COLPRO 2005

Coatings for Expedient Collective Protection

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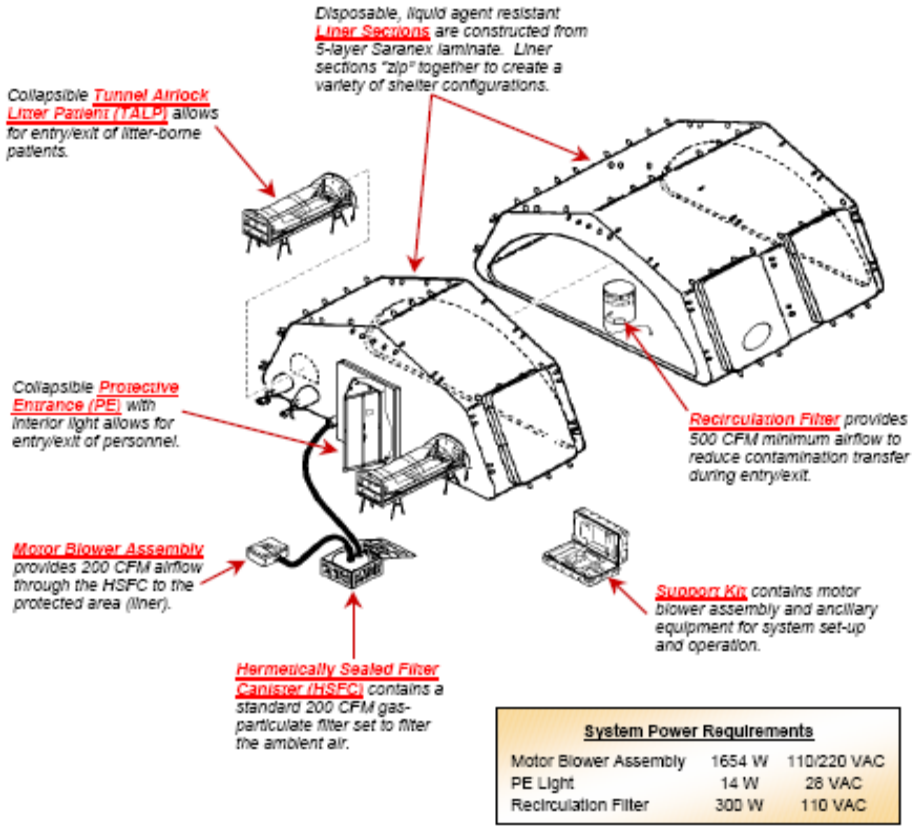
Overview

- The problem and our approach
- Shelter “proof-of-concept” study
- Results
- Current and future studies
- Benefits to the warfighter

The Problem in Need of a Solution

M28 ColPro Components



System Power Requirements

Motor Blower Assembly	1654 W	110/220 VAC
PE Light	14 W	28 VAC
Recirculation Filter	300 W	110 VAC

Current ColPro systems are good, but…

Security provided outside medical examination room in Afghanistan

How do we provide ColPro in situations like the one shown above?

Project Objective

Objective:

Provide a means of expeditionary collective protection where no pre-existing ColPro capability exists

Approach:

Evaluate performance of non-toxic coatings for simple and effective application to interior of any structure for the purpose of facilitating a positive pressure barrier against CB intrusion

First Question – Is it feasible?

Technical Approach for Proof-of-Concept

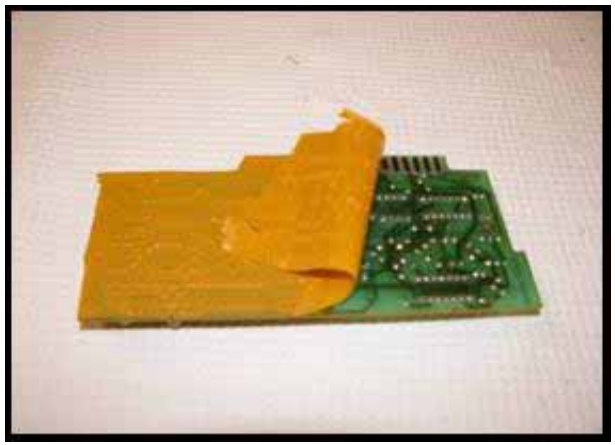
- **Conduct Preliminary Search for Coatings**
  - **Evaluate potential coatings**
    - **COTS**
    - **Encapsulating or protective**
    - **Strippable preferred**
  - **Down select two for shelter study**

