Reduction of Solvent Based Paint Waste

Y0817 Pollution Abatement Ashore Program

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Technical POC
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Objective & Navy EQ Requirements

- Objective
  - Reduce the costs associated with the disposal of ESL solvent base paint
- Problem Statement
  - Solvent base paint is the costliest hazardous waste generated Navy wide
- EQ Requirements
  - 2.III.01.b Advanced Control and Destruction Capability for Hazardous Waste. (Priority - High)

Problem Statement/Drivers-Regulatory

- Pollution Prevention Policy
  - Eliminate source
    - » Military Requirement prohibits source elimination
  - Recycle source
    - » Limited market for Mil-Spec paints
    - » Military Requirements prohibit recycling
  - Minimize source
    - » CHRIMP process already implemented
  - Treatment
    - » Last alternative

Approach

- Characterize Waste
- Identify Appropriate Technologies
- Evaluate Technologies
- Select Technology
- Conduct Laboratory Tests
- Conduct Pilot Tests
- Install Full Scale Process

Technology Description

Biological Treatment/Biofilters

- Waste paint is treated aerobically in a sequencing batch reactor amended with simple organic and inorganic nutrients.
- Resins unique to each paint type are comprised of short polymers held together by ester, ether, or amide bonds. Microbial hydrolysis of these bonds yields smaller fragments that are rapidly degraded.

Before/After Comparison

Before	After
High costs of disposal	Reduce the costs of treatment
Liability associated with shipping	Eliminate the liability associated with shipping
High costs associated with paper work and managing waste	Reduce paperwork and costs of management

Benefits: Before/After Comparison

Methodology (San Diego Area)	Costs ($13.60 per gallon Bulk, $17.92 per gallon Non Bulk)	Nominal Annual Savings
Contractor Disposal	$973K/59K gal - $16.49/gal	None
Biological Treatment	$0.20 to $0.50 per gallon	$900K +

	Costs	
Capital Costs	($500K)	
R&D Costs	($710K)	
Total Savings (10 YRS)	$9,000K	
ROI (5 activities)		14.0

Milestones and Major Deliverables of Task

MILESTONE	FY02				FY03				FY04			
	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
1. Waste Characterization												
2. Technology Survey												
3. Preliminary Testing												
4. Interim Report												
5. Pilot Testing												
6. Test Report												
7. Full Scale Reactor Demonstration												
8. User Data Package												

Technical Accomplishments to Date

Pilot Test at Pearl Harbor Public Works Center

pH Control System

Air Lift Reactors

Technical Accomplishments to Date

Air Driven Centrifugal Pumps: Provides paint emulsification

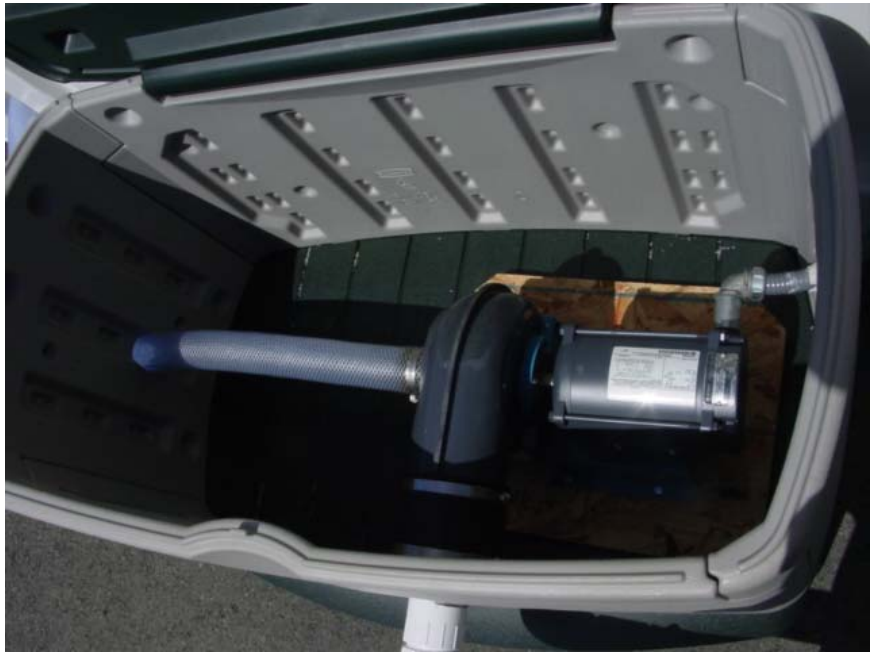
BioFilters: Treats exhaust from bioreactors

