

Facilities Corrosion Impacts: “When Corrosion Wins, the Mission Ends”

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Control Program

ERDC-CERL, Champaign, Illinois, USA

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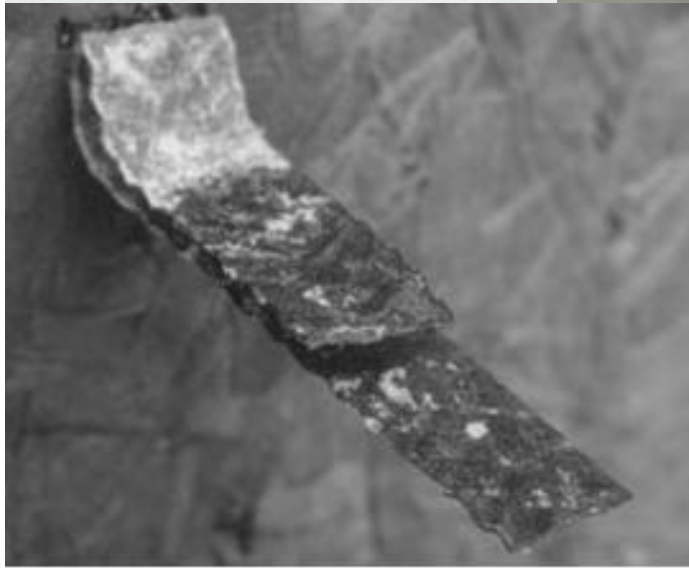
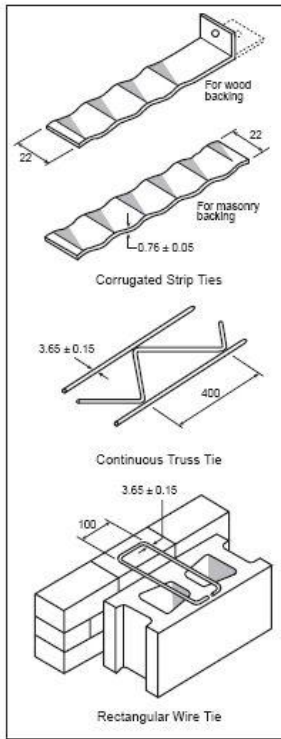


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Impact of Corrosion on Army Facilities