http://www.generalchem.com/peelable_coatings.asp

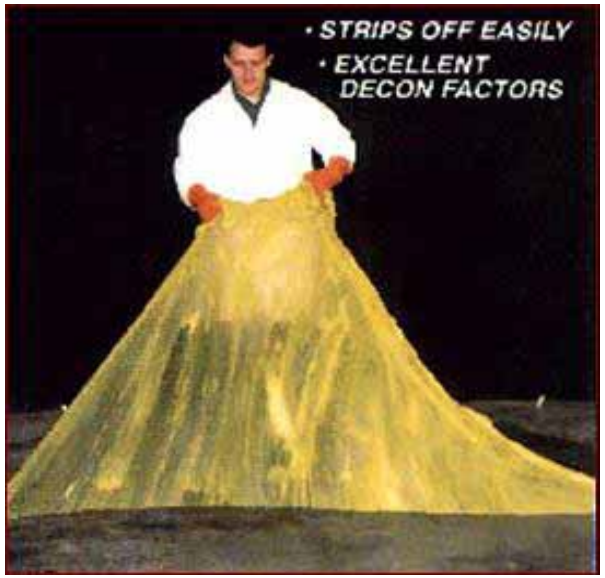
- **Perform Shelter Study**
  - **Evaluate application**
    - **Difficulty**
    - **Coverage efficiency**
    - **Dry time**
  - **Determine leakage rate**
    - **Uncoated (baseline)**
    - **Coated**

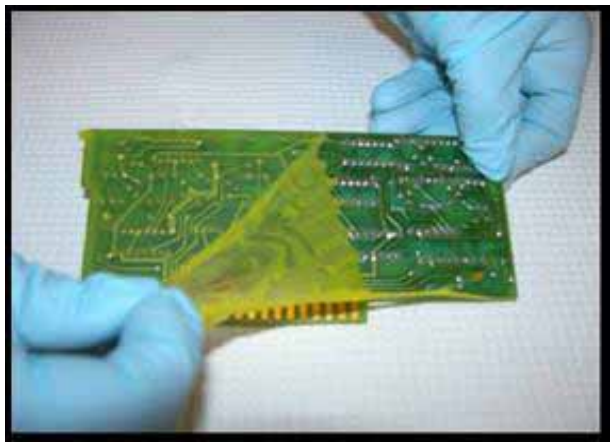
Commercial Coatings

Coating A

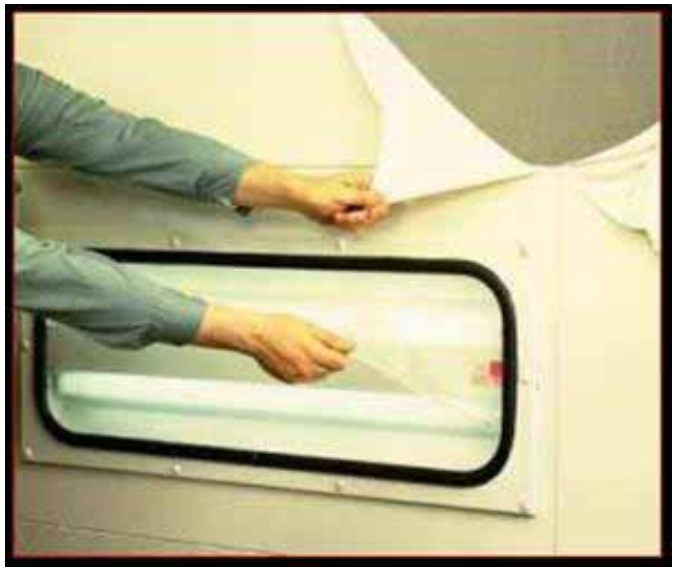


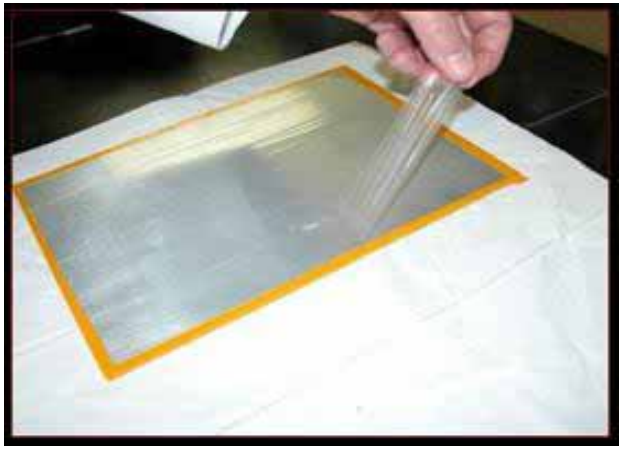
Coating B





Coating C





Shelter “Proof-of-Concept” Study

Baseline Leakage Rate: Uncoated Shelter

- **Minneapolis Blower Door™ & Tectite v.3.1 software**
- **Positive pressures applied to measure leak rate at 0.1, 0.2, 0.3, 0.4, 0.5, & 0.6 iwg (triplicate measurements)**
- **Recommended over-pressurization of ColPro shelter: 0.3 - 0.5 iwg**
- **Weather station to monitor barometric pressure, temperature, & humidity**
- **Corrects for wind speed by sampling 100 data points @ each pressure**
- **Data corrected to standard conditions (scfm): 68ºF, 29.92 in Hg, 50% relative humidity**

