**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**

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| **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** |  |

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| **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 |

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| **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**

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

**Partners not receiving ENRTF funding**

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| **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**