ADVANCED STREAMING AGENT DEVELOPMENT

J. Douglas Mather, Robert E. Tapscott, and Ted A. Moore
The University of New Mexico
Center for Global Environmental Technologies
Albuquerque, NM 87106 USA

OBJECTIVE

The objective of the overall effort is to develop new chemical compounds that are highly efficient fire suppressants; are environmentally and toxicologically benign; have the same performance characteristics as Halon 1211; and are fully compatible with existing equipment and aircraft materials. The current and past project efforts include synthesis or acquisition of new compounds, laboratory and intermediate-scale field testing of fire suppression characteristics, analysis of toxicity parameters, acute inhalation toxicity testing, and analysis of stability, compatibility, and manufacturability factors. The outcome of the effort will be identification and large-scale testing validation of the most promising replacement candidates.

SUMMARY

An earlier phase of this project employed two technical approaches to the development of a replacement for Halon 1211 in US Air Force streaming applications. (1) Tropodegradable halocarbons were selected, obtained, and successfully tested in laboratory fire suppression evaluations. Laboratory testing demonstrated fire suppression performance by the tropodegradable bromofluoroalkene 2-bromo-3,3,3-trifluoropropene to be approximately equivalent to Halon 1211. Other tropodegradable bromofluoroalkenes were identified as candidates for future assessment. Investigation of tropodegradable halocarbons involved toxicity and environmental property assessment, identification of synthetic routes, and syntheses. Limited toxicity information indicates that bromofluoroalkenes are a realistic source of Halon 1211 replacements. (2) Addition of readily available nonfluorinated bromoalkanes to hydrofluorocarbon **(HFC)** and hydrofluoropolyether (HFPE) carriers dramatically improves the fire extinguishment effectiveness of the carriers by themselves. Laboratory and field testing demonstrated that blending bromocarbons with **HFCs** and HFPEs improved the extinguishment effectiveness, flow rates, and extinguishing times found for **HFCs** and HFPEs by themselves up to 35%. Limited toxicity data indicate that the blends may have acceptable toxicity.

The current phase of this project will complete the identification and testing of advanced fire suppression agents as replacements for Halon 1211. The research will make a final selection of tropodegradable bromocarbon fire extinguishing agents, synthesize or acquire targeted compounds, support preliminary acute inhalation toxicity testing, perform preliminary field-scale testing to allow transfer of information for final field-scale tests, and provide technical information and overview to permit fielding of a Halon 1211 replacement.

TESTING

Laboratory evaluation **and** medium- and large-scale field testing have employed a variety of platforms that allow rapid screening of compounds and chemical blends and realistic evaluations