Technical Accomplishments to Date

Empty Biofilter

Filled Biofilter: Filled with compost

Technical Accomplishments to Date



Blower: Provides negative pressure for biofilters

Activated Carbon Filters: Provides additional VOC treatment if required

Technical Accomplishments to Date

Pilot Test Site at Pearl Harbor

Technical Accomplishments to Date

Emulsified Polyurethane Part B Paint

Technical Accomplishments to Date

Part B Polyurethane Paint with microorganisms

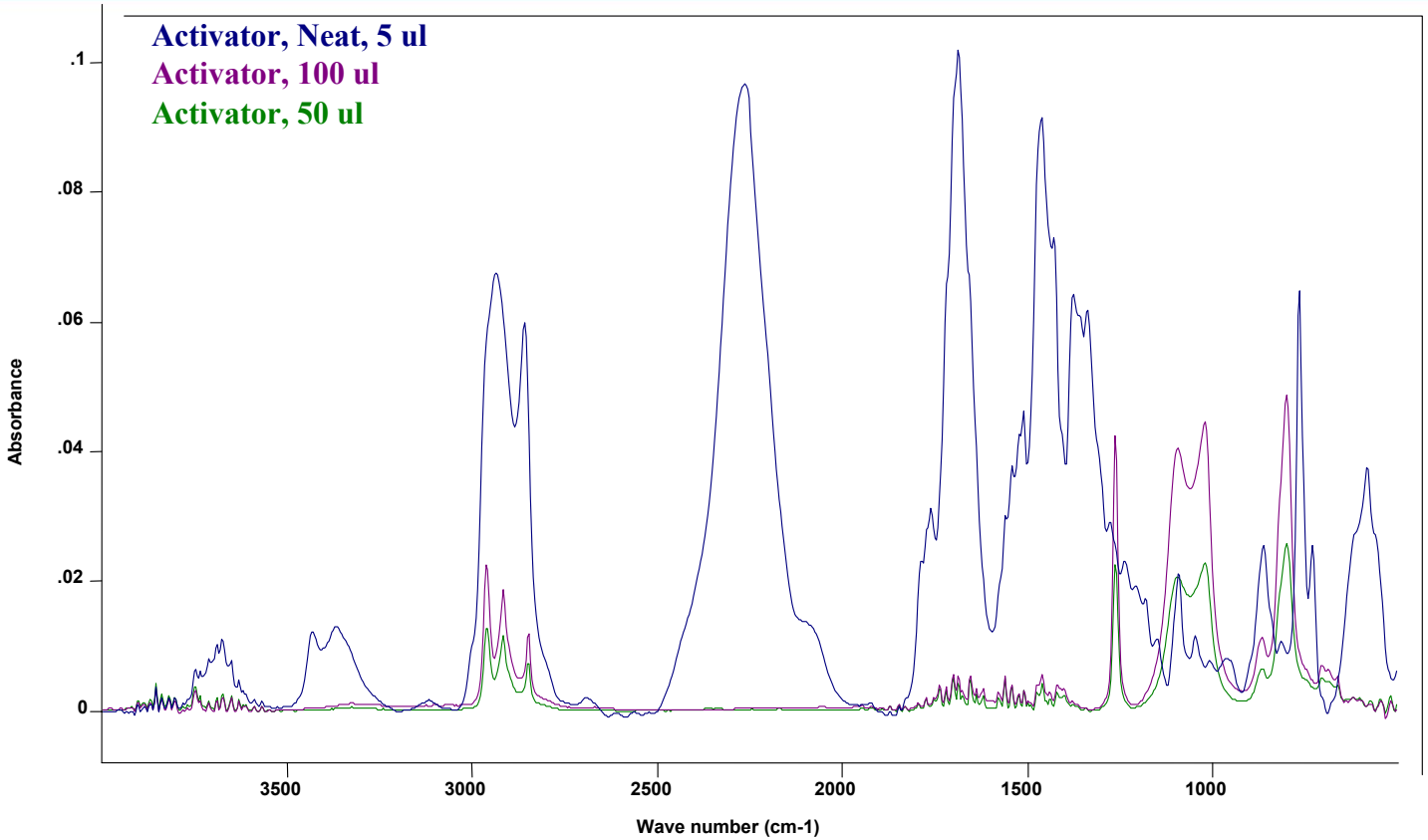
Technical Accomplishments to Date

Solids generated from first test run

Technical Accomplishments to Date

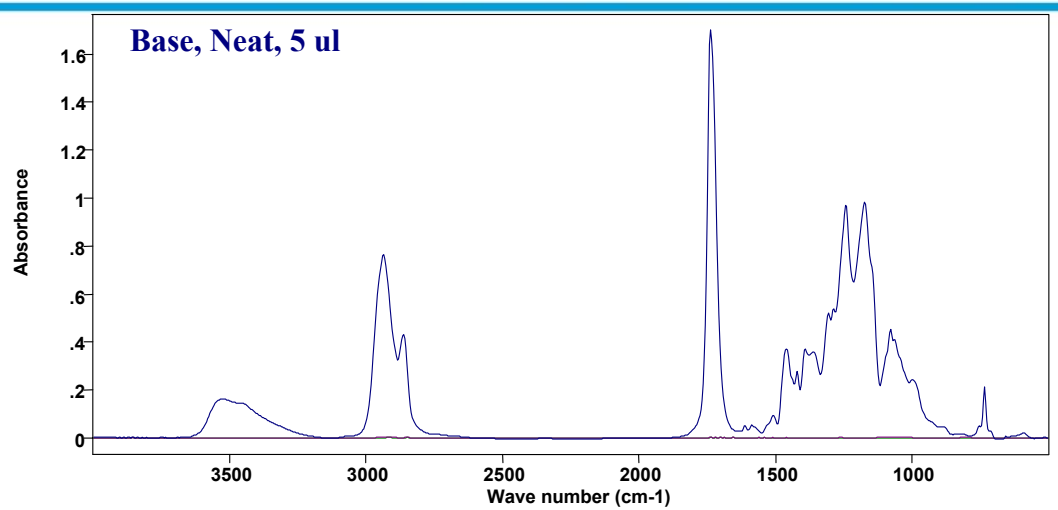
