

Use of Fixatives to Accelerate Building Decontamination and Decommissioning (D&D) – 9047

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ABSTRACT

The Office of Decontamination and Decommissioning (D&D) and Facility Engineering is developing the D&D Toolbox to reduce risk and technical uncertainty in the Department's cleanup programs and projects. The D&D Toolbox Project uses an integrated systems approach to develop an innovative suite of D&D technologies that can be readily used across the DOE complex to reduce technical risks, improve safety, and limit uncertainty within D&D operations. In support of the D&D Toolbox the Oak Ridge National Laboratory (ORNL) has identified the highest risk facilities at Oak Ridge and the associated technical risk or technology issues.

INTRODUCTION

The objective of the Decontamination and Decommissioning (D&D) Toolbox Project is to use an integrated systems approach to develop an innovative suite of D&D technologies that can be readily used across the DOE complex to reduce technical risks, improve safety, and limit uncertainty within D&D operations. In support of the D&D Toolbox the Oak Ridge National Laboratory (ORNL) has identified the highest risk facilities at Oak Ridge and the associated technical risk or technology issues.

TECHNICAL RISK AND UNCERTAINTY

The 2000 Complex at Oak Ridge has been identified as a high risk facility due mainly to structural breaches and water damage. The 60-year-old series of connected metal buildings were built during the Manhattan Project to house metallurgical and health physics laboratories. The 2000 Complex has deteriorated to the point that it has been condemned and is unsafe for routine human entry. Additionally, the polychlorinated biphenyl (PCB)- and lead-containing paint which is flaking off the exterior of the rusting metal building is the single largest source of PCB contamination to the ORNL storm water system. The flaking paint provides additional problems for D&D waste segregation and disposal, as only adhered paint may be disposed in the on-site disposal cell; paint chips which separate during demolition will require separate segregation and disposal. This flaking paint will also present a serious hazard to human health and the environment during D&D when the paint could become pulverized and airborne. These airborne particles, if not properly controlled, could become an exposure hazard for the D&D workers, co-located site workers, adjacent soil and surface water, and the privately funded buildings adjacent to the 2000 Complex along Bethel Valley Road. The method most often used for dust

suppression during D&D is a water spray. Unfortunately this water spray could allow the PCB-contaminated water to enter the storm water drains or run down the hill even with proper diking.



Fig.1. The 2000 Complex before fixative application

TECHNICAL APPROACH

The recommended approach to address this issue was to coat the building with a fixative or sealant that would prevent the paint from flaking off prior to and during D&D and prevent further rain intrusion into the building. Coatings offer the potential to stabilize the contaminants in preparation for D&D without requiring entry by workers into these unsafe facilities.

Assistance was received from the Hanford ALARA Center [1], Florida International University [2,3] and NuVision Engineering, Inc. and a literature search was conducted [4] to identify and evaluate the fixatives for demonstration. Available cost and performance data were used to identify the most promising commercially available fixative products that could be applied to the outside of 2000 Complex buildings and meet the following requirements:

- adhere to a dusty, weathered, rusting, metal surface with flaking paint
- keep lead/PCB-containing paint from flaking off prior to and during D&D
- fix radioactive contamination
- seal small holes in the exterior (i.e. stop water leaks into the building from rain)
- be applied through spray-on application without removing flaking paint during application
- be applied without surface preparation
- be applied in hot, humid weather conditions
- be weather resistant – freeze/thaw, rain, sleet, hail, 100°F (38°C), high humidity
- be non-toxic/non-carcinogenic – to workers and environment during and after application;
- meet Land Disposal Restrictions and/or on-site disposal criteria

- be non-leaching
- be non-flammable
- not present additional problems during demolition - hard to cut, loss of adhesion, etc.

The fixatives chosen for demonstration on the ORNL 2000 Complex were Bartlett's Polymeric Barrier System (PBS) and Global Encasement's PrepLESS PRIMER™ with Your Last Coat™. One-half of the 2000 Complex was coated with PBS and the other half was coated with the combination system from Global Encasement.

