Project ID: **65328**

Project Title: **Electrically Driven Technologies for Radioactive Aerosol Abatement**

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*Progress Report*

RESEARCH OBJECTIVE

The objective of this research program is to develop an improved understanding of how electrically driven processes, including electrocoalescence, acoustic agglomeration, and electric filtration, may be employed to efficiently treat problems caused by the formation of aerosols during DOE waste treatment operations. The production of aerosols during treatment and retrieval operations in radioactive waste tanks presents a significant problem of cost, worker exposure, potential for release, and increased waste volume. Electrically driven technologies offer promise as remote technologies for improved treatment; however, existing theoretical models are not suitable for performance prediction and design.

The basis for the project is the general fact that for most particulate collection technology, the marginal collection efficiency increases as the aerosol to be separated increases in size. Using this as a premise, we are investigating mechanisms for increasing the size of particles in an effluent stream as a preprocessing step. Our work is aimed at employing recent advances in theoretical approaches and experimental techniques to improve our understanding of how electrical and acoustic methods may be employed most efficiently alone or in tandem to tackle aerosol problems. The fundamental understanding achieved may provide the basis for development of innovative new approaches and for optimizing removal processes.

RESEARCH PROGRESS AND IMPLICATIONS

Following is a summary of the work after 9 months of a 3-year project. Progress in this project has been made both in identifying relevant DOE EM problems and in technical investigations.

<u>Relevance to DOE problems:</u> O. A. Ezekoye represented this project at the EMSP/TFA Workshop in Richland, Washington on November 17-18, 1998. This was a valuable meeting, describing in detail the problems associated with tank waste retrieval and treatment, and discussing the relevance of the EMSP projects to these problems. Washable ceramic and fritted metal filters have been identified as the primary treatment technology for aerosol loading in tank off-gas. Therefore, the DOE end-users have not placed electrically driven aerosol treatment as a high-priority item for tank waste treatment. However, through discussions with Mike Terry, Safety

Technical Integration Manager for Tanks Focus Area, an alternative high-priority need was identified: aerosols produced from calcining operations (see ID-2.1.2). Experimental and theoretical investigations will be conducted for generic process situations with both waste streams in mind, focusing on the capability for removal of aerosols of size distribution, concentration, and density of those applications.

Technical progress: Through literature review and model testing of acoustic agglomeration dynamics of aerosol particles, we have ascertained that there is still an incomplete picture of particle-particle interactions in the presence of external fields. Design codes for agglomeration processes will require more accurate models. Unfortunately, the dynamics of acoustic and electric agglomeration of the aerosols of interest occur on length scales that cannot be readily examined under realistic conditions. To address this problem, we have designed and built a simple experiment involving spherical particles falling through a vibrating glycerin bath. Experimental conditions have been designed to closely match those of acoustic agglomeration of aerosols. Experiments have begun, and the results are expected provide needed information on relative motion of particle pairs.

Work has been performed to investigate the capabilities of an "acoustic barrier particulate separator" that is similar to a commercial technology under development. This separator employs secondary pressure fields to push small particles toward a collector. We are in the process of modifying an existing apparatus at UT-Austin to characterize the performance of the process and compare with existing theory.

Two additional experimental setups have been devised and are in the final design stage. The apparatus will allow fundamental, lab-scale research on the agglomeration of aerosols in flowing gas streams under controlled conditions with applied acoustic and/or electric fields. The experiments have been planned to take best advantage of the resources available to this project at UT-Austin and ORNL, and they will provide data on agglomeration and particle removal performance that can be directly compared with theoretical predictions. These experiments are expected to begin in July.

## PLANNED ACTIVITIES

We plan closely coupled experimental and theoretical work. Experiments will employ the apparatus described above to investigate particle-particle interactions at the fundamental level, and macroscopic particle agglomeration in flowing gas streams under applied fields. The experimental results will be compared with simulations for development and verification of design tools.

As stated above, current understanding of fundamental mechanisms responsible for acoustically enhanced agglomeration of aerosols is poor. Conventional models based in population dynamics rely strongly on unavailable information, at the particle-to-particle/fluid scale, embedded into collision frequency functions. We plan to advance the state-of-the-art of modeling in this area by fully accounting for interaction of particles and fluid. Exploiting terascale-computing power, we plan to apply lattice-Boltzmann methods to recover the Navier-Stokes regime of flow in fluid under the effect of an acoustic field while employing a Langevin equation to describe the motion of aerosol particles. On a second stage we plan to incorporate an electric field into the model to observe combined effects of acoustic and electric fields.

In parallel with our technical work, we will continue to develop contacts with end-users to determine relevance and feasibility for practical applications.

## INFORMATION ACCESS

No results have been published to date.