



“WORK ON WATER”

2010 ENVIRONMENT, ENERGY,
& SUSTAINABILITY CONFERENCE

JUNE 17, 2010 - DENVER, CO

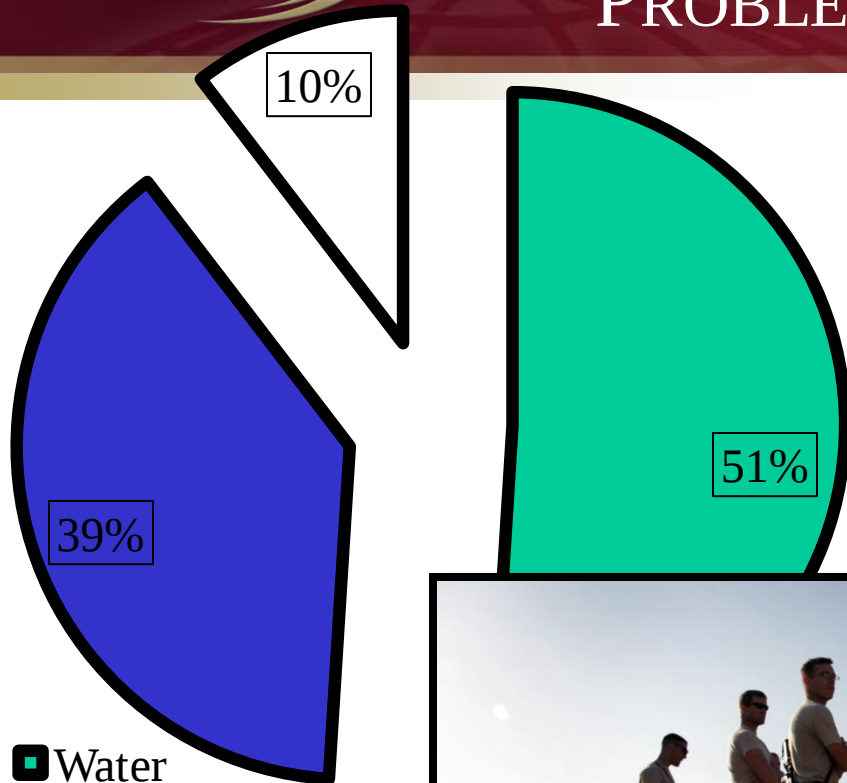


TECHNOLOGY DRIVEN. WARFIGHTER FOCUSED.

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PROBLEM DESCRIPTION



- Water
- Fuel
- All Other (Ammo, Food, etc.)

The Army's requirements for water are diverse and large!

During the summer months in Afghanistan a soldier may need up to drink 12 liters of water per day to avoid dehydration and heat injuries.



* Source: Data source, Mr. John Munroe, PM FSS, from 4th ID Iraq, 2003, Number of Logistic Packages.

In recent operations, bottled water made up 100% of initial potable water consumption and it continues to be consumed (although in lesser amounts) throughout the duration of those operations, never completely displaced by bulk water.



Production

ROWPU - Reverse Osmosis Water Purification Unit (two types 600 and 3000 gph)



600 GPH ROWPU for Divisions and below (600 GPH on Salt water)



3000 GPH ROWPU for EAD (2,000 GPH on salt water) (shown with **3000 gal onion tank**)

Distribution

TWDS - Tactical Water Distro System (10 mi hoseline sets)

SMFT - Semi-Trailer Mounted Fabric Tank (3k and 5k sizes)

FAWPSS - Forward Area Water Point Supply System

400 Gallon Water Trailer

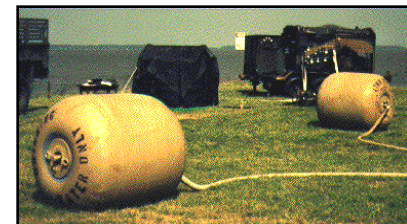
M149A2 Water Trailer



TWDS--10 miles of hoseline; six 600 GPM pumps; two 20K storage tanks; two 125 gpm pumps



400 Gallon Water Trailer (400 Gal)



FAWPSS
Six 500 gallon drums, one 125 GPM pump, and hoses



SMFTs two sizes (3K & 5K)

Storage Systems

SDS - Storage & Distro Systems consist of 50K and 20K bags

Onion Bag - 3,000 gal thin skinned bag for temp storage



SDS come in 800K, 300K, 40K and 20K sizes complete with bags, hoses, & pumps.