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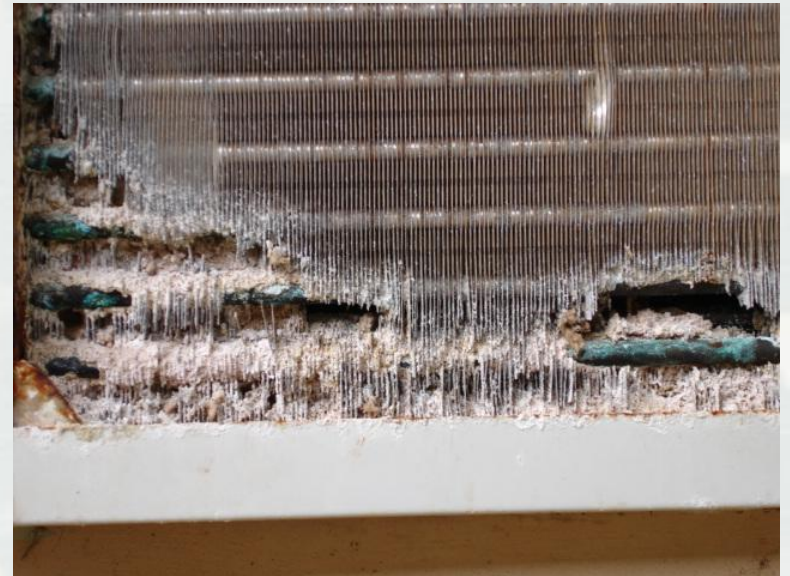
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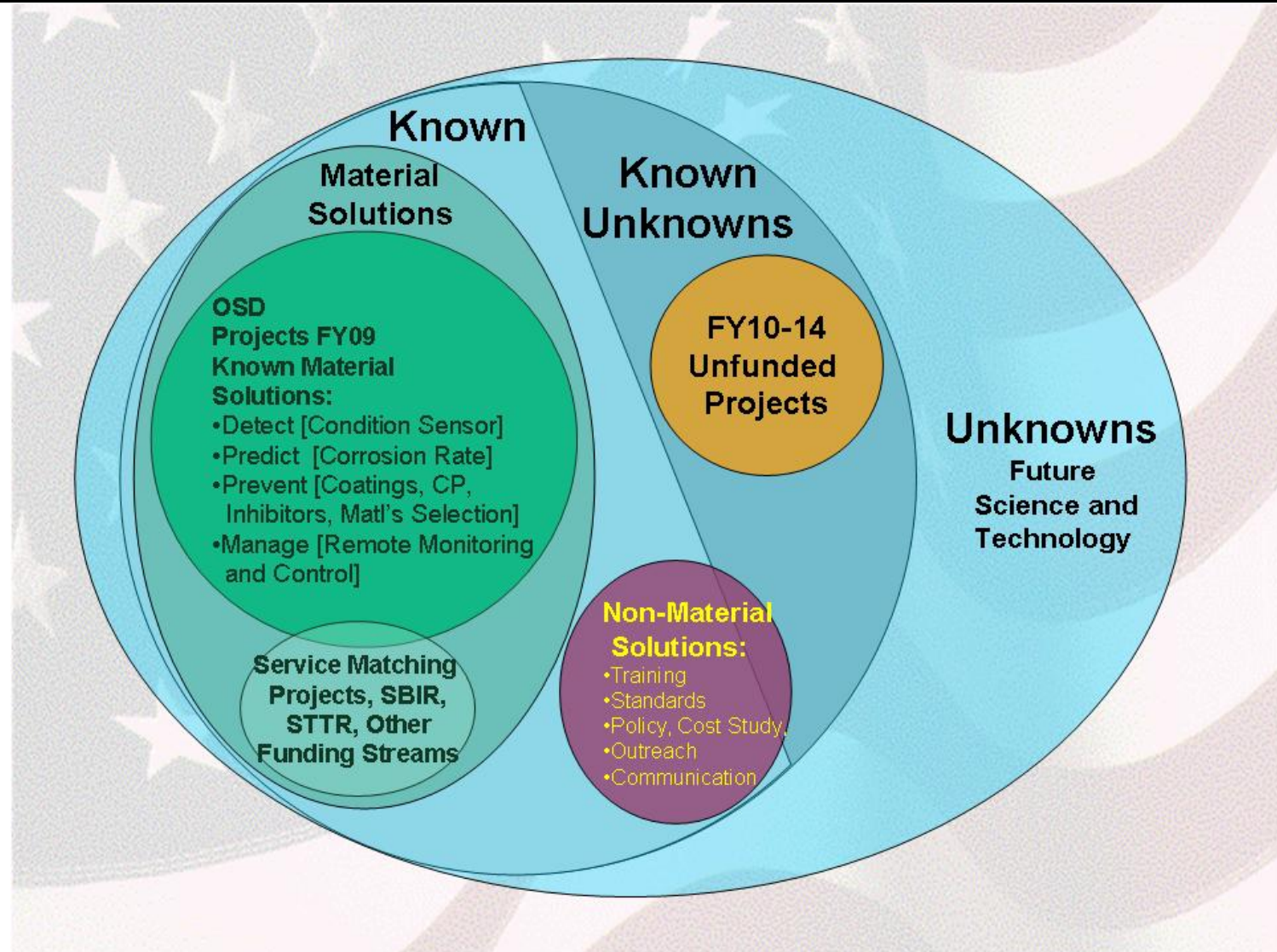
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Impact of Corrosion on Army Facilities

- Coating degradation on steel structures - roofing, storage tanks, bridges, etc.
- Water and fuel distribution systems, storage tanks, and pumping systems
- Water intrusion through concrete and masonry structures below grade
- Corrosion of underground pipelines, pier structures, airfields and pavements
- Corrosion of industrial heating and cooling systems



THE DoD UNIVERSE OF FACILITIES CORROSION



Corrosion Prevention & Control (CPC) Technologies for Facilities

Purpose

To demonstrate and validate emerging corrosion control technologies at DoD Installations under the OSD sponsored Corrosion Prevention and Control Program.

