Expeditionary Basing and Collective Protection Directorate

Fabric Structures Team

Advanced Textiles for Fabric Structures & Life Support Technologies

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Fabric Structures Team Overview

FST Goal: **Mature technologies for fabric shelter systems providing increased protection, improved habitability, and reduced logistics burden.**

The Team:

- **Jean Hampel - Team Leader, Mechanical Engineer**
- **Tom Larkham - Equipment Specialist**
- **Kristian Donahue - Chemical Engineer**
- **Robin Szczuka – Chemical Engineer**
- **Julia McAdams – Chemical Engineer**
- **Liz Swisher – Electrical Engineer**
- **Chris Aall – Mechanical Engineer**
- **Clinton McAdams – Mechanical Engineer**
- **Allyson Stoyle – Chemical Engineer**

Technologies:

Advanced Fabric Structures including Airbeam Shelters :

- **Maintenance Shelters**
- **Mobile Warehouses**
- **Large Command Posts**
- **CB Medical**
- **Backpackable**

Insulation, energy & organizational equipment

- **Insulation**
- **Radiant Floor Heating**
- **Water demand reduction systems**

Collective Protection – CB Defense:

- **Overpressure/Negative Pressure Shelters**
- **CB Fabrics**
- **Reactive Airlocks**
- **Self-Decontaminating Fabrics**

Airbeam Technology

- Provides Rapid, Lightweight, Durable Deployment
- Technology transitioned to Force Provider (HDT-Vertigo, Inc.) and Chemically and Biologically Protected Shelter (Federal Fabrics-Fibers, Inc.)
- Airbeam backpackable shelters – Nemo, Inc.

Medium and Large Airbeam Shelters

- Mobile Warehouses for Defense Logistics Agency (DLA) customer

- Eight, 44’ wide,100’ long shelters delivered

- 80’ foot wide shelter for Joint Strike Fighter Decontamination Shelter

Airbeam TEMPER with Collective Protection

- Sponsor: Army Medical Materiel Development Activity (USAMMDA)

- Goal: provide chemical/biological protection to Army Combat Support Hospitals using airbeam TEMPER design

- Shelter fabric is a certified ColPro material made by Bondcote

- Integral Airlock with bump-thru doors

- Incorporates air-tight seals to enabling protective overpressue and complexing

MANTECH Improvements to Non-woven Composite Insulation Liners

Airbeam Shelter with a Prototype Non-woven Insulation Liner

Non-Woven Composite Fibrous Batting

Manufacturing Quilt Lines of Current Prototype Liner System

Purpose:

- To develop an improved manufacturing process for a non-woven composite, insulation liner to be used in expedient soft wall shelters. Manufacturing improvements will increase thermal performance and likelihood of transition while decreasing product cost and weight.

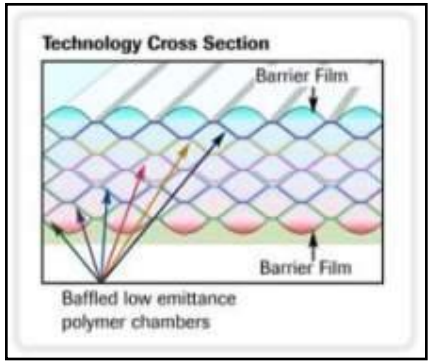
Product(s):

- An improved manufacturing process for non-woven insulation tent liners shown through prototyping and pilot demonstration.
- Three or more 12” x 12” hand samples of non-woven composite liner fabricated with improved manufacturing techniques. These samples will be used for evaluation towards a new manufacturing process.
- Hand sample test results regarding thermal performance, weight, tear strength, flame resistance, etc.
- Demonstration of enhanced manufacturing capability through two full-scale prototype tent liners – one for a standard 32’ TEMPER and one for an air-supported tent.
- System level test results providing weights, pack volume, overall system R value (thermal performance).
- A final test report documenting the efforts under this project, test methods used, and overall benefits achieved.

Payoff:

- Enhanced non-woven composite tent liners will provide improved thermal performance in highly-agile soft wall shelters resulting in less fuel consumption for expeditionary operations
- Soldiers will experience an higher quality of life due to better climate control, and enhanced ease of insulated shelter set-up

Cellular Insulation



Purpose:

- Advance manufacturing technology for a multi-layer, cellular insulation that transports flat and expands into a robust, flame resistant, honeycomb construction that maximizes thermal efficiency when deployed.

