

Chemical Warfare Agent (CWA) Simulant Project

Mr. Frank Palya,
NIOSH

PI: Dr. Donald Rivin,
RDECOM

16 October 2003



Workplace
Safety and Health



Background

- April 2001 NIOSH Public Meeting, some respirator manufacturers requested that NIOSH identify simulants for CBRN respirator standards
- International Safety Equipment Association (ISEA) letter to NIOSH, January 22, 2002 requested NIOSH develop surrogate test agents
- Literature search revealed studies on the permeation effects of CWA simulants through barrier materials, however, inadequate data available to derive a reliable correlation between the simulants and CWA
- Jun 02 CWA Simulant Project began [Phase I]



Workplace
Safety and Health

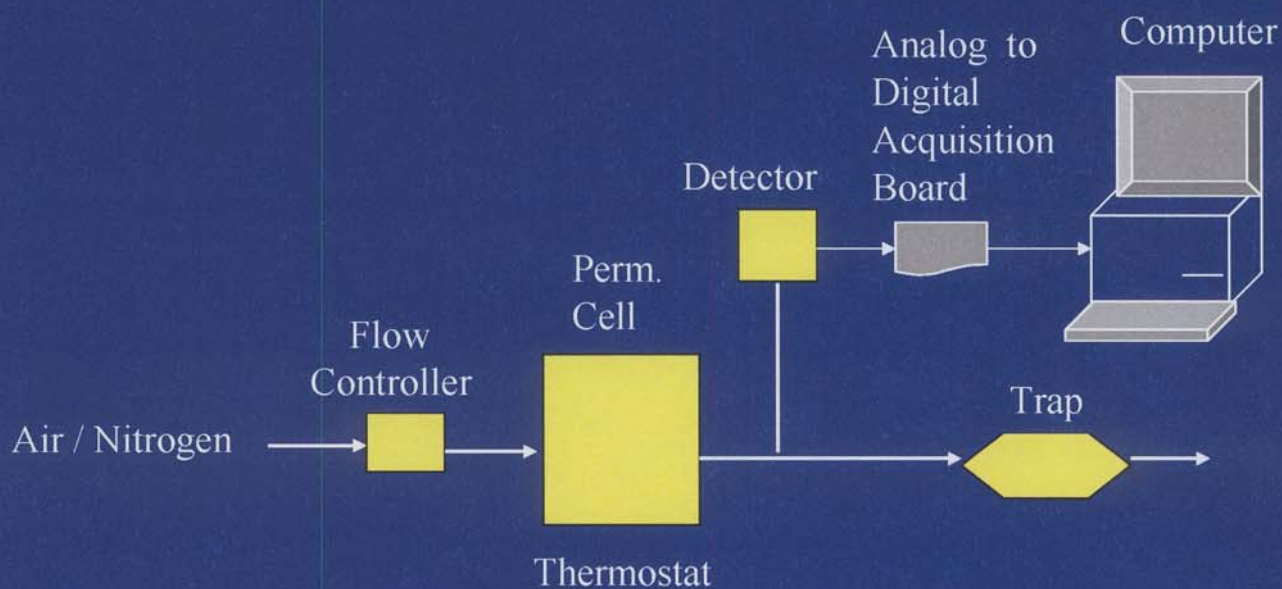


Accomplishments of Phase I

- 1.) Developed an inexpensive permeation system with a new cell design for testing both hard and soft barrier materials up to at least 1 cm thick.
 - **Goal:** Low cost, rapid, simulant screening method for determining agent barrier performance
 - Flooded Cell Technique for Testing Liquid Permeation Through Nonporous Barrier Polymers which was incorporated into the interim NIOSH Test Method

