United States
Environmental Protection
Agency

EPA-600/R-01-039
June 2001

Research and Development

Application of Pollution Prevention Techniques to Reduce Indoor Air Emissions From Aerosol Consumer Products

Prepared for

Office of Prevention, Pesticides, and Toxic Substances

And

Office of Radiation and Indoor Air

Prepared by

National Risk Management
Research Laboratory
Research Triangle Park, NC 27711

FOREWORD

The U. S. Environmental Protection Agency is charged by Congress with protecting the Nation's land, air, and water resources. Under a mandate of national environmental laws, the Agency strives to formulate and implement actions leading to a compatible balance between human activities and the ability of natural systems to support and nurture life. To meet this mandate, EPA's research program is providing data and technical support for solving environmental problems today and building a science knowledge base necessary to manage our ecological resources wisely, understand how pollutants affect our health, and prevent or reduce environmental risks in the future.

The National Risk Management Research Laboratory is the Agency's center for investigation of technological and management approaches for reducing risks from threats to human health and the environment. The focus of the Laboratory's research program is on methods for the prevention and control of pollution to air, land, water, and subsurface resources, protection of water quality in public water systems; remediation of contaminated sites and-groundwater; and prevention and control of indoor air pollution. The goal of this research effort is to catalyze development and implementation of innovative, cost-effective environmental technologies; develop scientific and engineering information needed by EPA to support regulatory and policy decisions; and provide technical support and information transfer to ensure effective implementation of environmental regulations and strategies.

This publication has been produced as part of the Laboratory's strategic long-term research plan. It is published and made available by EPA's Office of Research and Development to assist the user community and to link researchers with their clients.

E. Timothy Oppelt, Director
National Risk Management Research Laboratory

EPA REVIEW NOTICE

EPA-600/R-01-039
June 2001

APPLICATION OF POLLUTION PREVENTION TECHNIQUES TO REDUCE INDOOR AIR EMISSIONS FROM AEROSOL CONSUMER PRODUCTS

By

Charlene W. Bayer
Electro-Optics, Environment & Materials Laboratory
Georgia Tech Research Institute
Atlanta, Georgia 30332-0820

Richard A. Browner and Stacy Ho
School of Chemistry & Biochemistry
Georgia Institute of Technology
Atlanta, Georgia 30332-0400

Leslie L. Christianson, Ling Ying Zhao, Per Heiselberg, Mike E. Tumbleson, and Michael M. Cui
Biochemical Engineering Research Laboratory
University of Illinois at Urbana-Champaign
1304 W. Pennsylvania Avenue
Urbana, Illinois 61801

EPA Cooperative Agreement Number: CR 822007

EPA Project Officer: Kelly W. Leovic
National Risk Management Research Laboratory
Research Triangle Park, North Carolina 27711

Prepared for

U.S. Environmental Protection Agency
Office of Research and Development
Washington, DC 20460

Abstract

Aerosol consumer products potentially are amenable to pollution prevention strategies that reformulate or redesign products, substitute raw materials, or improve consumer use procedures. A basic understanding of the behavior of aerosol consumer products is essential in the development of pollution prevention strategies, which may reduce occupant exposures and guide manufacturers in the development of more efficacious, less toxic products. This research project was undertaken to develop tools and methodologies to measure aerosol chemical and particle dispersion through space. EPA's National Risk Management Research Laboratory sponsored a cooperative agreement with the Georgia Tech Research Institute (GTRI), and the University of Illinois (UI) to develop tools and methodologies to measure aerosol chemical composition and particle dispersion through space. These tools can be used to devise pollution prevention strategies that could reduce occupant chemical exposures and guide manufacturers in formulating more efficacious products. The GTRI researchers built an Aerosol Mass Spectral Interface (AMSI), which is interfaced with a mass spectrometer (MS), that chemically characterizes aerosol consumer products through space. The UI researchers developed techniques for measuring aerosol movement indoors by tracking particle size changes via particle velocity measurements using particle image velocimetry (PIV). A group of Industry Partners participated in this research project to ensure that the technologies developed would be useful to industry.

The AMSI was designed, constructed, and optimized to transfer a focused beam of aerosol particles into a mass spectrometer for chemical analysis. It was shown experimentally during this project that the AMSI can quantitatively detect compositional changes as the aerosol travels through space. These data provide important information for the formulating of aerosol consumer products for pollution prevention strategies. The PIV system demonstrated a correlation between the material properties of the aerosol components and the spray pattern. These data were used to develop a model for prediction of the major characteristics of aerosol spray patterns. The model can be a useful guide for developing pollution prevention strategies.

This report was submitted in fulfillment of grant number CR822007 under the sponsorship of US EPA. This report covers a period from July 1994 to September 1997, and was completed as of December 31, 1997.

Table of Contents

Contents (Cont.)

List of Tables

List of Figures

Figures (Cont.)

Figures (Cont.)

Acknowledgments

This work was supported by the U.S. Environmental Protection Agency's National Risk Management Research Laboratory under Cooperative Agreement CR 822007. The authors are grateful for the expertise, guidance, and efforts of the Industry Partners, chaired by Dr. Armin Clobes of SC Johnson Wax. We are especially grateful to the Industry Partners for designing, preparing, and supplying the Surrogate Aerosols, test aerosols representative of the "World of Consumer Aerosol Products," used for methodology and instrument development during this research project. The Industry Partners are listed in Appendix 1.