Sample of Polyurethane Part A & B mixed

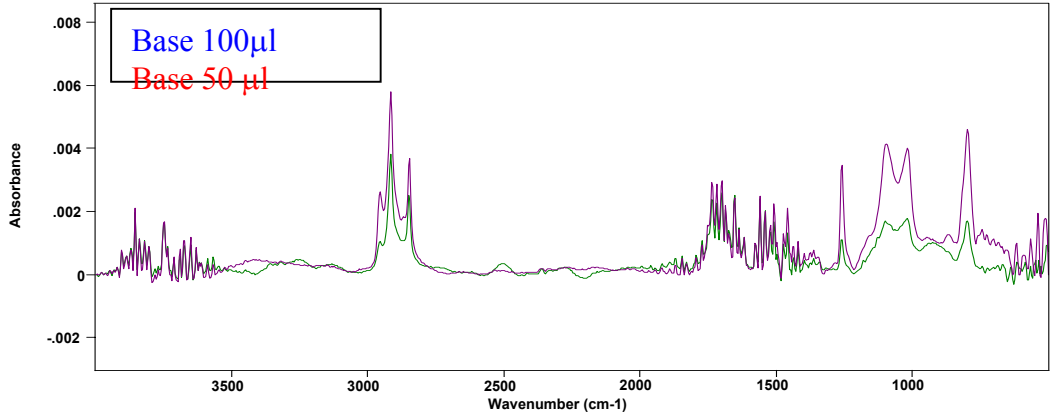
Technical Accomplishments to Date



FTIR spectrum of polyurethane activator (neat) and hexane extracts of two week cultures fed activator. Activator and extracts (50µl and 100 µl) were applied to a potassium bromide window and dried in a desiccator.

Technical Accomplishments to Date





FTIR spectrum of hexane extracts (50µl and 100 µl) of base fed cultures after two weeks of growth. Extracts were applied to potassium bromide windows and dried in a desiccator prior to running the spectra. Note that the absorption scale has been expanded to show the peaks.