Production---Tactical Water Purification System (TWPS) and Light Weight Water Purifier (LWP)



TWPS is transported by HEMMT LHS and produces 1500 GPH from fresh and 1200 from salt water. Each TWPS replaces two 600 ROWPUs.

The **HIPPO** is a 2000 gallon hardwall tank, mounted on a tankrack. It includes a hose reel, 125 gpm pump, and a canteen fill stand.

The **CAMEL** replaces the current water buffalo in units with 5-ton trucks. It will carry 800 gallons and includes a heater and chiller.



The **LWP** can be transported in the back of a HMMWV and produces 125 GPH from fresh or 75 GPH from salt water.



800 gal

Tricon Water Re-use System

Concept

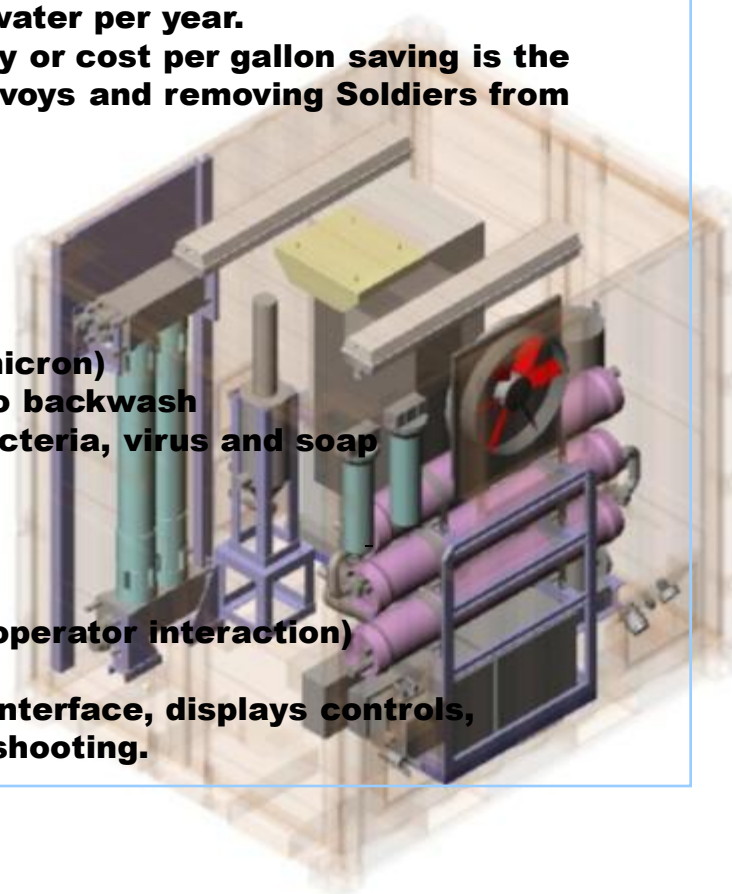
- Leveraging off existing technology from the Hospital Containerized Batch Laundry (CBL) and 1500 GPH Tactical Water Purification System (TWPS), both contact awards in production with SFA, and applying the concept to integrate into the Force Provider a water reuse capability for the Containerized Shower (CS) and potentially the FP CBL.
- FP Containerized Shower utilizes 12,000 gallons of water per day, 4.4M per year. The potential to save 75-80% of this water equates to 3.3M gallons saved per year, per system. Currently 70 CS in operation in the AOR, stand to save 231M gallons of water per year.
- In this case, more importantly then the resource efficiency or cost per gallon saving is the capability of drastically lessening the logistic resupply convoys and removing Soldiers from harms way.