Average Temperature: 94ºF
Average Humidity: 55%

Coating Application via Paint Sprayer

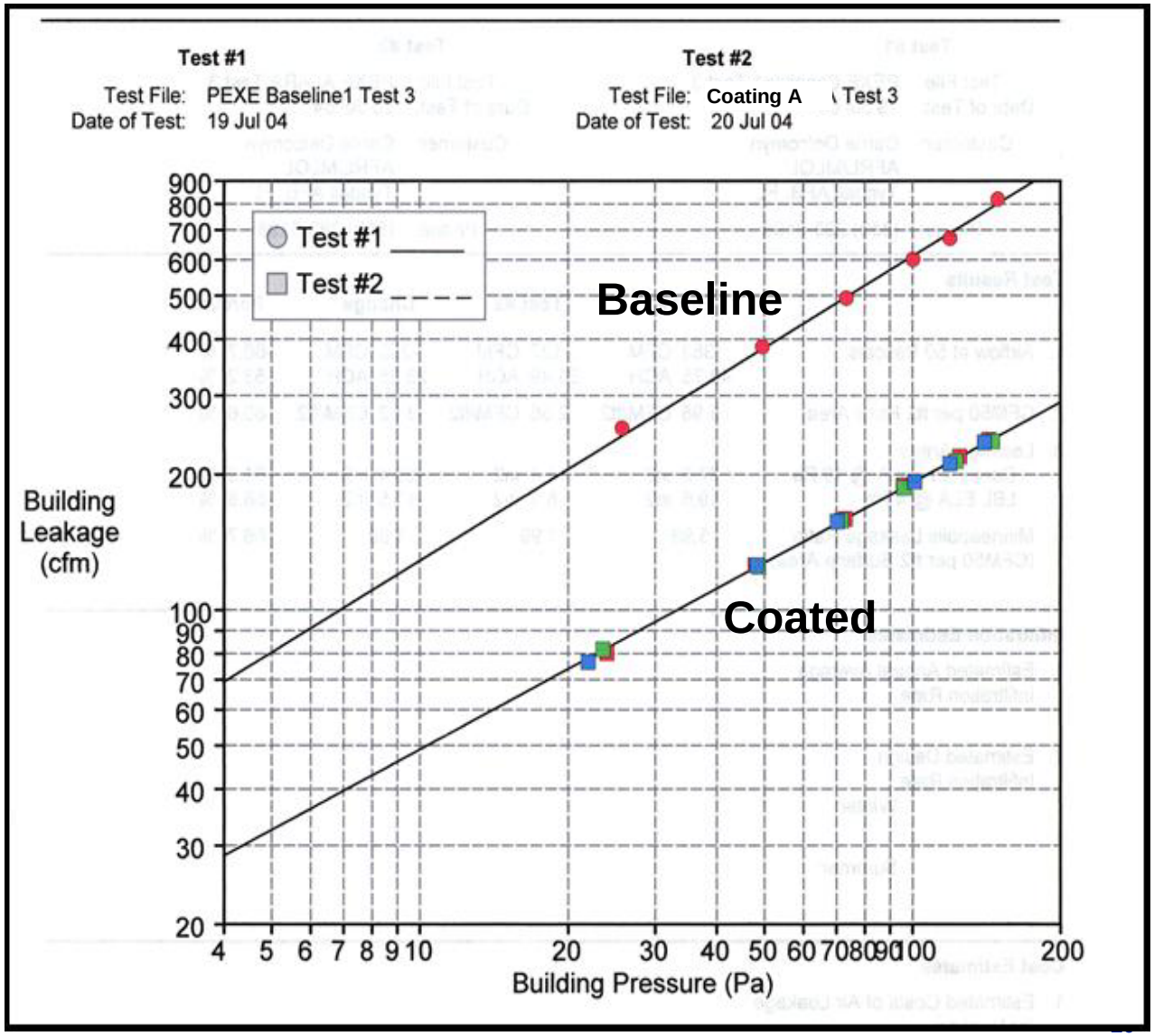
Wagner Paint Sprayer

Leakage Rate: Uncoated vs. Coated Shelter

Leakage rate (scfm) at 0.5 iwg:

