

Biodegrading Paint

Pilot Project May Result in Better Paint Disposal Method

A pilot project at the Navy Public Works Center (PWC) Pearl Harbor, HI is expected to eliminate the Navy's left over and expired paint through bioremediation.

Funded by the Naval Facilities Engineering Command (NAVFAC), the Naval Facilities Engineering Service Center (NFESC) teamed up with the PWC Pearl Harbor to look at the feasibility of biologically treating paint waste. Positive results from this project could create Department of Navy and Defense-wide savings and eliminate future liability costs by transforming a hazardous waste into non-hazardous, easily disposed of residue.

Schematic view of the bioreactor used to degrade solvent-based paint.

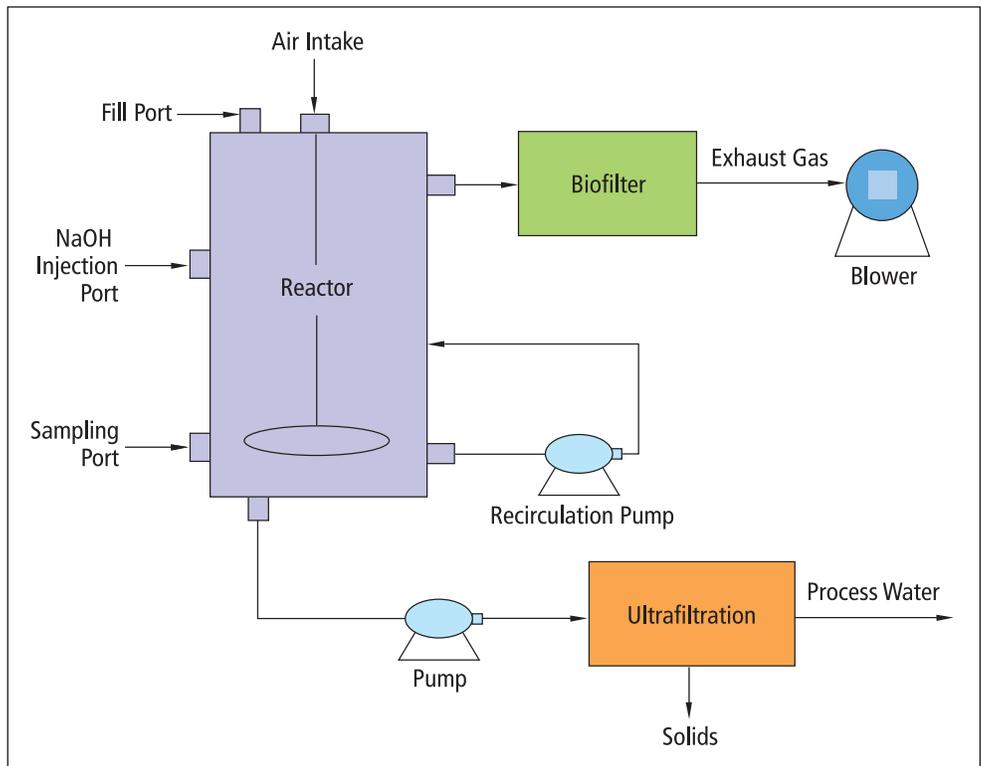
Each reactor is equipped with a recirculation pump, air supply, and pH controller. Exhaust air passes through a biofilter before being vented to the atmosphere. The ultrafiltration unit is used to process the contents of the reactor at the end of a degradation cycle. Process water can be reused or discharged to the sewer and the solids are landfilled.

Each year the Navy uses thousands of gallons of paint in every facet of its business—for ships, buildings, equipment, and fences—the list is endless. This pilot project could eliminate this costly waste stream in an economical and environmentally sound manner.

Classified as a hazardous waste, paint cannot be 'thrown out with the garbage.' Paint must be tracked from

cradle-to-grave, from purchase through disposal. And, responsibility does not end with disposal. The Navy remains liable for its paint in perpetuity, costing millions every year.

"The bioremediation of paint is quite a challenge," said Fred Goetz, professor from the University of California, Santa Barbara and an NFESC contractor. "We are using a technology that is similar to land farming and composting which promotes the growth of naturally occurring bacteria that break down and remodel hazardous compounds into non-hazardous derivatives."



Bioremediation uses naturally occurring bacteria to break down or biodegrade the resins and solvents in paints.

NFESC researchers began the long road to designing this pilot project by first getting specifications on the types and quantities of paint used by the Navy. They compiled the chemical composition of various paints and examined available technologies to determine technical feasibility, cost, and ease of implementation, including regulatory permitting. After reviewing their findings, the researchers chose biological treatment, or bioremediation, as the method of choice for converting hazardous waste paint to a non-hazardous material.