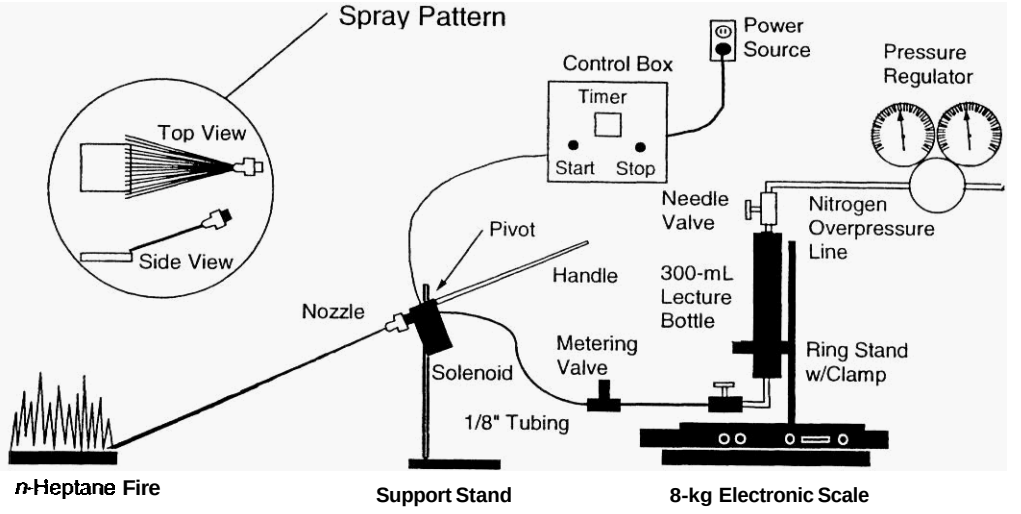

Figure 1. Laboratory-Scale Apparatus for screening of Candidate Streaming Agents.

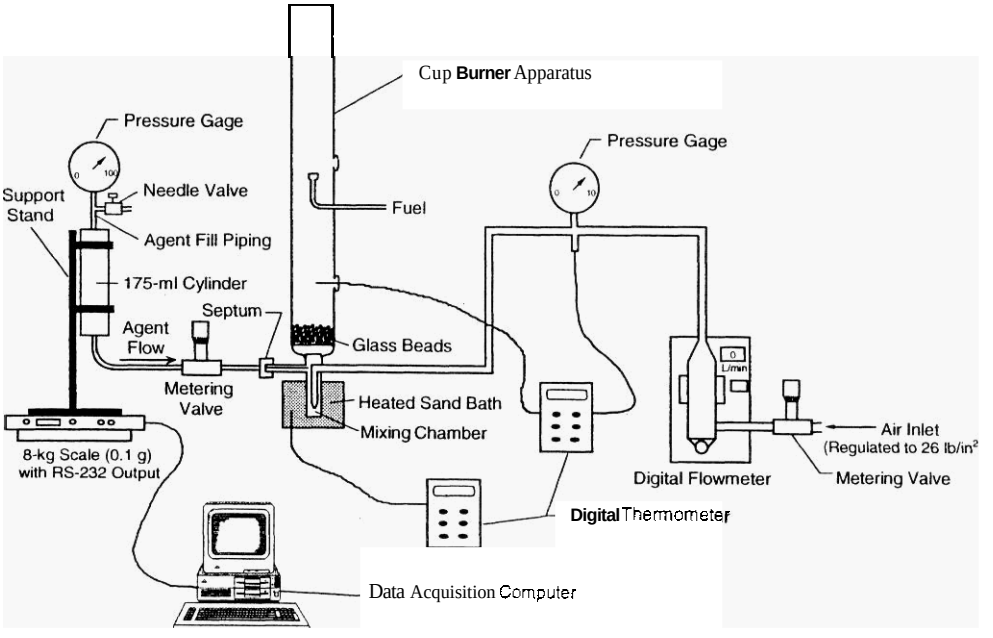

Figure 2. Cup-Burner Schematic.

of their fire suppression performance. The laboratory-based streaming agent testing and cup-burner test apparatuses are depicted in Figures 1 and 2.

An example of the field-scale extinguishment testing is presented in Figure **3.** Pan fire testing primarily involved extinguishment of Jet **A-1** fuel fires. Limited extinguishment tests using heptane fires was performed to establish baseline comparisons **of** the advanced agents being