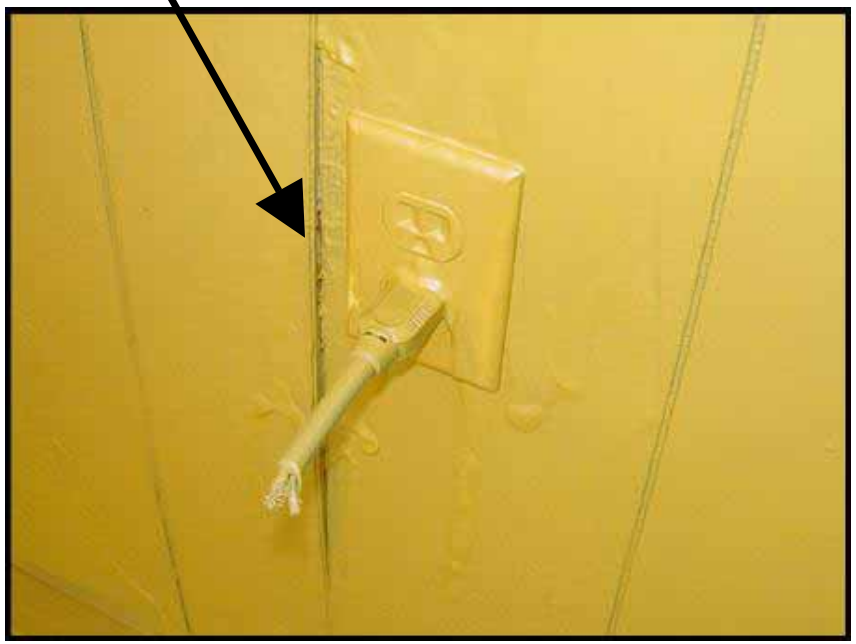
Baseline	Coated
706.6	219.1

Resulted in 69% reduction of leakage

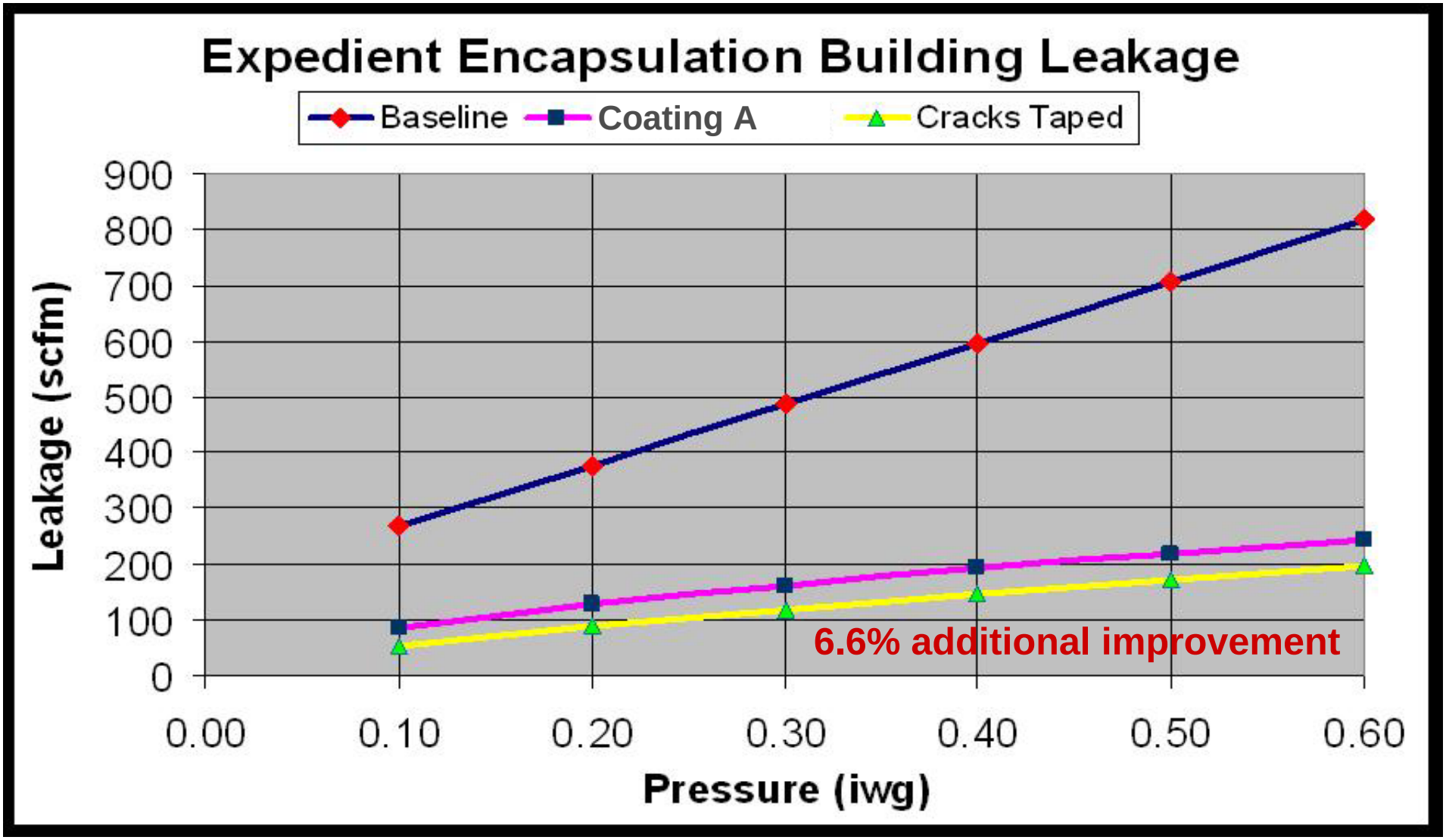


Cracks & Gaps