Product/Results

- Technology demonstrations and implementations at DoD Installations.
- Cost and performance reports.
- Recommendations for design guidance updates– ACSIM Installation Design Standards

Payoff

Service life extension of aging mission critical utilities and structures. Reduction in sustainment, restoration and modernization (SRM) costs.



Typical
facilities
corrosion
problems

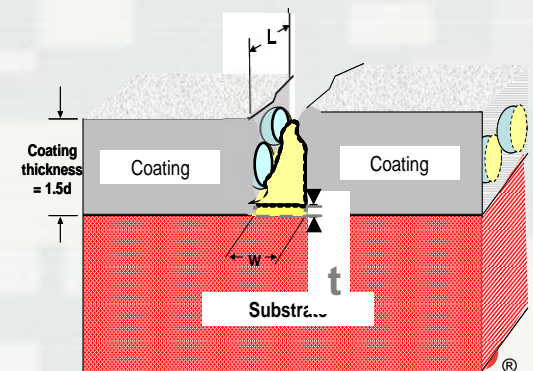


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Self-Healing Coatings

[RDTE-Funded; Developed & Patented at CERL]

- **Purpose-** Paints and Coatings degrade fast due to mechanical damage. These areas are highly susceptible to corrosion.
- **Technology-** Microcapsules in the form of microscopic spheres on the order of 50 to 150 microns in diameter containing corrosion-inhibiting compounds and coating “healants”
- **Application-** Dispersed into various paint formulations and applied to Field demonstration of self-healing coatings on a fire suppression deluge water tank
- **Benefits-** Judiciously chosen microcapsules exhibit stability against degradation



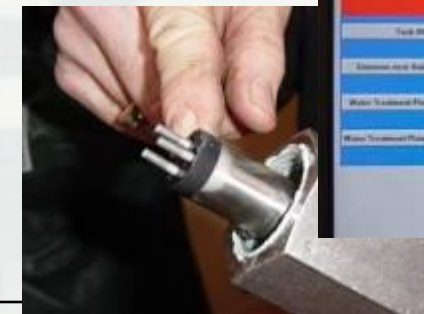
Pipe Corrosion Sensors for Potable Water Systems

Purpose- Potable water distribution systems can have significant corrosion problems, leading to water quality and health issues.

Technology- In situ sensors have been developed that can measure the corrosivity of water and the instantaneous corrosion rate of piping. In-line corrosion rate sensors, In-line multi-parameter water quality sensors are combined via a SCADA system and viewable to operators.

Application- Sensors are installed at critical locations in potable water distribution systems. They continuously provide data on water corrosivity and pipe corrosion rates to a Supervisory Control and Data Acquisition (SCADA) system or other data logger.

Benefits- Public Works personnel are immediately alerted to water quality problems or active pipe corrosion so that they can take corrective action.



	Corrosion Rate	Salinity	pH	Conductivity	Hardness	Ca ⁺⁺	Total Phosphate	Temp	DO
Truck Hill	0.0	0.0	6.8	0.1 uS/cm	0.0	88.2	0.0	58.0	0.0
Stonewall Building P. Well	0.0	0.1	9.1	0.0 uS/cm	0.0	443.2	0.0	58.0	0.0
Water Treatment Plant Raw Water	0.0	0.0	8.4	0.0 uS/cm	0.0	100.9	11.1	58.0	0.0
Water Treatment Plant Treated Water	0.0	0.0	8.5	0.0 uS/cm	0.0	400.3	0.0	58.0	0.0