Progress:

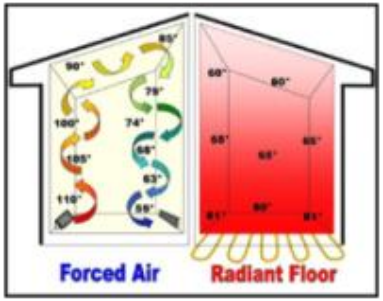
• FY12-13: Concepts pursued under four separate contracts:

- Warwick Mills, Inc.
- Federal Fabrics-Fibers, Inc
- Johnson Outdoors
- Zipflat

• FY14: Manufacturing scale-up and fabrication of prototypes

• Also monitoring Army Corps of Engineers SBIR project with L'Garde on improving their cellular insulation concept and incorporating phase-change materials

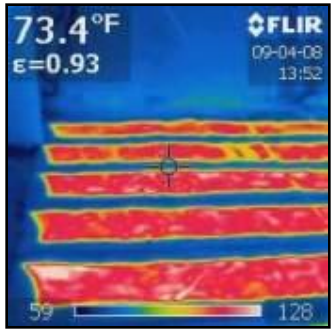
Radiant Floor Heating



Heat Distribution Comparison
Forced Hot Air vs. Radiant Floor Heating

Electric and Hydronic Radiant Floor Heating Systems

Radiant Floor Heating Prototype



Thermal Imaging of Radiant Floor Heating Prototype

Purpose: To reduce the energy required to power shelter heating systems which would reduce the logistical burden of fuel supply. The effort focuses on the design and development of a radiant floor heating system that would efficiently heat an airbeam shelter in cold weather climates, either replacing or in addition to current Environmental Control Units. Background research and technology downselect comparing electric or hydronic (liquid) systems.

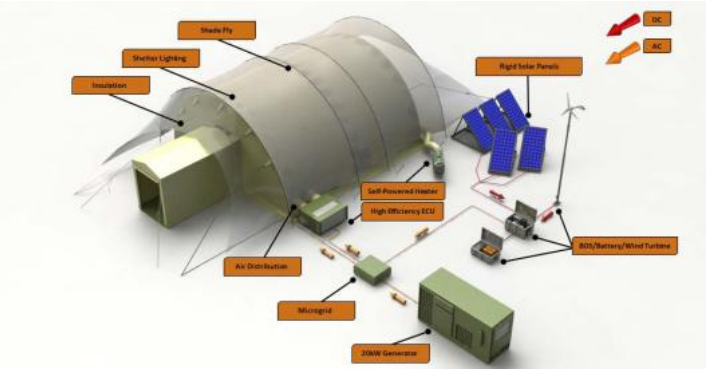
Results/Products:

- Design and manufacturing process that is financially feasible and proficient.
- Energy Efficient radiant floor heating system prototype(s) that are lightweight, deployable, portable and durable.

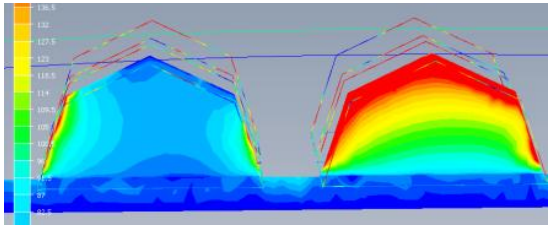
Payoff:

- More energy efficient?
- 100% silent heating system.
- Increased soldier comfort levels by eliminating hot spots created by forced hot air heating systems.

Energy Efficiency (E2) Optimization of Command Post (COP)/Patrol Base (PB) Shelters Army Rapid Innovation Fund (RIF) with HDT, Inc



Integrated Energy Efficient Solutions



Purpose:

To reduce fuel consumption for Platoon-sized (50-75 Man) camps via demand control management, shelter system and support component energy efficiency improvements.

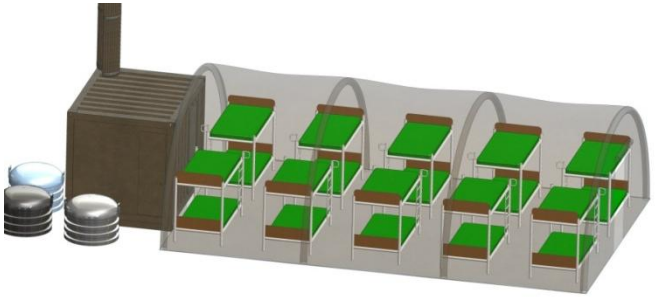
Results/Products FY12 Program:

- Two prototype systems incorporating all energy efficient solutions developed under the effort.
- Baseline test plan and results & prototype test report

Payoff:

- Reduced fuel consumption, cost savings and reduced generator run times.