Filtration System Details

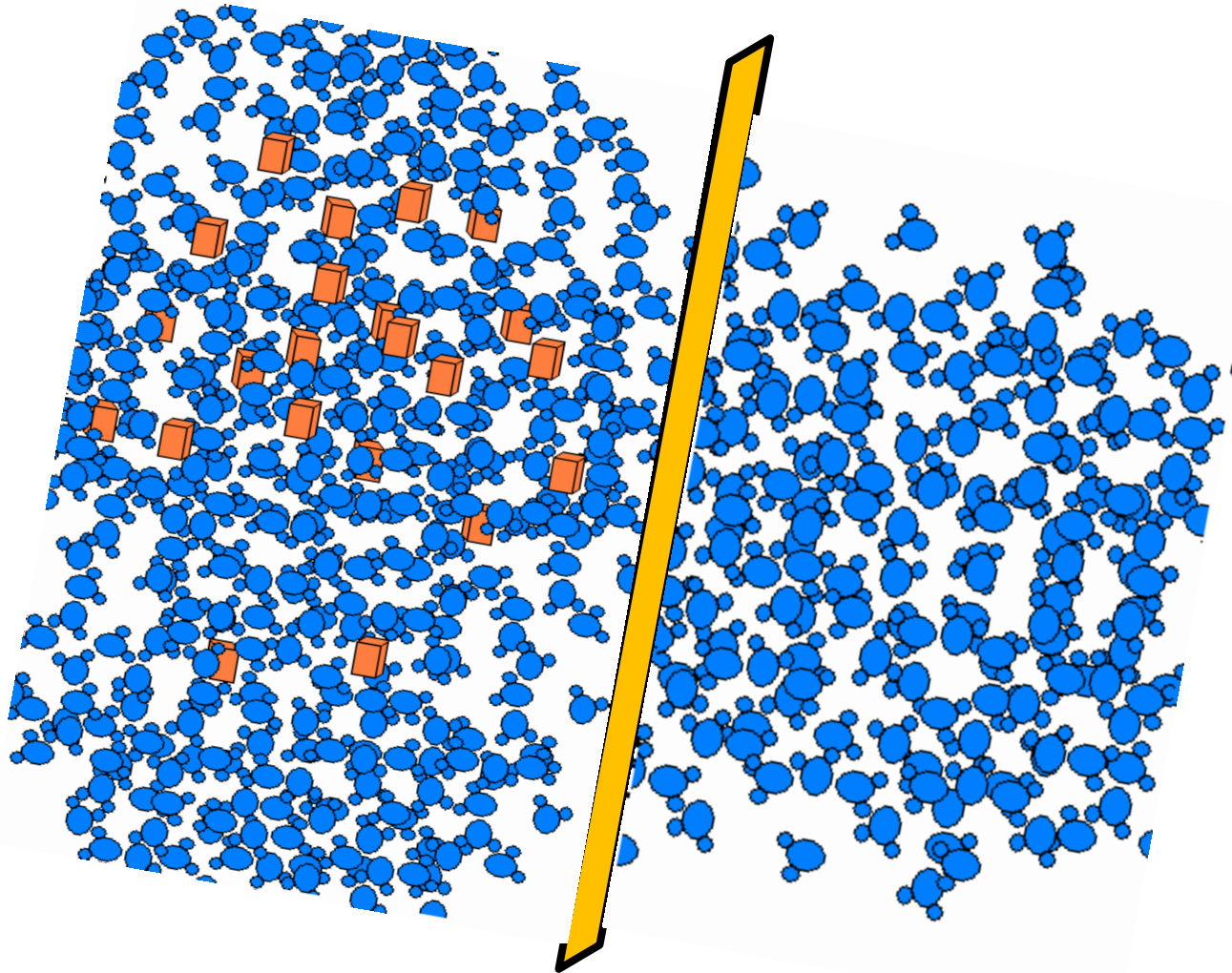
- 12,000 Gallons Per Day capacity (40 GPM peak flow)
- 70%-80% recovery
- automated chlorine injection
- Self cleaning (air purge) pre-filter to remove hair/lint (50 micron)
- Micro filters (.2 micron) to remove suspended solids w/auto backwash
- Saltwater RO membranes to remove organic materials, bacteria, virus and soap
- Carbon filtration after membrane

Features

- System operational temperatures -25 F to 140 F
 - Unattended automatic operation ,(7 days minimum w/out operator interaction)
- Built in Test Equipment, self-monitoring**
- Programmable Logic Control (PLC) with LCD screen user interface, displays controls, flows, pressures, set-up/operating instructions and troubleshooting.