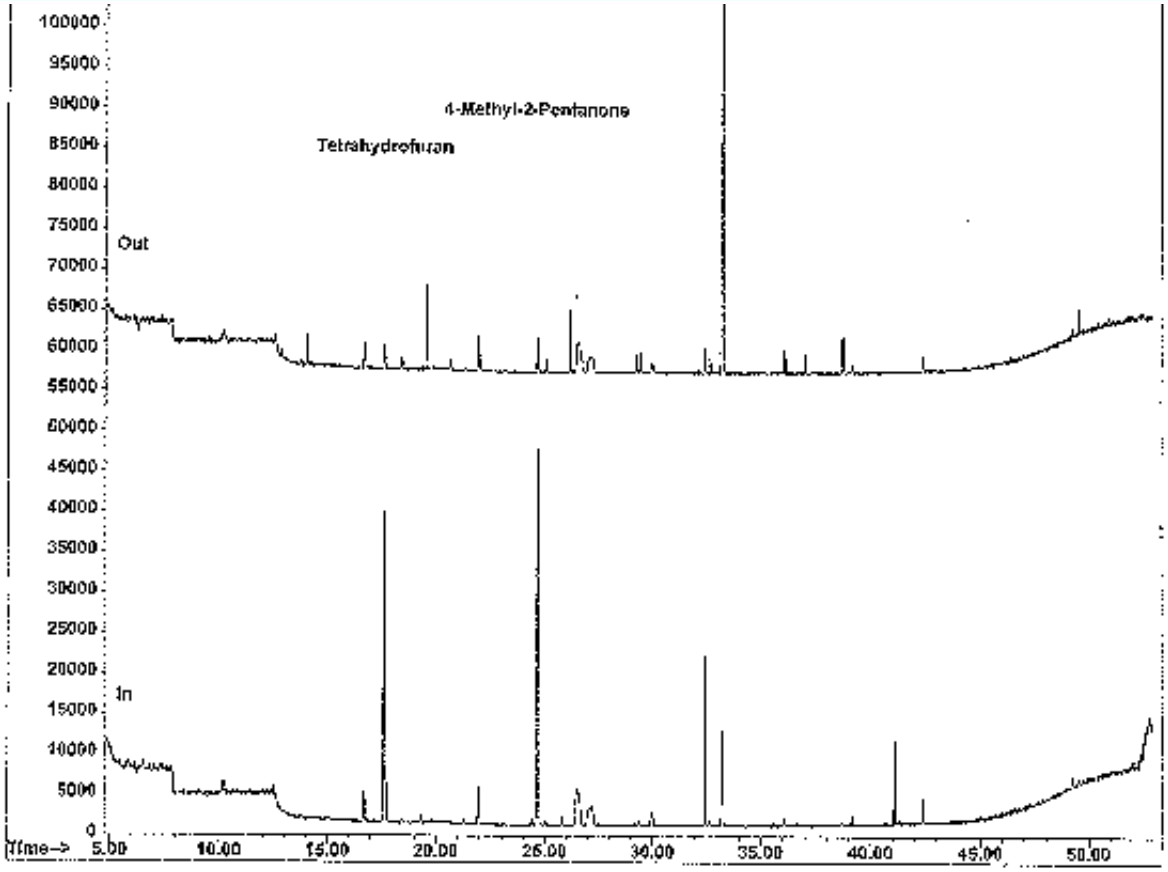
Technical Accomplishments to Date

Compound	Inlet Concentration PPB (V/V)	Outlet Concentration PPB (V/V)	Per-Cent Reduction
Benzene	2.0	ND[1]	> 91
Toluene	0.92	0.13	85.9
Ethyl Benzene	2.2	ND	> 91
o,m,p-Xylene	9.6	ND	> 94.9

[1]ND Nondetect. The analytical laboratories reported minimum detection levels (MDL's) were used to calculate per-cent reduction for samples reported as ND.