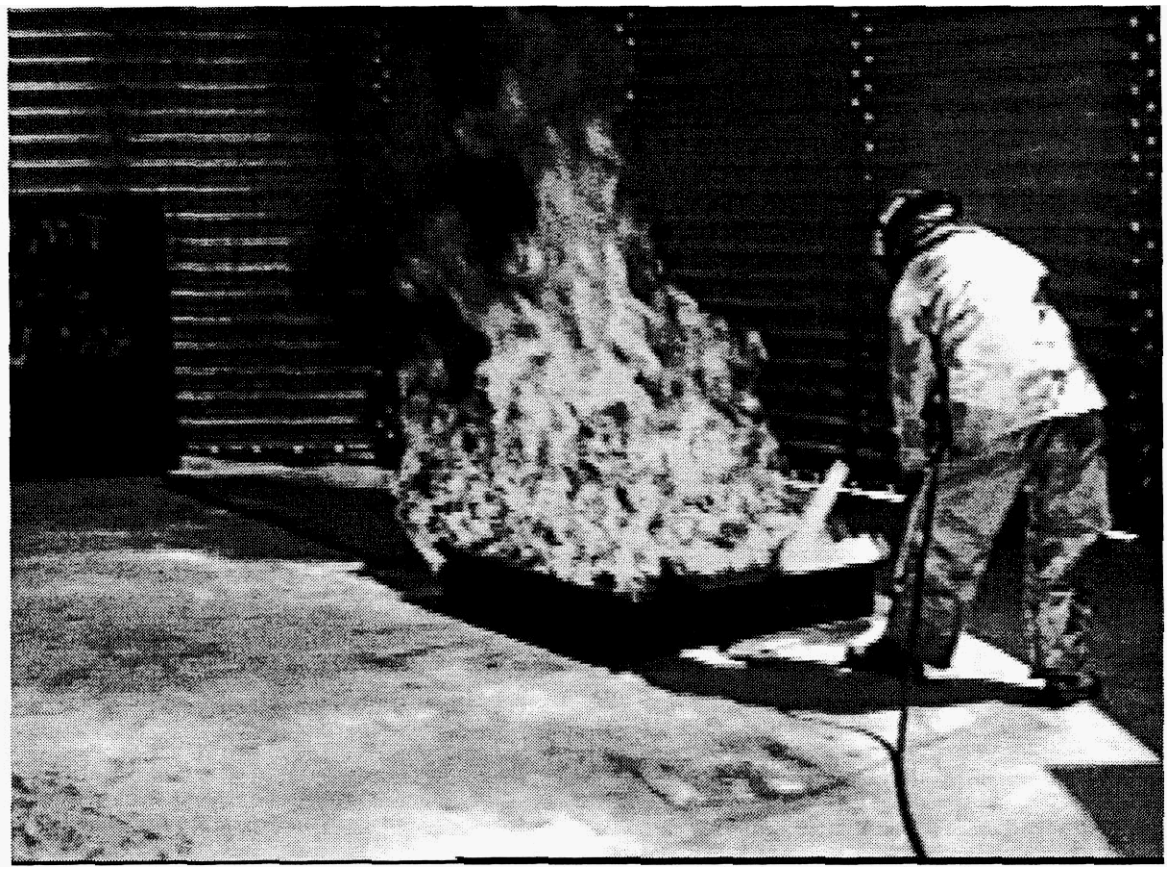

Figure 3. Pan-Fire Testing of Streaming Agents.

developed to the extinguishment performance of Halon 1211 and current commercial halon replacement (e.g., FE-36, FM-200, NAF P-IV, Halotron I) agents.

A synopsis of the program is presented in Figure 4 (poster). This overview reflects several of the significant aspects of the streaming agent development effort. What is absent though is the historical perspective surrounding halon replacements in general.

The technical gains made in this project reflect the progress in understanding in both fire science and environmental science areas. The potential of bromofluoroalkenes and blended bromoalkane based agents to perform as replacements for Halon 1211 has been conclusively demonstrated. The need to develop an acute inhalation toxicity screen allowing the cost effective and timely comparison of fire extinguishing candidate compounds and identification of the least toxic compounds was recognized and is being addressed in the current phase of this project. At present, exposure protocols have been developed and commercial laboratories identified for this testing.

ACKNOWLEDGMENT

The authors would like to acknowledge the sponsor of this project—Department of Defense (DoD) Strategic Environmental Research and Development Program (SERDP), the Project Manager—Air Force Research Laboratory (AFRL/MLQC) Technology, Tyndall AFB, FL, and the joint contractor, Applied Research Associates (ARA).