NIOSH Test Method Technical Details

Permeation Test System



Workplace
Safety and Health



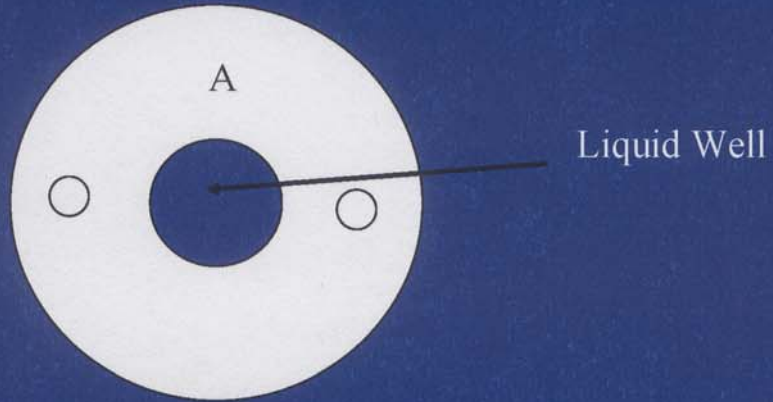
Liquid Permeation Cell Component

Side View

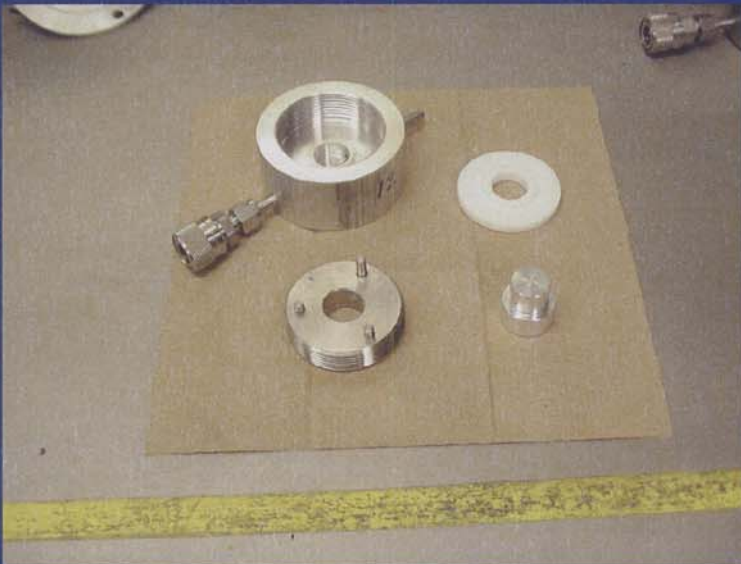
$\frac{3}{4}''$



Top View



Permeation Cell Photographs



Workplace
Safety and Health



Accomplishments of Phase I (Cont.)

- 2.) Based on correlation, identified four (4) simulants that can be used to estimate CWA permeation through barrier materials:
- **Nominal HD Simulants**
 - DCH - 1,6-Dichlorohexane
 - CEPS - 2-Chloroethyl phenyl sulfide
 - **Nominal GB Simulants**
 - DEMP - Diethyl methanephosphonate
 - DIMP - Diisopropyl methylphosphonate



Workplace
Safety and Health



The Selection of CWA Simulants Based on:

Testing of 3 Materials:

The test materials with specimen thickness selected for convenient breakthrough time were:

Butyl Rubber: 12 mil

EPDM: 30 mil

Silicone Rubber: 125 mil

Note: Permeation and immersion testing was conducted on seven reinforced, cured elastomer compounds known to span a wide range in barrier properties. These 3 were chosen as standard materials for comparative testing with CWA (HD, GB) and simulants



Workplace
Safety and Health



Accomplishments of Phase I (Cont.)

3.) Developed an Interim NIOSH Test Method to be made available to stakeholders

Test Method:

- Describes required equipment, procedures, and data analysis techniques; Also, will include mechanical drawings of Permeation Cell
- Interim Test Method will be made available in Draft form on NIOSH/NPPTL WebSite in Dec 2003
- Test Method will be published in the future as an official NIOSH Numbered Document



Workplace
Safety and Health



Permeation Test

Phase II

Primary Goals

- Improve estimation reliability of Flooded Cell Technique by testing additional simulants with other barrier materials
- Determine quantitative relationship between Flooded Cell Technique and traditional test loading (5-10 g/m²)
- Determine CWA/simulant sorption/desorption of representative barrier materials
- Identify critical properties of permeants and barrier materials that control permeation
- Develop capability to predict barrier permeation based on available chemical and physical properties of barrier polymers and permeating molecule