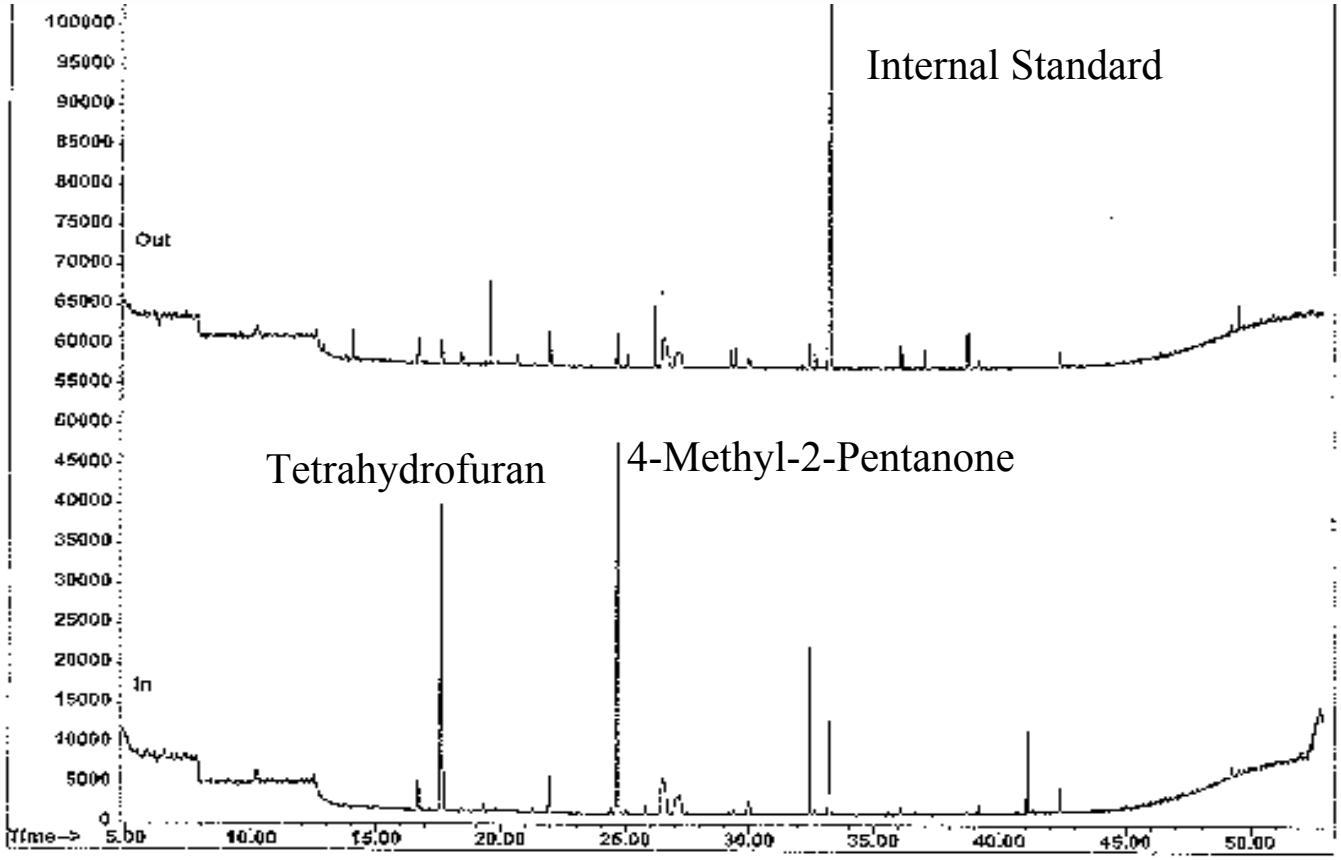
Concentrations of priority air pollutants entering and exiting biofilters installed at the sequencing batch reactor used to treat oily sludge at PWC Pearl Harbor. Samples were collected after charging the reactor with fresh oily sludge.