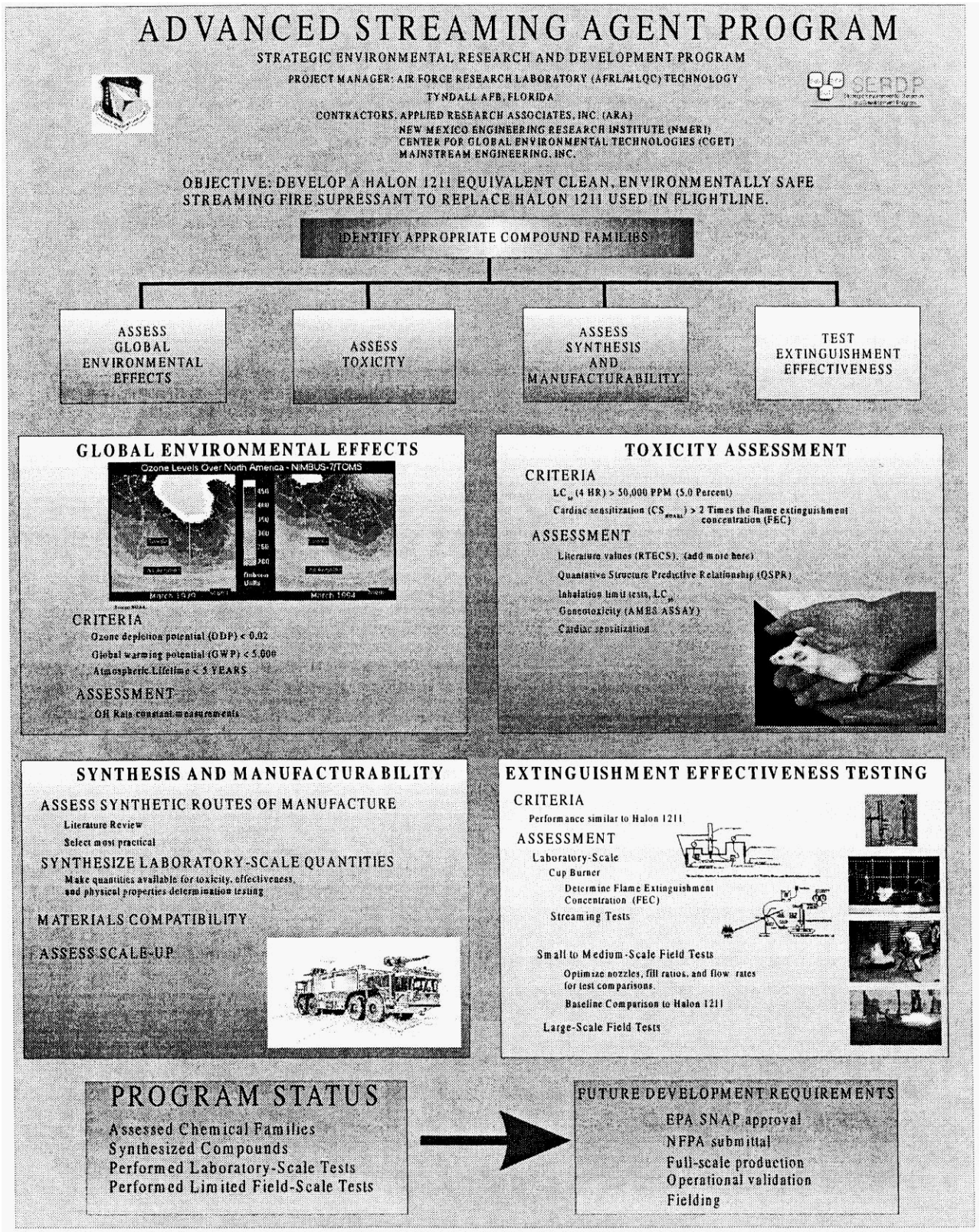

Figure **4.** Poster.