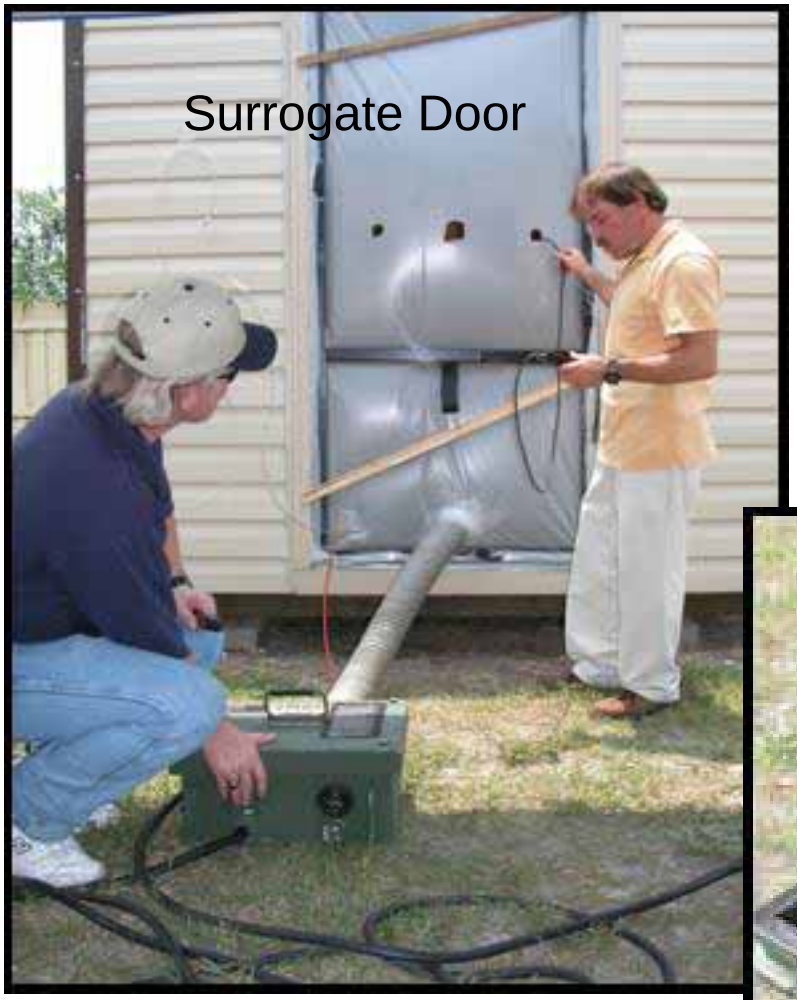
Apparent gaps remaining…



Summary of Results:
Coating A and Coating A w/ Cracks Taped

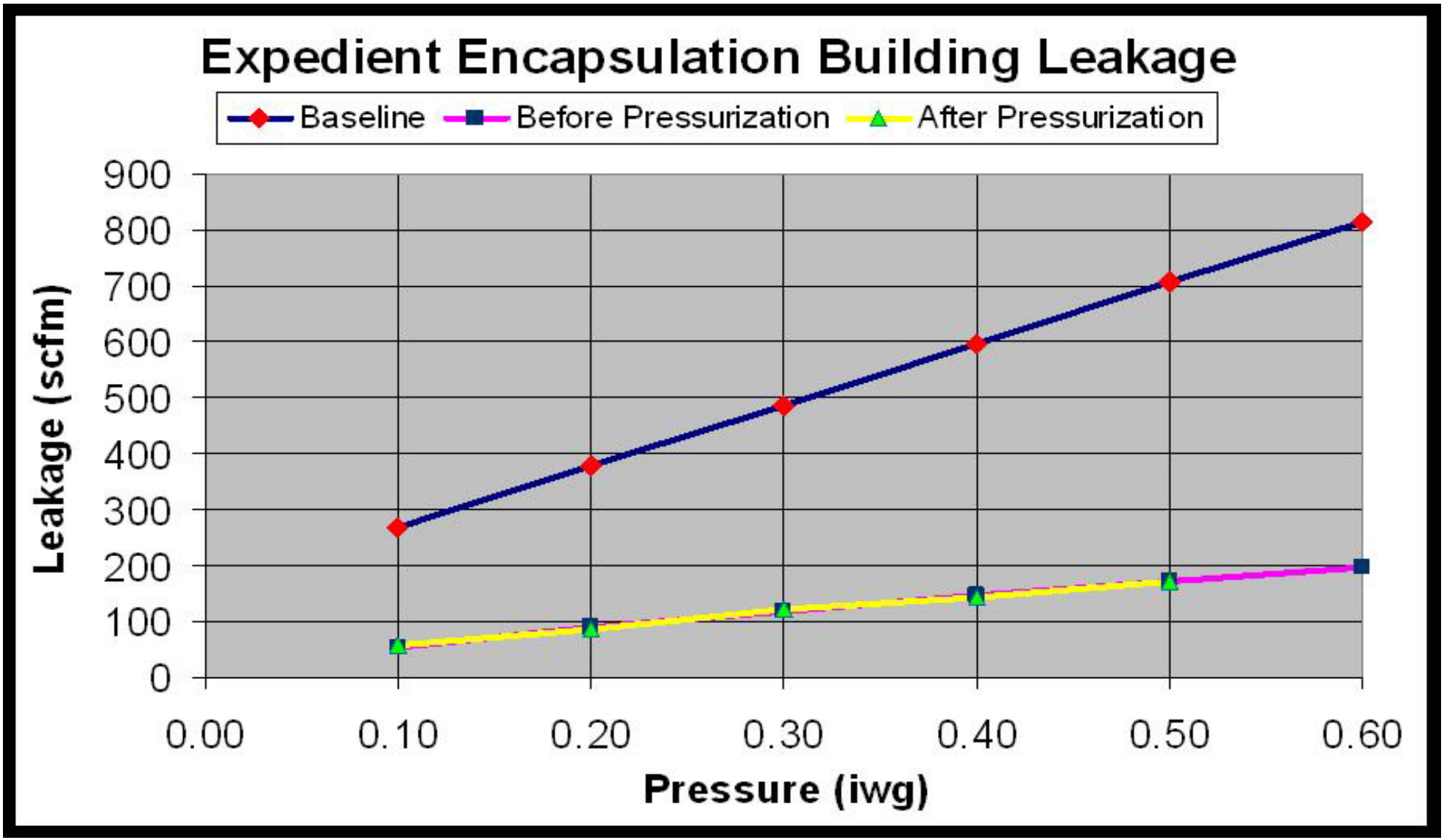


Pressurization Test



- **Fabricated door using plastic**
- **M28 blower used for extended supply**
- **Purge holes cut to achieve stable pressure at 0.5 iwg**
- **Pressurized for 19 hours**