Technical Accomplishments to Date



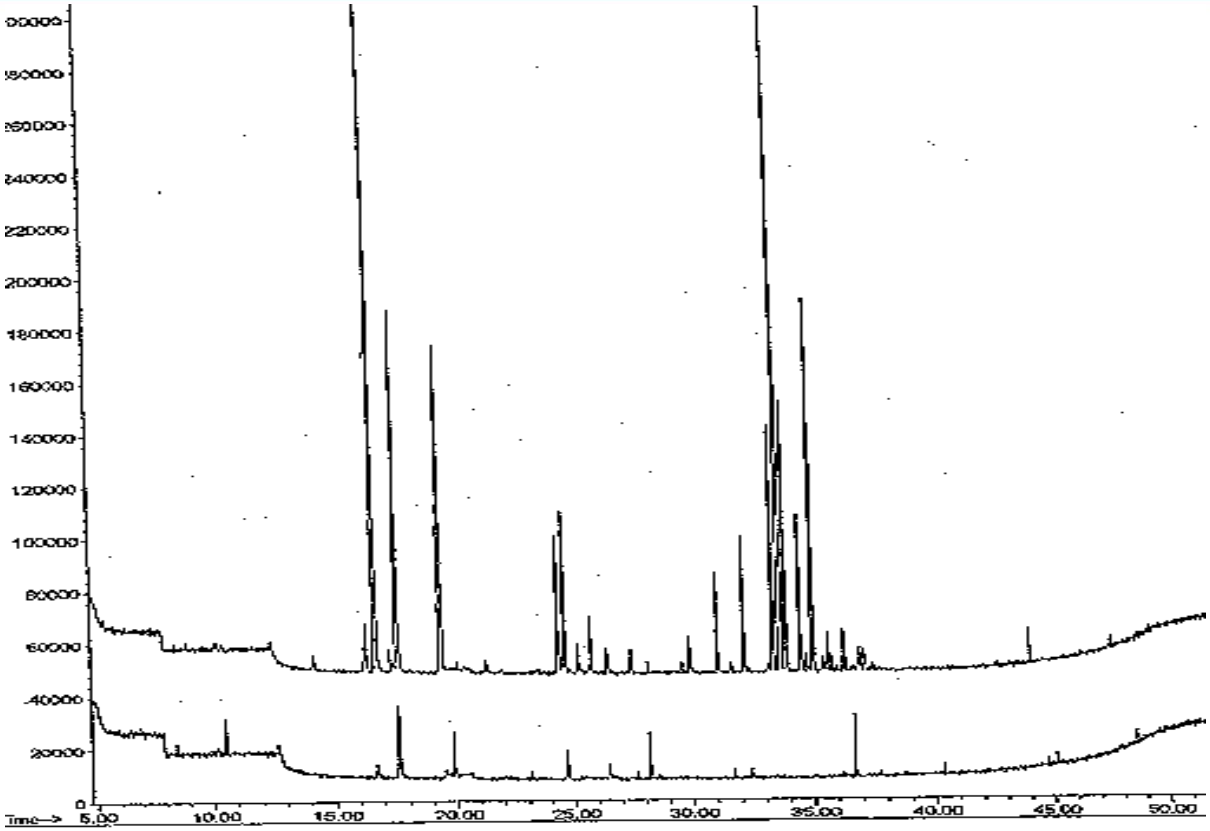
Chromatograms of reactor exhaust air entering (lower) and exiting (upper) the biofilters. The major components are tetrahydrofuran and 4-methyl-2-pentanone both of which have been reduced by >90% by the biofilters.

Technical Accomplishments to Date



Chromatograms of reactor exhaust air entering (lower) and exiting (upper) biofilters treating exhaust air from bioreactors used to degrade solvent based paint. Concentrations of the major major components (tetrahydrofuran and 4-methyl-2-pentanone) have been reduced by >95%.

Technical Accomplishments to Date



Chromatograms of reactor exhaust air entering (upper) and exiting (lower) biofilters treating exhaust air from bioreactors used to degrade solvent based paint. Concentrations of the major major components have been reduced by >95%.

Technical Accomplishments to Date

Things are looking great!

Implementation Accomplishments and Plan

Users

- **PWC Hawaii**
  - **Steve Christiansen**

Permitting

- **Department of Health**
  - **40 CFR Part 264 exemption**

Logic Model for Reduction of Solvent Based Paint Waste

Navy Benefits	Navy will reduce the costs associated with disposal of solvent based paint
Customer Capability	Navy will have on site treatment capability for expired solvent based paint
Products	Biological Treatment System
Project Milestones	MS 7 (Q4,FY04) – Full scale reactor demonstration

Summary

- Navy-wide solvent based paint is the costliest HW generated
- Significant savings can be realized if treated on site
- Treatment eliminates long term liability
- Biological treatment is the most cost effective alternative