Self-Sustaining Living Module (SLiM)
NEW! Rapid Innovation Fund (RIF) Projects

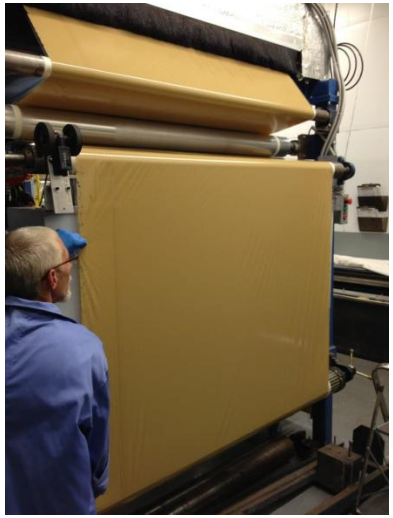


- 2 new contracts awarded under Rapid Innovation Fund Program
- Leidos, Inc. (fka SAIC)
- Technical Products, Inc.
- Advancing integrated habitat systems that minimize logistics footprint

15-Man Arctic Tent Condensation Test Support to Marine Corps Program

- NSRDEC developed new tent condensation test under Marine Corps Program
- Evaluated condensation in new Marine Corps 15-man Arctic Shelter in the Doriot climatic chamber in June 2013
- 15 occupants slept two 8-hour nights within the shelter between 1130 hours and 0730 hours
- The shelter was instrumented with temperature and humidity sensors to record conditions
- After test completion, the shelter was evaluated for condensation by the engineering staff

MANTECH: High Performance Chemical/Biological Agent Resistant Shelter Fabric



Purpose:

- **Provide Chemical, Biological, Radiological and Nuclear (CBRN) protection at a low mass, low cost in high volume for shelter & airlock applications**

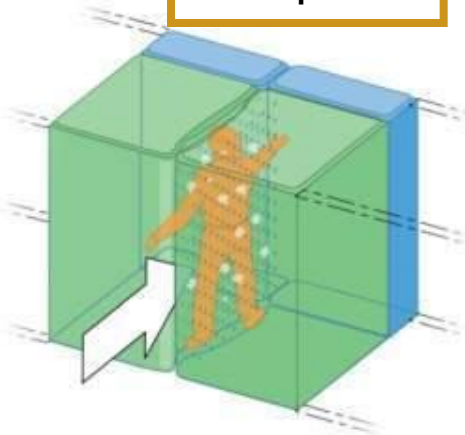
Results:

- **11 oz/sq yd**
- **High volume CBRN laminate production through manufacturing technology improvements**
- **Prototype full-scale structures will demonstrate system construction processes**

Contractor: Warwick Mills, Inc.

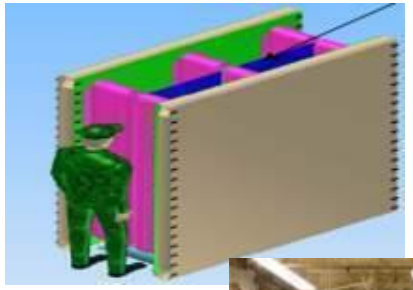
Next Generation Airlocks for Col Pro Applications

"Zero Volume" Concept



- New airlock technology concepts that are lightweight, compact, easily deployed, reduced volume and incorporate self-decontaminating textiles.
- Full-scale bio-simulant test apparatus and procedure developed
- Testing of prototypes ongoing

Inflatable Airbeam Concept



Self-Decontaminating and Biocidal Textiles

Goal: Reduce nosocomial infections in fabric shelters through the incorporation of reactive fabrics into shelter interiors.

