OVERVIEW

Chemical protective clothing is used in a variety of applications. These applications range from protecting workers against chemical exposure in industrial processes to hazardous waste site cleanup. Each application has its own special demands and requirements for the protective clothing used dictating different designs and levels of performance. Chemical emergency response represents one application of protective clothing where a large number of complex issues must be considered in both selecting and using the appropriate protection. Unlike many applications, chemical emergency response involves widely ranging conditions and a great deal of uncertainty. Any number, concentrations, and type of chemicals may be encountered. Emergency situations may include train derailments, marine vessel spills, or accidental industrial releases of chemicals. Generally, most sites are uncharacterized initially and require individual onsite evaluations of protective clothing needs. Differences in the performance offered by the various types of chemical protective clothing can make the difference between adequate protection and hazardous acute or chronic exposure.

This Special Technical Publication has been published as a result of the 1989 international symposium on protective clothing and focuses on chemical protective clothing performance in chemical emergency response. This was the third international symposium organized by ASTM's F23 Committee on Protective Clothing. Unlike prior symposia which were open to all protective clothing applications, this symposium was held to provide a state-of-the-art review of the problems, new technologies, and uses of protective clothing related specifically to chemical emergency response. This publication includes the majority of papers presented at the third international symposium and as such serves as a consolidated source of information on protective clothing testing, selection, and use for those organizations engaged in chemical emergency response.

Twenty-one papers are presented in this publication. In the first section, three overviews on chemical protective clothing are provided. The first paper provides an overview of the activities within the ASTM F23 Committee involving the preparation of new standard methods, guides, and practices for chemical emergency response. The second paper in this section gives background information on protective clothing material resistance testing and the interpretation of chemical resistance or permeation data. This information is paramount to understanding a number of the studies described in other papers found in the Special Technical Publication. A third paper presents a discussion of physical property tests that can discriminate the performance of protective materials against a variety of physical hazards. The relative merits and current "state-of-the-art" for these tests are discussed.

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In the second section, four papers are offered on protocols used to evaluate entire protective suits, in addition to a paper dealing with specific tests of a suit-related problem - decontamination. Two of the papers deal principally with heat stress: one providing a comparison of four chemical protective suits under a variety of laboratory conditions, the other presenting a field study which shows the relative performance of four protective ensembles at different work sites involving varying climatic conditions. Each paper provides a basis for comparing the effect of suits and the likelihood for heat stress to occur. A third paper provides an overview and comparison of different test methods which can be used to assess the overall integrity i.e., presence of leaks, of protective garments. A fourth paper covers clothing decontamination techniques with specific reference to rocket propellants. However, the techniques and outcomes have general application. A final paper proposes a series of tests to measure protective clothing material resistance to thermal hazards principally flammability and heat degradation.

Several papers are presented covering different aspects of protective clothing material chemical resistance testing or chemical permeation research. Some of these papers examine the effect of different variables in the permeation resistance of protective clothing materials. Of these, two papers investigate the effect of solvent type and concentration on pesticide permeation; a third evaluates the effects of increasing temperature showing reduced breakthrough times and elevated permeation rates. The fourth paper of this series looks at how mixture permeation compares to permeation of single chemicals through protective clothing materials and attempts to explain and predict the outcomes using solubility parameters.

The fourth section of this publication concentrates on specialized applications within chemical emergency response. One paper discusses the role and problems associated with spill response within the semiconductor industry and the special considerations required to select protective clothing. Two papers look at the unique environmental conditions associated with diving in contaminated water and relate many of the requirements for conventional protective garments to diving scenarios. These papers also examine the development of a program for designing a protective dive suit and gloves which can meet the rigors of contaminated water environments. A final paper examines the degradation of suits used by propellant handlers in emergency response. Again, this is a specific application but general application of the results and methods is possible.

Four papers are included in a section on standards, policies, and procedures for protective clothing with direct and indirect application to emergency response. Two papers in this section relate to various considerations relevant to clothing design including a way of evaluating suit design based on failure modes analysis and its implications to fabrication technologies. The last two papers relate to clothing standards. One paper recommends a specific parameter for quantifying and comparing

chemical resistance or permeation test data in order to avoid problems with breakthrough time. A detailed analysis is provided to justify both the determination of this parameter (the minimum detectable permeation rate) and its use in publishing chemical resistance results. The other paper provides an overview of three draft National Fire Protective Association standards which apply performance criteria to the manufacture of various protective suits. This paper also describes a number of specific test methods developed or selected for use in these standards.

The papers described above should provide the reader with much of the latest information on protective clothing which can be related to the practices of its testing selection and use within the application of chemical emergency response. This comprehensive collection of papers should advance a number of new concepts and considerations that will help emergency responders and other parties in understanding the limitations and performance offered by protective clothing. The symposium co-chairmen gratefully acknowledge the efforts of the authors and ASTM personnel that have made this publication possible.

Jeffrey O. Stull
Texas Research Institute
Austin, Inc.
9063 Bee Caves Road
Austin, Texas 78733

Jimmy L. Perkins
University of Alabama at
Birmingham
School of Public Health
Birmingham, Alabama 35294