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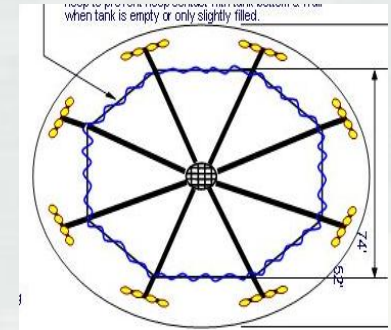
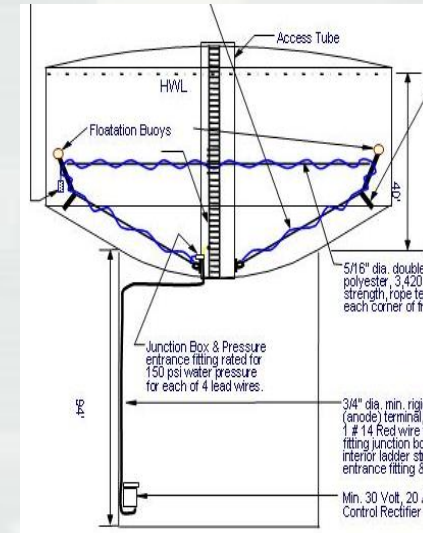
Ice Free Cathodic Protection (CP) Systems for Water Storage Tanks at Fort Drum

Purpose- In northern climates, ice buildup in potable water storage tanks destroys conventional cathodic protection systems.

Technology- An innovative design for an ice-free impressed current CP system for water storage tanks.

Application- This new system uses ceramic-coated wire anodes along with a flotation and support system that keeps the anodes submerged in water underneath surface ice, regardless of the water level. Demonstrated at Ft. Drum.

Benefits- Because the anodes and their supports are physically kept away from the ice, they are no longer subject to ice damage. The structure is cathodically protected regardless of the water temperature or level.



Without CP, accelerated corrosion occurs at defects in tank's interior coating.



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ERDC Materials Vision

Sciences

Nanomaterials

**Nano-bio
Technology**

**Multi-scale
Modeling**

**Computational
Materials Science**

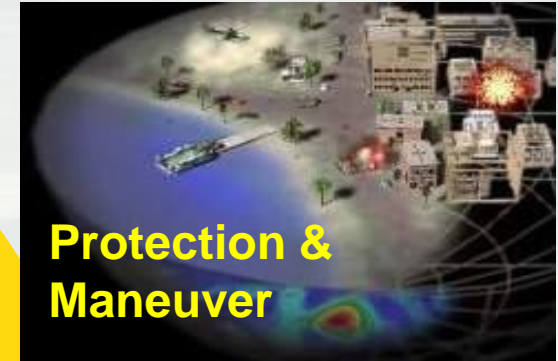
**Network Science
& Informatics**

Technologies

“Multifunctional Materials”

- Biostabilization**
- Embedded Sensors**
- Renewable Energy**
- Micro Powered**
- Thermal Management**
- Self Diagnosis &
Self Healing**
- Detox Surfaces**

Applications



RDT&E - Prediction of the Degradation of Composite Materials for Emerging Facilities and Equipment

Purpose:

Develop predictive models and algorithms for durability of fiber reinforced polymer (FRP) composites for facilities and equipment, based on mechanisms of deformation and degradation

Results:

- ***Multi scale (micro to macro) modeling of degradation mechanisms, based on chemistry, bridging length and time scales***
- ***Simulation algorithms based on multi-factor deformation and degradation models***

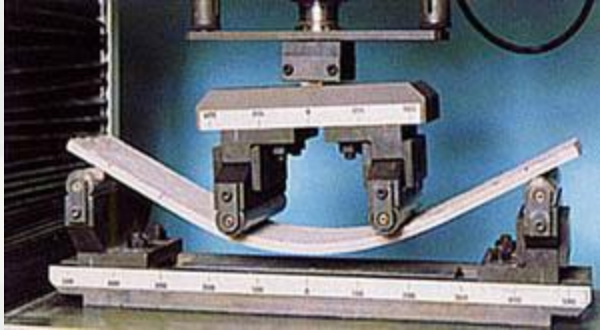


Payoff:

