

Chemical Warfare Agent (CWA) Simulant Project

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Purpose of CWA Simulant Project

- Stakeholder wanted NIOSH to Identify chemical compounds that can simulate the permeation effects of GB and HD through barrier materials used in PPE
 - GB: Sarin CWA
 - HD: sulfur mustard CWA
 - Barrier material: base material used in a PPE product that separates user from a contaminated atmosphere

Project Goals (Phase I)

- Identify chemical compounds that simulate the permeation effect of GB and HD through barrier materials
- Develop a laboratory procedure that can be used by stakeholders for estimating permeation breakthrough times using (GB and HD) simulants
- Provide Stakeholders with a low cost, rapid screening method for evaluating materials using available, low toxic simulants

Accomplishments (Phase I)

- 1.) 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 methylphosphonate
 - DIMP - Diisopropyl methylphosphonate

Accomplishments (Phase I)

- 2.) Developed test procedure
 - Used for testing liquid permeation resistance through nonporous barrier polymers
 - Uses a new cell design, the Flooded Cell Technique, for testing both hard and soft barrier materials up to 1.0 cm thick
 - Flooded Cell Technique: challenging chemical compound covers the entire surface area of the test specimen

Accomplishments (Phase I)

- 3.) Developed written test method
 - Describes required equipment, procedures, and data analysis techniques; Also, includes mechanical drawings of permeation cell
 - Test method will be published as an official NIOSH numbered document
 - Status of document: peer review process initiated which will include (verification testing) of test method

Project Goals (Phase II)

- Improve estimation reliability of Flooded Cell Technique by testing additional simulants with other barrier materials
- Determine quantitative relationship between Flooded Cell Technique and conventional test loading (10 g/m²)
- Determine CWA/simulant sorption/desorption of representative barrier materials

Project Goals (Phase II) (cont)

- 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

Project Status (Phase II)

Candidate materials selected

- Thermoplastics:
 - PVDF [Poly(vinylidene fluoride)] 0.05 mm
 - PP [Polypropylene] 0.04 mm
 - PET [Poly(ethylene terephthalate)] 0.006 mm
- Elastomers:
 - Poly(tetrafluoroethylene-co-propylene)
AFLASTM rubber 0.8–2.4mm

Project Status (Phase II) (cont)

Comparison tests

- Flooded cell vs. conventional (10 gm/m²) w/DIMP and DCH on butyl
- Breakthrough times essentially equal

Summary/Conclusion

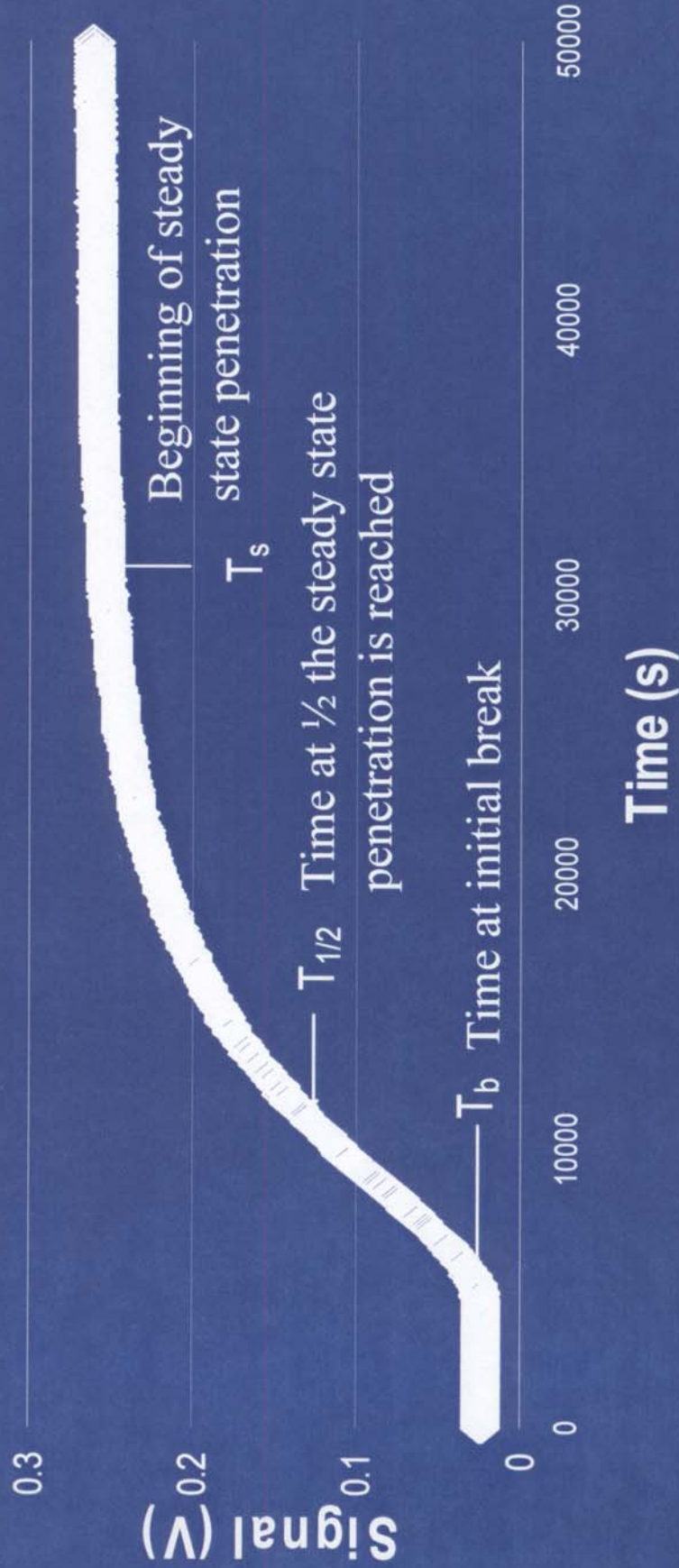
- Developed a rapid, relatively low cost laboratory procedure that can be used to estimate CWA permeation through barrier materials
- Identified four (4) CWA simulants for permeation testing
- Developed written test method that describes equipment, test procedures, and data analysis techniques: peer review process initiated