“Per pound, paint is the most expensive hazardous waste that the Navy generates,” said Tom Torres, project engineer at NFESC. “This project has the potential to significantly reduce recurring and escalating costs and eliminate the liability associated with the disposal of solvent based paints.”

Bioremediation uses naturally occurring bacteria to break down or biodegrade the resins and solvents that comprise alkyd, polyester, polyurethane, and epoxy paints. Although biodegradation is normally slower than physical-chemical technologies, it is the simpler or “low tech” nature of biodegradation that makes it easier to implement, operate, and control. It is also the most economically feasible option currently available.

“To our knowledge, this is the first time that the bioremediation of industrial paints has been studied in this manner,” said Steve Christiansen,

PWC’s environmental department head. “Applying bioremediation technology to solvent-based paints will help Navy commands at Pearl Harbor deal with a major hazardous waste stream that is strictly regulated by the Resource Conservation Recovery Act (RCRA).”

Once NFESC researchers conducted laboratory tests demonstrating the feasibility of using biodegradation to treat paint, their next step was to carry out testing on a larger scale, outside of the laboratory as a “pilot project.” This pilot testing is used to validate the process and identify problems that will need to be dealt with prior to full-scale implementation.

For this phase of the project, NFESC found a willing partner in PWC’s Environmental Department. Since one of the department’s responsibilities is the handling and disposal of Pearl Harbor’s hazardous waste, the advantages of onsite treatment were easily recognized. PWC provided a site at its Industrial Waste Treatment Center (IWTC) and support for the pilot project.

The bioremediation system consists of five, 20-gallon reactors, a biofilter, and a pH controller, housed in two, refurbished shipping containers at the IWTC. The reactors are simply closed vessels, or tanks, equipped with a pump to keep the paint suspended and provide air/oxygen required by the bacteria. The bacteria used in this process are naturally occurring and

are the same as found in biological reactors for treating oily sludge. The paint is diluted with water and bacteria are added, along with a diluted solution of vitamins and other supplements that make it easier for them to grow.

In short, the reactors are used to create and maintain the optimal conditions that bacteria require for the rapid degradation of paint. Optimal conditions include retaining and promoting the growth of the best bacteria for the job, over the course of the molecular breakdown process, by providing

Cradle-to-Grave MANAGEMENT OF WASTE

Under the Resource Conservation Recovery Act (RCRA), paint requires cradle-to-grave management. The Navy pays not only the original purchase price for the paint but also must absorb the costs for tracking and labeling, proper handling and storage of expired or used product, transportation, treatment and finally disposal. In addition, the Navy remains liable for the paint in perpetuity.



LEFT: Five, 20-gallon bioreactors handle expired and excess paint by providing a nurturing environment for bacteria to break down solvents and resins found in paint. The reactors were modified to deal with volatile and potentially hazardous compounds.

BELOW: Biofilters (the rectangular boxes) contain shelves that hold compost which houses bacteria that capture and degrade volatile solvents in the exhaust air from the bioreactors prior to venting it to the atmosphere.



(DRMO) from where it is shipped out of Hawaii to the mainland for disposal. Paint disposal costs vary \$0.65 to \$2.05 a pound.

“This biological process really makes both business and environmental sense,” said Christiansen. “This process will reduce Pearl Harbor’s hazardous paint waste stream and eliminate the Navy’s future liability in its disposal.”

Environmental personnel from PWC will operate the system during the pilot phase and NFESC researchers will visit the site to make certain everything progresses to a successful conclusion. The results will demonstrate that the biodegradation of paint produces end products that are innocuous and non-hazardous. At the conclusion of the pilot project, it is expected that a full-scale system will be installed at Pearl Harbor eliminating this significant waste stream for good. ⚓

oxygen, maintaining a neutral pH, and supplying additional nutrients to help the bacteria work faster and better. The end products are non-hazardous components (mostly bacteria or biomass) and inorganic compounds that can be disposed of as non-hazardous waste.

The pilot project began in January 2004 and will continue for approximately one year. During this time, the bioremediation system will treat various mixtures of excess and expired paint and is expected to process it into a non-hazardous residue within 10 to 15 days.

Inorganic compounds and biomass, which are not hazardous wastes, will be captured in an ultrafiltration unit. Volatile organic compounds in the exhaust air from the reactors will also be captured and bioremediated in the biofilter. The left over non-hazardous aqueous solution will be reused or sent to the Navy’s wastewater treatment plant.

Projected cost per pound for biodegradation of paint is about 50 percent less than what the Navy currently pays for disposal. At Pearl Harbor, excess and expired paint is sent to the Defense Reutilization and Marketing Office

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