Summary of Results: Integrity of Interior Structure



Contribution of Paneling and Window

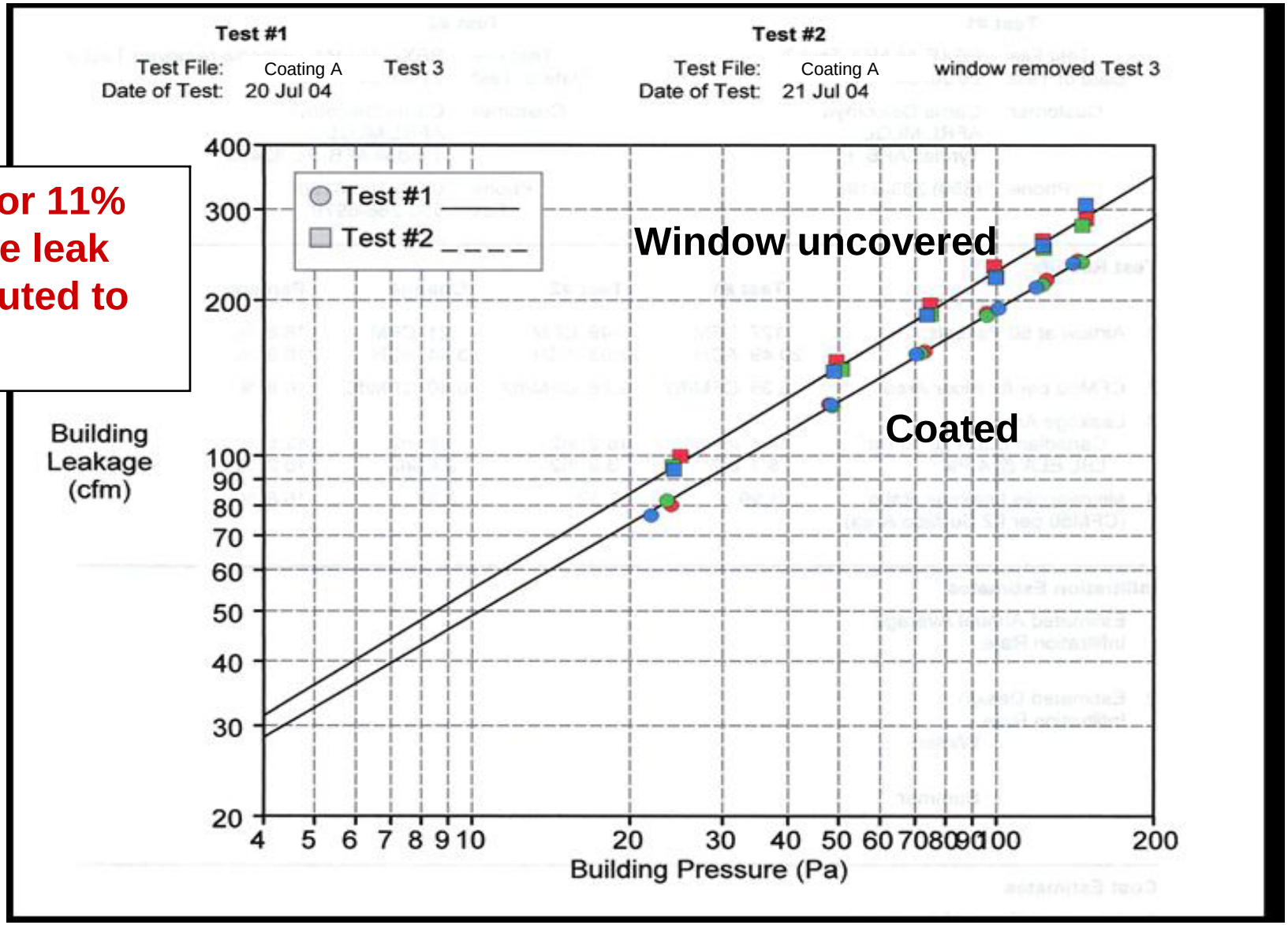
Leakage through paneling?

Coated plastic

Contribution of window?

Leakage Rate:
Coated vs. Coated w/ Window Uncovered

~75 scfm or 11% of baseline leak rate attributed to window



Overall Performance Results

- **Coating interior of shelter achieved a 69% reduction in leakage**
- **Taping large gaps after application of coating achieved 76% reduction in leakage**
- **Window covered with plastic, duct tape and coating contributed 11% to the measurements**
- **Insignificant pressure loss observed through uncoated paneling**
- **Proof-of-concept demonstrated feasibility of using coatings as expedient ColPro barriers**

Penetration and Permeation

Penetration

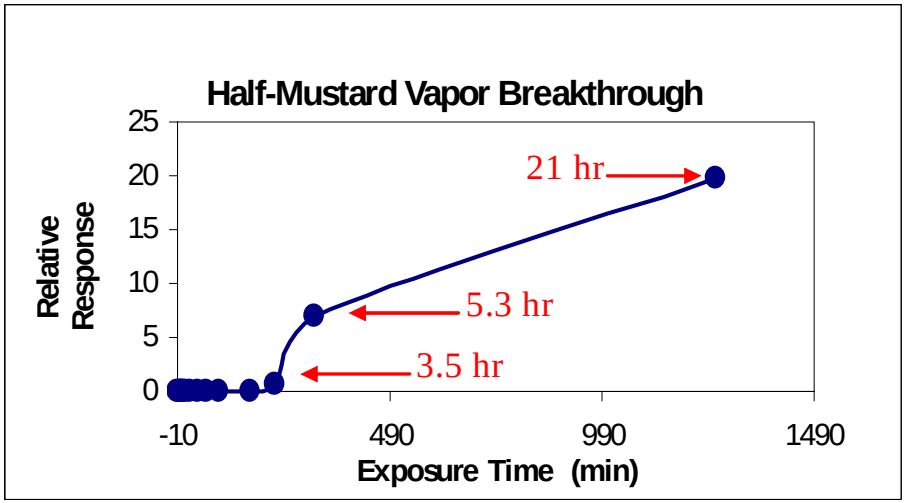
- Occurs through pores and unsealed cracks and openings
- Compounded by pressure gradients
  - Wind can overcome positive interior pressure
  - Shock from an explosion can cause air to infiltrate
- Current guidance is to maintain overpressure at 0.02-0.3 iwg