TECHNOLOGY DESCRIPTION

Bartlett

According to the manufacturer [5], "The Polymeric Barrier System (PBS) is a non-toxic, water-based solution which forms an impermeable barrier between hazardous or contaminated materials and the environment. PBS can be applied to any surface to lock down loose contamination and prevent leaching of contaminants after decontamination efforts. PBS is commonly used to stabilize large plant components, concrete, valves, and other problematic radwaste items prior to shipment. PBS is also used to control environmental contamination and soil erosion - providing a far superior alternative to the traditional approach of plastic sheeting or tarpaulins. Easily applied in the field, PBS is ideal for minimizing the dispersion of contaminated materials, covering contaminated soil or construction debris, protecting equipment, stabilizing burial trench soil, confining spills and coating asbestos materials. Applies quickly with industrial airless sprayer, paint roller, or brush. One gallon (0.189 cubic meters) covers approximately 50 square feet (4.65 square meters) at 25 mils (0.635 millimeters) and dries in 8 to 24 hours. Application of 50 sq.ft./gallon (1227 sq meters/m³) produces a 25 mil (0.635 millimeter) thickness".



Fig. 2. Building 2001 after application of PBS

Global Encasement

The manufacturer's information states that [6], "PrepLESS PRIMER™ is a water-based, non-toxic, flexible, clear primer-sealer-neutralizer that acts as a stabilizer for building surfaces that can be only

marginally cleaned and where tenacious adhesion is needed. It applies milky white and dries clear, leaving a tacky finish ready to receive GLOBAL Encasement's topcoats, including Your Last Coat™. PrepLESS PRIMER™ can be applied over Lead-Based Paint, Asbestos Containing Materials, and surfaces that are difficult to adhere to, such as cracked and painted plaster, concrete, masonry, stucco and various fibrous materials including fiberglass, vermiculite, ceramic fiber. It is excellent for interior and exterior walls, ceilings, trim, wallboard, sheet rock, ducts, pipes, roofing, all non-friction surfaces, treated or untreated wood, stone and metal. It can also be used with various scrim reinforcement for repairs.”

PrepLESS PRIMER™ Features:

- Class A Fire Rated
- Suitable for interior or exterior use
- Easy to use
- Waterproof
- Flexible
- Re-attaches loose, peeling, flaking paint
- Zero Volatile Organic Content VOC
- Apply by brush or roller, or airless sprayer.
- Apply in temperatures between 50°F (10°C) and 100°F (38°C).
- Cool temperatures and high humidity can affect dry and cure time
- Easy to use and clean up is with water

Information provided by the manufacturer states [7], “Your Last Coat™ is a high performance, water-based, acrylic, non-toxic, coating that is tough, abuse-, rust-, mildew-, fire- and chemical-resistant and forms a waterproofing membrane. Its moisture vapor transmission qualities make it perfect for historic preservation and can be custom tinted almost any color. It can be applied over PrepLESS Primer™ to form a GLOBAL Encasement System. Your Last Coat™ is excellent for interior or exterior use and is suitable for application over walls, ceilings, trim, ducts, pipes, roofing and siding, windowsills, frames and trim, porch railings, posts, overhangs and fences. It securely seals and encases materials on wood, plaster, stucco, masonry, concrete, structural steel, Transite, shingles, built-up roofing, fiberglass or ceramic fiber.”

Your Last Coat™ Features:

- Class A Fire Rated
- Extremely tough, durable and flexible
- Mildew and mold resistant
- Waterproof
- Flexible
- Low in Volatile Organic Content
- Ready to use and should not be diluted
- Apply by brush or roller, or airless sprayer
- Apply in temperatures between 50°F (10°C) and 100°F (38°C)
- Dries in 2-8 hours. Cool temperatures and high humidity can affect dry and cure time
- Easy to use and clean up is with water