Summary/Conclusion (cont)

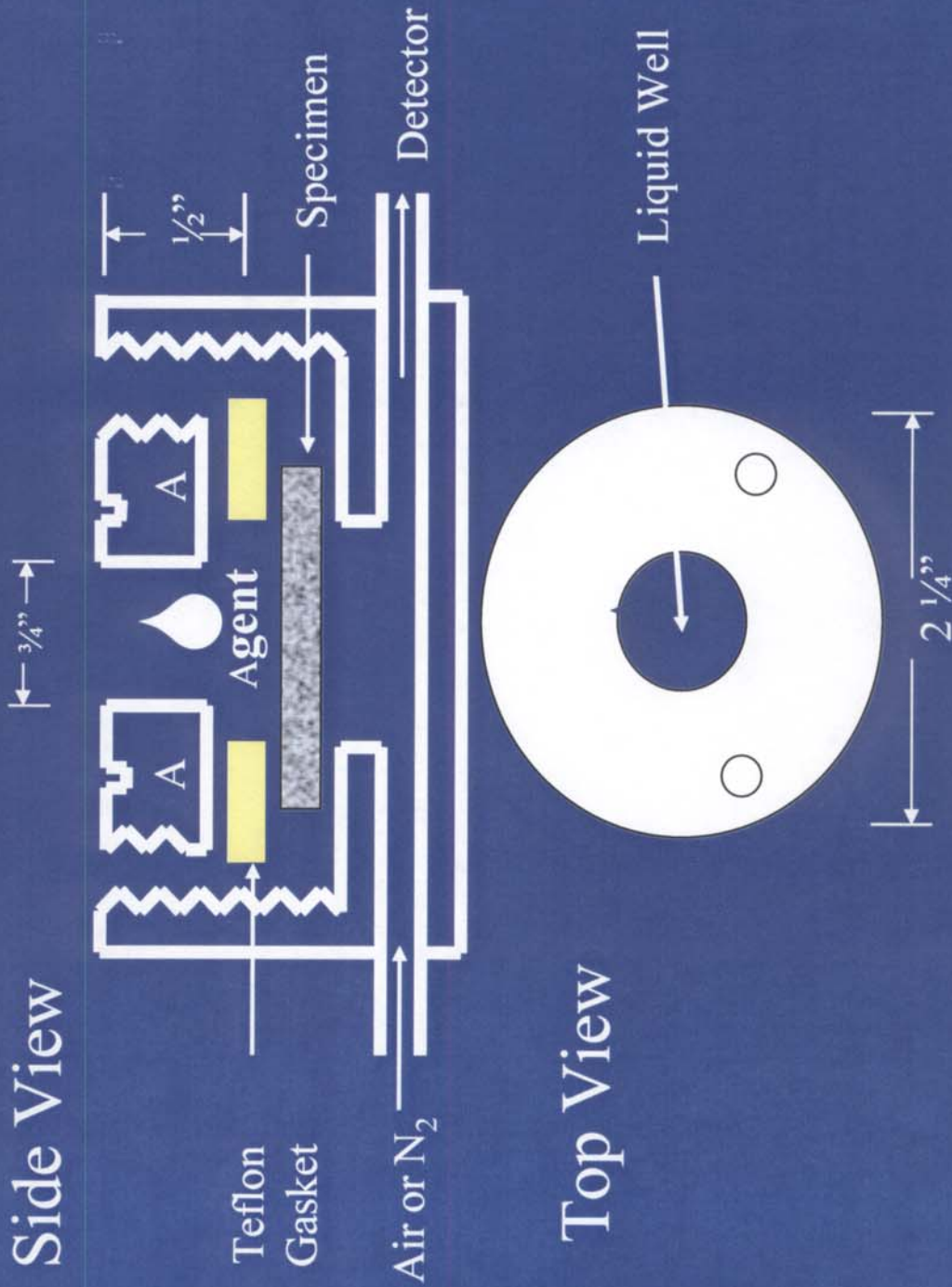
- Initiated Phase II of the CWA Simulant Project

Note: NIOSH or RDECOM 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



Liquid Permeation Cell Component



Permeation Cell Photographs