Workplace
Safety and Health



Potential Benefits of CWA Simulant Project (Phases I and II) will:

1. Assist manufacturers in selection of barrier materials based on scientific information and reduce product development time and cost
2. Expedite availability of new respirators and materials technology for the users
3. Determine quantitative relationship between Flooded Cell Technique and traditional test loading (5-10 g/m²)
4. Determine CWA/simulant sorption/desorption of representative barrier materials
5. Identify critical properties of permeants and barrier materials that control permeation



Workplace
Safety and Health

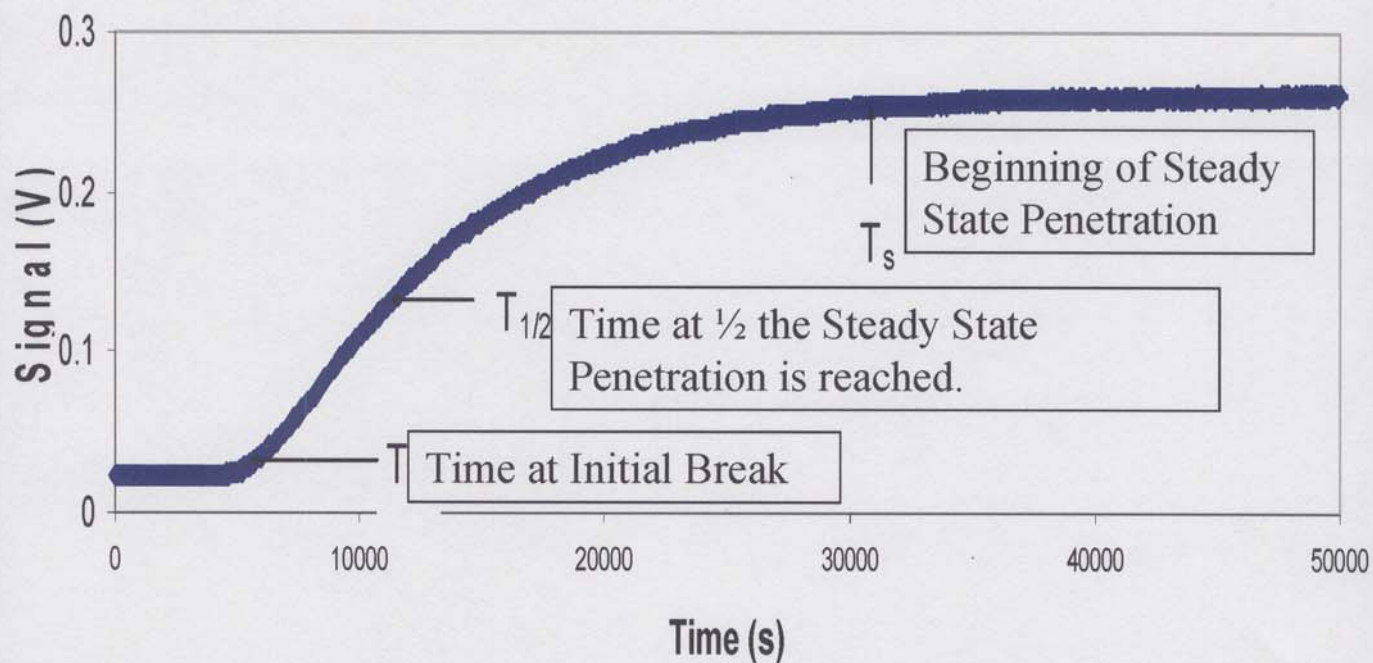


Summary/Conclusion

- Developed a rapid, relatively low cost laboratory procedure that can be used to estimate CWA permeation through barrier materials
- Identified four (4) CWA simulants for permeation testing
- Wrote an Interim NIOSH Test Method that describes equipment, test procedures, and data analysis techniques: Draft form will be made available on NIOSH/NPPTL WebSite in Dec 2003
- Initiated Phase II of the CWA Simulant Project
- NIOSH or RDEC does not guarantee that simulants identified will be suitable for all materials, nor does passage of manufacturer's pretest with a simulant guarantee passage of the official NIOSH certification testing