Fig. 3. Building 2000 after PrepLESS PRIMER™ and Your Last Coat™ application

Separate Demonstration of Energy Seal Coating

A third sealant, Acu-Shield produced by Energy Seal Coating for sealing roofs, had been previously used at the Paducah site on a metal building and was recommended by NuVision Engineering. According to the manufacturer [8], “Acu-Shield is a 100% acrylic elastomeric coating for all types of roofs. It can be applied to asphalt, concrete, stucco, wood, tile or any rust-free metal surface (galvanized metal, tin, cast iron or steel). “The product reportedly contains strong rust inhibitive pigments, prevents premature aging and leaks on metal roofing, has excellent adhesion to various metal substrates, is easy to use and clean up, is non-toxic, and is VOC compliant. Additionally, the manufacturer stated that “All surfaces to be coated must be clean, dry and free of any oil, grease or dirt. High pressure water washing is recommended. Any existing coating must be checked for good adhesion. Before application, any loosely adhered coating must be removed and bare surfaces must be prepared, cleaned and checked for compatibility.” Because of this warning and the designation of the product as a roofing material, the decision was made not to test this product on the 2000 Complex buildings. However, based on the successful application of the product on a Paducah facility and the fact that Acu-Shield could be applied in one step and was considerable less expensive than the other two products, the decision was made to test the coating on a small, rusting tank (Tank 2528A) with PCB-contaminated peeling paint.

DEMONSTRATION RESULTS

Table I. Comparison of Fixatives Demonstrated

Product	Coverage	Cost *	Ease of Application	Ease of Cleanup
Polymeric Barrier System	50 sq.ft./gallon (1227m ² /m ³) produces a 25 mil (0.635mm) thickness	\$50.17/gallon \$13,254/m ³	Easy	Easy
PrepLESS PRIMER™	72 sq.ft./gallon (1776m ² /m ³) produces a 10 mil (0.254 mm) thickness	\$42.97/gallon \$11351/m ³	Difficult	Difficult
Your Last Coat™	96 sq.ft./gallon (2356 m ² /m ³) produces a 10 mil (0.254mm) thickness	\$42.97/gallon \$11351/m ³	Easy	Easy
Acu-Shield	50 sq.ft./gallon (1227 m ² /m ³) produces a 20 mil (0.508mm) thickness	\$15.08/gallon \$3984/m ³	Easy	Easy

* from GSA schedule for 5-gallon (0.019-m³) containers including shipping

All products were applied with an airless sprayer, 3000 p.s.i.(535.74 kg/cm), 2 g.p.m. (0.008 m³/min) capacity with a #531 tip. The pump was a GMAX 7900 with a 3/8-inch (9.525mm) fluid line. All filters were removed from the equipment to prevent clogging.

After spraying of the fixatives was completed, the ORNL Facilities and Operations Group removed the old protective fabric and fallen paint chips from around the outside of the 2000 Complex and replaced it with new fabric. The area will be monitored for paint chips. A visual inspection of the condition and appearance of coatings after rain events and during the winter when subjected to freezing temperatures and freeze/thaw cycle will also be conducted and documented with photographs.

CONCLUSION

The site was pleased with the results of the demonstration and would recommend this technical approach for buildings with similar conditions. As can be seen in the before and after pictures below, the coating has “fixed” the paint to the building surface. The benefits of applying a fixative to the exterior of the 2000 Complex include:

- eliminate the largest known source of PCB-contamination to soil and surface water on the ORNL site
- retard continued external deterioration of the 2000 Complex
- reduce or eliminate rain water intrusion into the building
- reduce or eliminate worker exposure to PCB-containing paint during S&M and D&D activities
- reduce the cost of waste segregation and disposal
- accelerate the D&D schedule

REFERENCES

1. Hanford ALARA Center, “Fixatives List, Revision 12”, December 18, 2008
2. Florida International University, “Long-Term Monitoring and Stewardship”, Fiscal Year 2001 Year-End Progress Report
3. Florida International University, “Further Study of Fixatives for Long-Term Stabilization”, July 2001

4. W.E. FARRELL, C.G. MAY, and R.S. HOWELL, “Decontamination Techniques and Fixative Coatings Evaluated in Building 235-F Legacy Source Term Removal Study”, Savannah River Site, April 2005
5. Vendor web site, www.bartlettinc.com/sp.cfm?pageid=1760
6. Vendor web site, www.encasement.com/site/Products/PrepLESS-Primer.html
7. Vendor web site, www.encasement.com/site/Products/Your-Last-Coat.html
8. Vendor web site, www.acsiusa.com/acu-shield.php