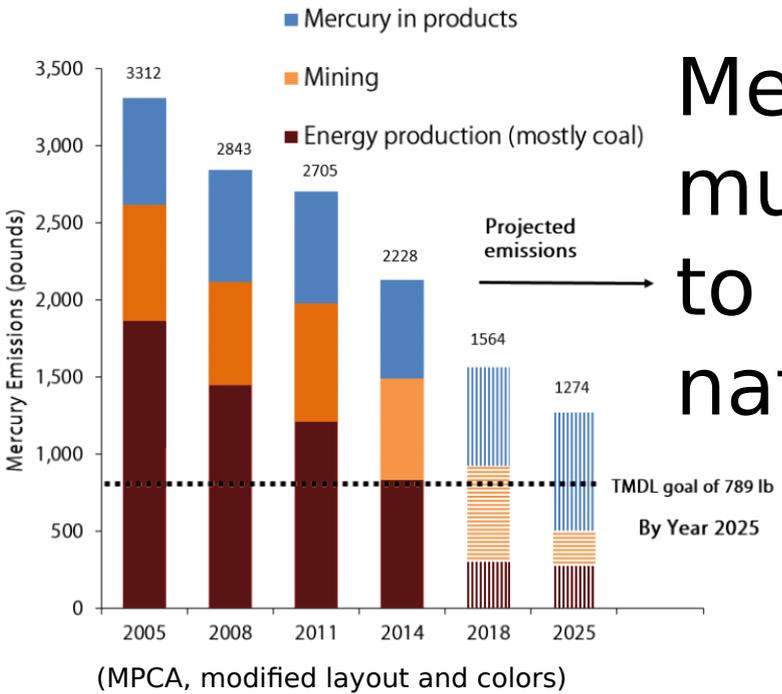
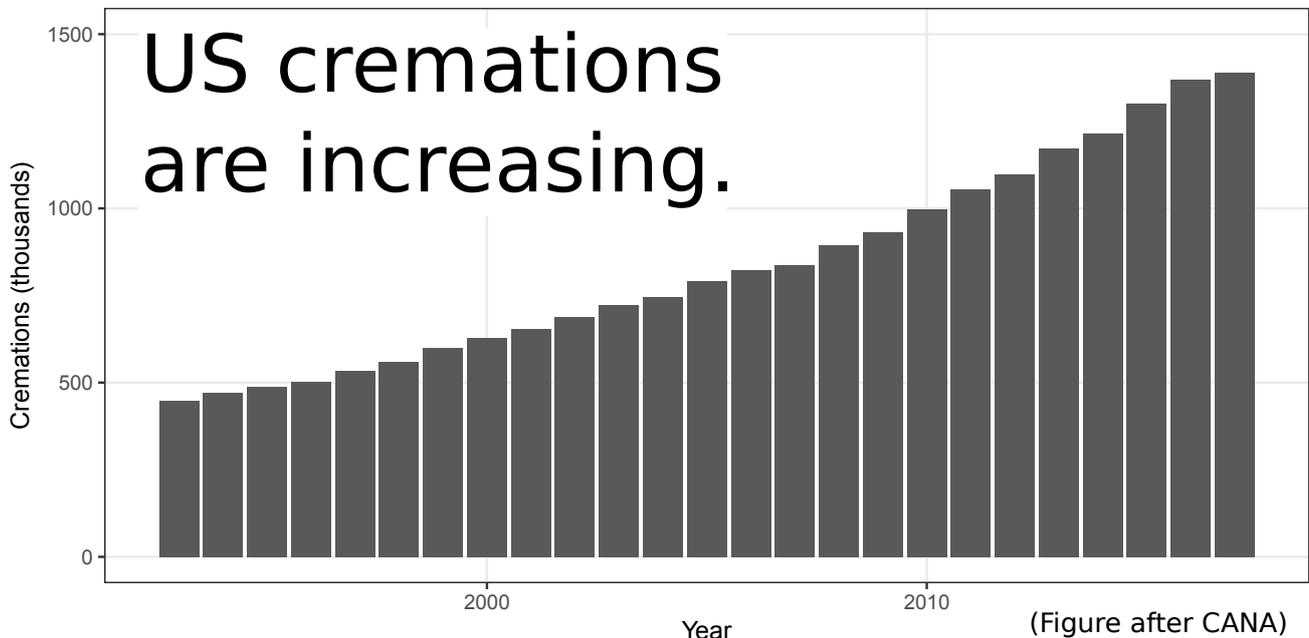
Organization: Mertron, LLC