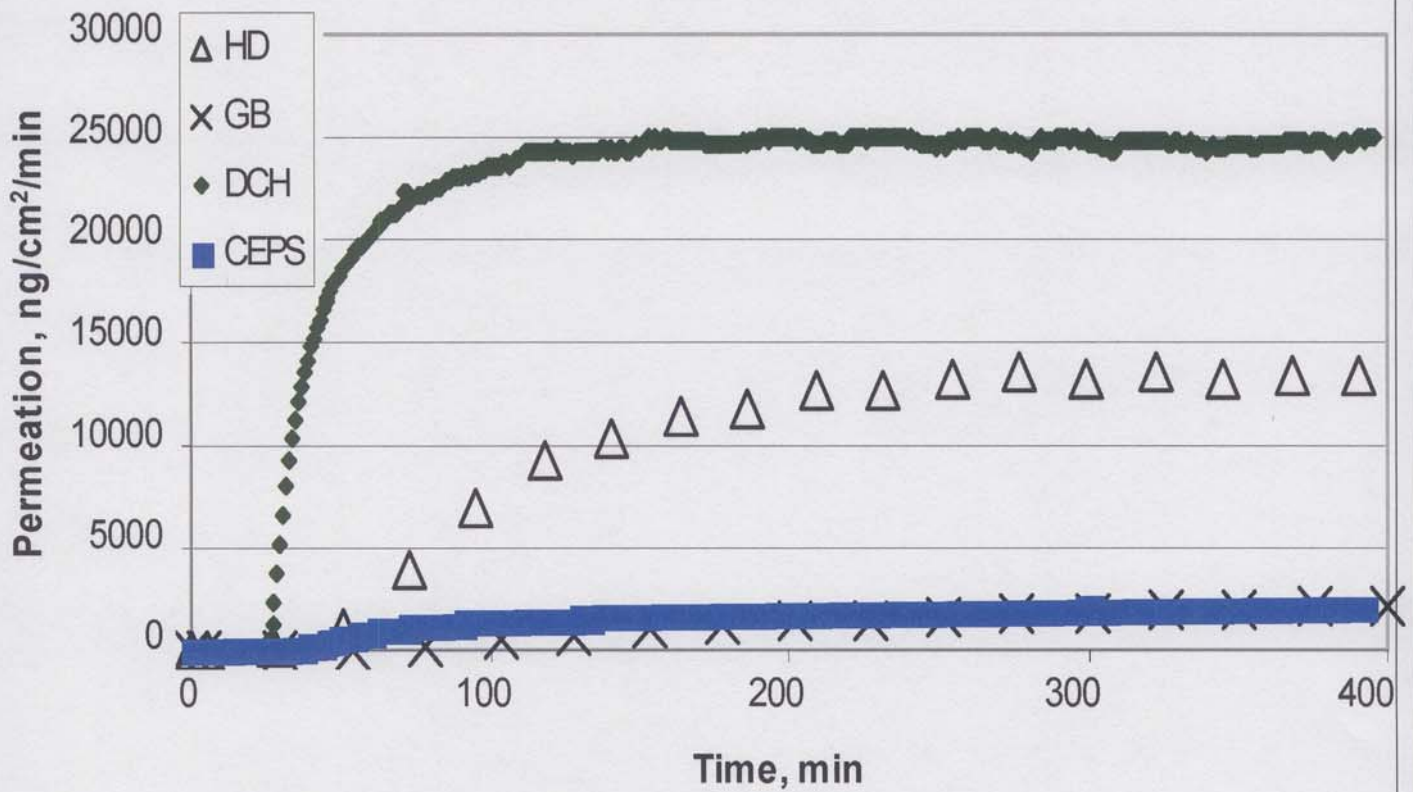
Liquid Permeation of EPDM With DIMP



Workplace
Safety and Health



PERMEATION in BUTYL RUBBER (12 mil)



Workplace
Safety and Health