New emerging textiles with the capability to neutralize common battlefield microbes in addition to chemical/biological warfare

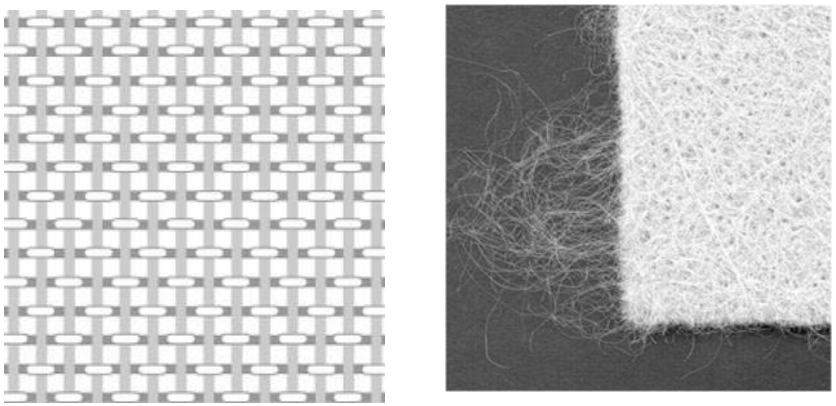
Warwick Mills, Inc:

- Chloramine based chemistry with hydantoin/siloxane attachment
- Advancements in textiles allow up to a 6000ppm load
- 3-log kill time in <1 hour on Bacillis Subtilis (Anthrax surrogate)
- Demonstrated reactive textile in developmental airlock

Ventana Reseach Corp.

- Light-activated, reactive photocatalytic coatings that *generate & reversibly store* singlet oxygen ($^1O_2$), a mild oxidant
  - *Rapidly disinfects* surfaces exposed to *microbiological pathogens & toxic industrial chemicals*
  - *Demonstrated technology with shelter prototype*

Exploration of Multi-Functional, Nonwoven Textiles for Applications within Expeditionary Basecamps



Woven vs. Nonwoven

Why we're Interested in Nonwoven Textiles:

- Cost savings through simplified manufacturing process
- Higher achievable strength at same cube & weight or same strength at reduced cube & weight
- Higher fiber surface area for attachment increases multi-functionality potential

•New FY14 S&T Project

•Investigate research advances by industry and academia in multi-functional nonwoven textiles.

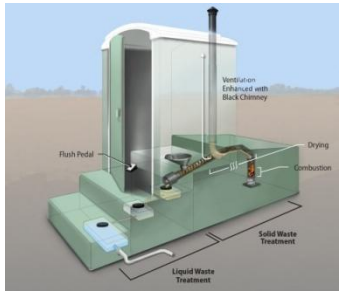
• Evaluate cutting edge technologies that have progressed beyond basic research and determine their potential application within expeditionary basecamps.

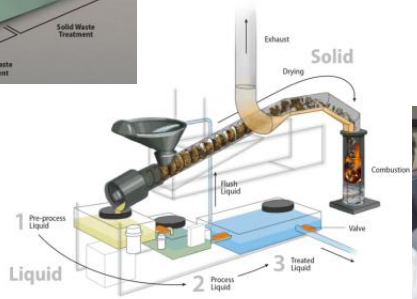
•Optimize textile properties within the most promising identified substrates incorporating application specific requirements.

•Target is a 20% weight, cube or cost reduction using nonwoven construction when compared to traditional woven and coated textiles of similar strength and durability.

Water Demand Reduction Technologies For Forward Operating Base Organizational Equipment

- ***Latrine Technology: Net-Zero, No Water, Recylcing***
- ***Showers: Quantitative & QOL Performance***
- ***Laundry: High Efficiency Technologies***





- Investigation of current water demand reduction technologies.
- Assessment of technology net water reduction vs. energy consumption.
- Test and evaluation of proposed water demand reducing technologies.
- Prototype component/desktop-scale water demand reduction technology.
- End user qualitative feedback on prototype system.

Black Waste Treatment Technologies

✓Improve Sanitation
✓ Net zero water use
✓ Net zero power use

- The design, if possible will minimize:
  - Biological or chemical materials that require special handling
  - Special bags or liners
  - High maintenance items like seals or flaps
- Technology approaches to investigate include:
  - Separation at source design
  - Gravity-driven filtration (or powered via renewable)
  - Electrochemical breakdown powered by renewable energy (solar and/or wind)
  - Precipitation
  - Ion-Exchange
  - Concentrated solar evaporation
  - Distillation
  - Reverse Osmosis
  - Dehydration

Description:

- **Investigate integrated technology approaches for handling and treatment of black waste generated by latrines at expeditionary, forward located combat outposts**

- The most effective black waste treatment system will utilize a combination of technical approaches to maximize breakdown speed and effectiveness

- Characteristics that will be minimized include:
  - Water use
  - Power use
  - Processing Time
  - Odor
  - Sound
  - Cleaning/Maintenance
  - Weight, cube & cost