Permeation

- Occurs through molecular diffusion across a polymer barrier (concentration gradient)
- Pressure does not prevent transport through the barrier material
- Can be controlled through various mechanisms
  - Additives - impervious or sorptive
  - Reactive

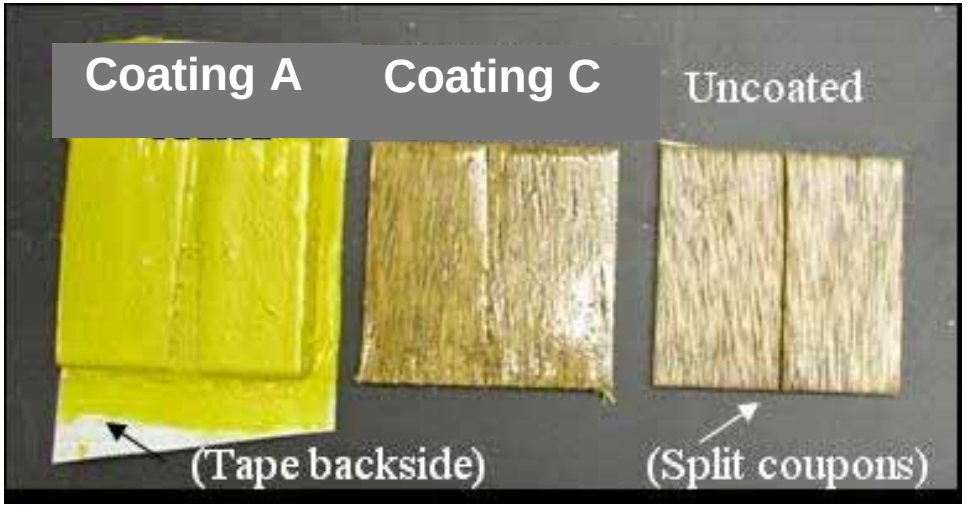
Ongoing Studies

- **Comprehensive bench-scale evaluation of numerous coatings**
- **Permeability studies with CW simulants**

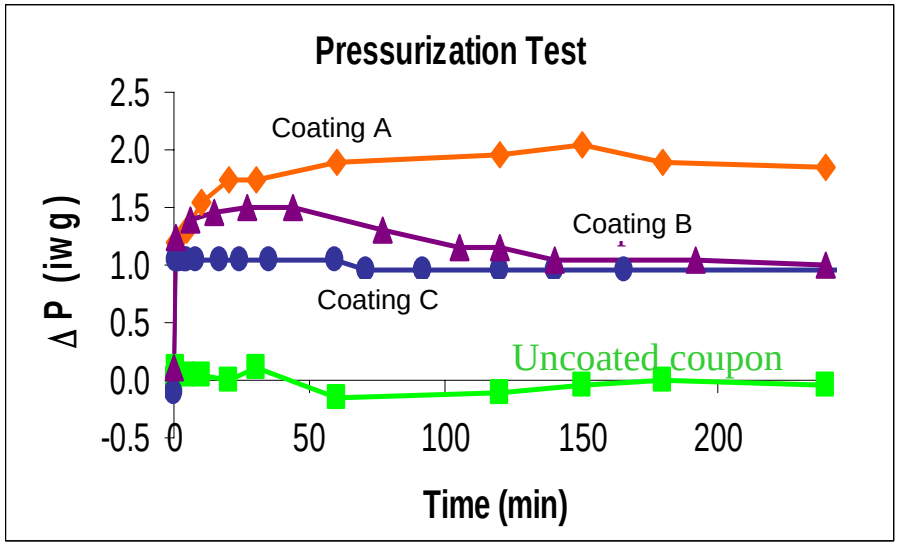


Breakthrough of half mustard vapor through a 7 mil dft film

Penetration Studies



Split wood panel coupons sealed with coatings for leakage studies



Pressurization data at 22°C of uncoated versus coated split wood panel coupons

Future Efforts

- **Determine applicability with tentage (TEMPER)**
- **Define desired coating characteristics and performance criteria**
- **Perform agent permeation and compatibility studies**
- **Evaluate performance of expediently coated shelter system against vapor and environmental challenges**

Benefits to Warfighter

- Capability to setup ColPro virtually within any structure
- Compatible with existing ColPro filtration/airlock systems
- Temporary (removable coatings) or permanent concepts
- Quick, easy and familiar application techniques
- Uses non-hazardous materials
- Minimal logistics burden
- Facilitates rapid restoration of operations

- Potential to reduce size and weight necessary for ColPro
- Rapidly increase quantity and availability of expedient ColPro systems

Acknowledgements

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