Project Budget: \$597,500

Project Length and Completion Date: 2 years; June 30, 2022

Today's Date: March 15, 2019

ENVIRONMENT AND NATURAL RESOURCES TRUST FUND BUDGET		Budget	Amount Spent	Balance
BUDGET ITEM				
Personnel (Wages and Benefits)		\$ 149,000	\$ -	\$ 149,000
Project Manager, \$125,000 (75% salary, 25% fringe); 50% FTE years 1, 2				
Research Assistant, \$24,000 (75% salary, 25% fringe); 20% FTE years 1, 2				
Professional/Technical/Service Contracts				
Temperature sensors and control software (competitive bid)		\$ 75,000	\$ -	\$ 75,000
Engineering and installation of custom filtration platform (competitive bid)		\$ 250,000	\$ -	\$ 250,000
Minnesota Nanocenter Facilities and Services		\$ 15,000	\$ -	\$ 15,000
Equipment/Tools/Supplies				
Honeycomb filter supports (\$4500); air compressor (\$2000); natural gas (\$2000); chemicals (\$10,000); lab supplies (\$5000)		\$ 23,500	\$ -	\$ 23,500
Capital Expenditures Over \$5,000				
Pet-sized crematorium retort (for up to 200-lb animal)		\$ 85,000	\$ -	\$ 85,000
Fee Title Acquisition				
		\$ -	\$ -	\$ -
Easement Acquisition				
		\$ -	\$ -	\$ -
Professional Services for Acquisition				
		\$ -	\$ -	\$ -
Printing				
		\$ -	\$ -	\$ -
Travel expenses in Minnesota				
		\$ -	\$ -	\$ -
Other				
		\$ -	\$ -	\$ -
COLUMN TOTAL		\$ 597,500	\$ -	\$ 597,500
SOURCE AND USE OF OTHER FUNDS CONTRIBUTED TO THE PROJECT				
	Status (secured or pending)	Budget	Spent	Balance
Non-State: Nat'l Sci. Fdn. Small Business Innovation Research Grant	Pending	\$ 225,000	\$ -	\$ 225,000
Non-State: Mertron internal/private funding	Pending	\$ 600,000	\$ -	\$ 600,000
State:		\$ -	\$ -	\$ -
In kind: Partner facility use;	Pending	\$ 50,000	\$ -	\$ 50,000
Other ENRTF APPROPRIATIONS AWARDED IN THE LAST SIX YEARS				
	Amount legally obligated but not yet spent	Budget	Spent	Balance
		\$ -	\$ -	\$ -



Mercury emissions must be reduced to preserve our natural resources.



Project Title: Pilot Scale Crematorium Mercury Filter

Project Manager Qualifications (William Mitchell):

PhD in Chemistry, University of California, Berkeley, 2014.

- Planned experiments, and coordinated instrument & facility scheduling with other scientists.
- Monitored and maintained supply inventory levels (reagents, gases, labware).

BA in Chemistry, Carleton College, 2008.

Senior Scientist (Contract), Mertron, LLC, 2018 to Present.

- Principal Investigator on an NSF Small Business Innovation Research grant (pending)
- Develop technical goals, design experiments, and create implementation roadmap.

Program Aide, City of Minneapolis Elections and Voter Services, 2016-2018.

- Site supervisor for the North Minneapolis early vote center.
- Involved in recruiting, hiring, training, and supervising ~80 staff for the 2018 election.
- Created Access database to streamline hiring and complex Excel spreadsheets to track ballot inventory.

Heard Island Expeditioner, Heard Island (Australian Antarctic Territory), 2016.

- Drafted hardware and software specifications and sourced computers for the 14-person, 2-month expedition (3 weeks on-island).
- Coordinated between satellite data team and custom software team, to ensure minimum necessary bandwidth was available.
- Wrote requisite daily reports to the Australian Antarctic Division on expedition activities and plans.
- Maintained team cohesion while at sea and in two 20'x21' tents on the island.

Technical Aide, 3M Company, 2007.

- Performed spectroscopic analysis on experimental materials.
- Analyzed collected data and presented the analysis at group meetings.

Amateur Radio Operator, 2012 to Present.

- Create radio & antenna plan for annual Field Day event (5 radios, 20-40 people), lead deployment.
- Organize and lead operating events to engage newer operators ~4x/year.

Organization Description:

Mertron, LLC is a women-owned seed stage start-up founded in 2016 by Sandra Myers, DMD. Tom Williams, CEO of Mertron, LLC, is a long-time owner and operator of funeral homes and crematoria, and brings a great deal of knowledge, experience, and connections within the industry. The company aims to be a leader in mercury control technology for crematoria—which can release mercury from dental fillings (about 2.3 g/person in MN). Mertron, LLC, intends to have products ready by 2025 which can be installed by crematoria to reduce mercury emissions, addressing concerns of crematorium neighbors, keeping mercury out of the air, waters, and food chain, and helping meet the 2025 Minnesota Pollution Control Agency mercury emissions targets.

Mertron has received prior external support on this project from the University of Minnesota (UMN) Institute on the Environment (\$2500) and the UMN School of Dentistry (\$4800). Dr. Myers received support from the Minnesota Pollution Control Agency as a Principal Investigator quantifying the mercury emissions load from cremated dental amalgam.