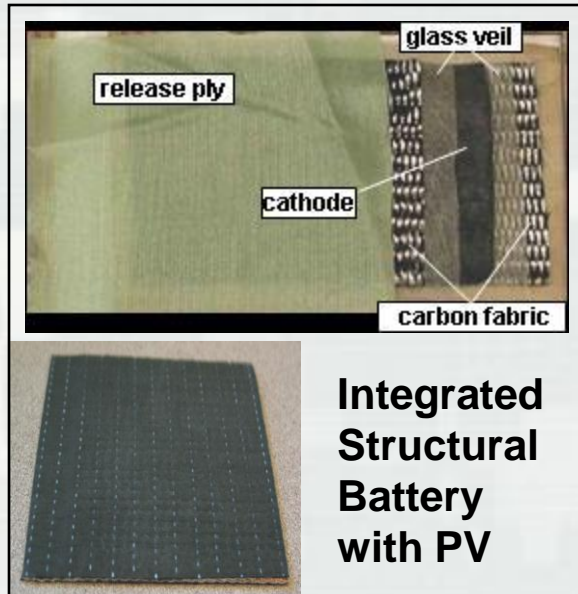
- ***Improved materials selection and increased use of corrosion-resistant composite materials***
- ***Transition to OSD/ACSIM Corrosion Control and Prevention Program***



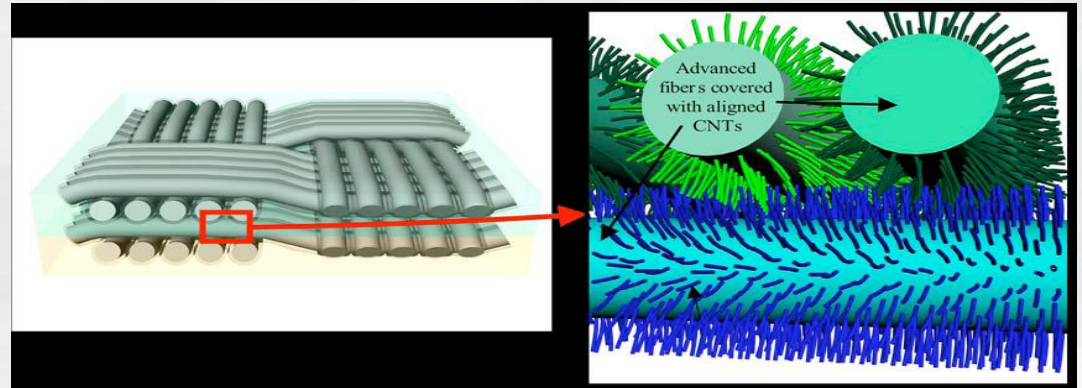
Opportunities/Challenges



Flexible Concrete



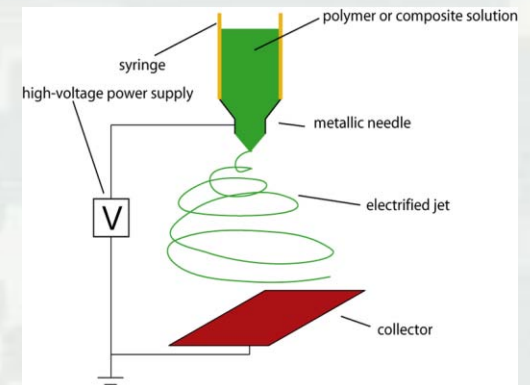
Integrated Structural Battery with PV



3-dimensional CNT-reinforced composite:
a 'fuzzy-fiber' composite with *in situ*-grown radially-aligned CNTs on the woven cloth.



Amorphous metal with Superior Corrosion Resistance



Electro-spun fibers