Membrane Centrality



Scientific Objectives: Exploit the theoretical and observed phenomena associated with the potential to design ordered molecular transporters, especially in aqueous regimes.

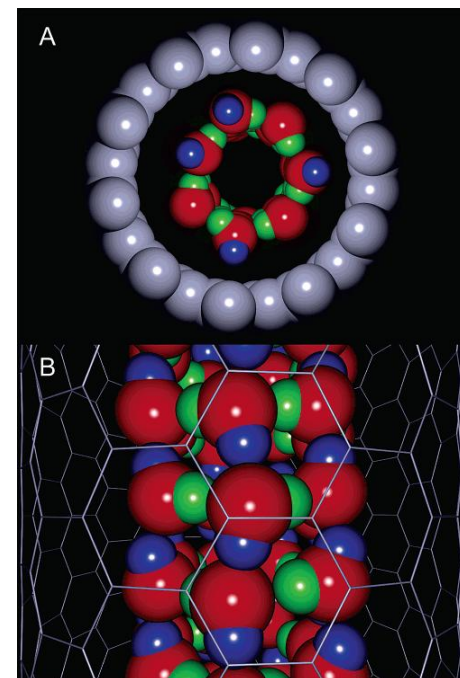
Scientific Opportunities:

Earlier ARO funded research observed unusual H-Bonding in water-filled carbon nanotubes.

Theoretical studies suggest that through asymmetric charge placement dipole ordering of water may produce spontaneous pumping. Experimental studies by the Hinds' group observed fluid flow rates 10,000x's that within conventional materials due to a nearly perfect slip boundary condition.

This thrust exploits those observations to determine if membranes utilizing the observed molecular ordering can mimick natural protein channels with unprecedented selectivity and flux.

Impact / Relevance: Robust man-made separation platforms mimicking the extreme. performance of Natural protein channels have relevance in water purification also in chemical protection, decontamination, sensors, fuel purification, energy storage... .



Snapshot from a molecular simulation of water adsorbed inside carbon nanotubes
Byl,†Jin-Chen Liu, et.al. 12090
9 J. AM. CHEM. SOC. 2006,
128, 12090-12097

ORDERED MOLECULAR TRANSPORTERS: APPROACH

Barriers

Fabrication of large area membranes with monodisperse (<1nm) diameter CNTs passing across a polymer barrier for 'single file' molecular transport.

Precise location of charge at CNT entrances to induce dipole ordering as chemicals enter pores.

Accomplishments

SWCNT membranes produced.

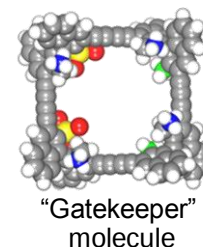
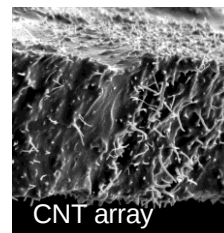
Program Dynamics

Established group that is building off of developments in drug delivery and energy storage projects using CNT membranes

Methods/Techniques

A new microtoming technique has been developed to utilize *powders* of the finest controlled SWCNT diameter as the starting material. Larger diameter CNTs are purposefully blocked by larger surfactant chemistry during processing.

A macro-molecular ring or 'Gatekeeper' is covalently bonded to CNT pore entrance. Precise charge placement is achieved through synthetic chemistry.



“You may talk o' gin and beer When
you're quartered safe out 'ere, An' you're
sent to penny-fights an' Aldershot it;

But when it comes to slaughter
**You will do your work on
water**, An' you'll lick the
bloomin' boots of 'im that's got

- Rudyard Kipling, 1892 –



U.S. Army Soldiers organize their food and water supply, inside of a container in Afghanistan, Nov. 28, 2009. (U.S. Army photo by Staff Sgt. Andrew Smith/Released)