Automated Chemical Stabilizing of Leaded Paint Residue from Bridge Maintenance Painting Operations
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Automated Chemical Stabilizing of Leaded Paint Residue from Bridge Maintenance Painting Operations

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16. Abstract
This study addressed the use of automated equipment to dose and mix lead stabilizing compounds to allow leaded paint residue/debris to be disposed at in-state contained landfills. The stabilizing would be conducted in situ at bridges being subjected to maintenance painting operations involving total coating removal and replacement. Many Kentucky bridges have existing painting that contains lead compounds at levels which may constitute hazardous wastes upon removal. The KYTC practice of recycling lead containing residue is working well at this time but the issue of a single recycler available continues to place KYTC in a position of returning to hazardous waste disposal should the recycling option be removed. Limited field sampling and testing of removed paint residue indicates high total lead content but, typically below the 5 mg/L, TCLP action level. A previous KTC report indicated that TCLP test results of paint removal residue will often be less than 5 mg/L, however some samples will exceed the hazardous waste threshold. KYTC should pursue the chemical stabilization of paint removal residue to provide an additional option to hazardous waste handling and disposal.

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1. INTRODUCTION

In December 2005 the Kentucky Transportation Center (KTC) published a research report entitled "Disposal of Bridge Paint Residue," (1).” Two of the recommendations in that report were that 1) recycling was the preferred method of dealing with surface preparation debris and 2) that the Kentucky Transportation Cabinet (KYTC) should research the option of on-site stabilization of lead containing debris.

Recycling is the preferred method because it eliminates or greatly reduces the liability of KYTC as co-owner of a lead containing material. KYTC, by contract specification, receives a letter of recycling after surface preparation debris has been accepted at the recycling facility and the recovered lead is reused in a commercial product. Recycling is also feasible because it costs about the same as conventional hazardous waste disposal. If debris is disposed as a hazardous waste, KYTC assumes a “cradle to grave” liability for the debris. This second recommendation is important because there is only one lead recycling facility that will accept lead paint residue for recycling. Business decisions, regulatory issues, cost increases or other factors could unexpectedly make that single option unavailable or unattractive and hence another disposal option is desirable.

The KYTC bridge inventory contains hundreds of bridges coated with lead based paints. For most of those bridges the current KYTC practice is to completely remove the existing lead coatings using abrasive blasting techniques. Typically, KYTC has specified that contractors use recyclable steel grit for blasting to limit the amount of leaded paint residue (debris) that must be disposed appropriately. Traditional disposal options include recycling and wasting. While recycling has been employed on recent projects, it is expensive and as previously noted only one out-of-state vendor offers that service. Wasting of the leaded paint debris is problematic due to its hazardous nature. As there are no treatment-storage-disposal (TSD) facilities in Kentucky, the hazardous material must be shipped out-of-state (commonly to Michigan) where it is treated and disposed in a Subtitle D contained landfill. That practice triggers significant environmental regulations including permitting, manifesting of the waste for transport and tracking of the TSD process. All of which includes significant record keeping requirements. This option is also costly and requires significant internal KYTC man-hours to address all the regulatory requirements. KYTC needs a simplified, additional lower cost option to those disposal practices. Desirable in-situ treatment would render the leaded paint residue as non-hazardous construction debris at the job site, avoiding most of the tenuous regulatory requirements, and permitting for disposal in a registered Kentucky landfill. This would also significantly reduce transportation costs.

KYTC authorized a study in fiscal year 2009 (KYSRP 09-378) to address the “Automated Chemical Stabilizing of Leaded Paint Debris from Bridge Maintenance Painting Operations.” The objectives of the study were to: 1) ensure that the necessary equipment (abrasive recycling unit) and chemical lead stabilizer were available for an experimental bridge maintenance painting project, 2) develop necessary letting documents (special notes) for use of equipment/chemical stabilizer on a KYTC experimental project, 3) monitor the performance of the equipment/chemical stabilizer during the experimental project, 4) evaluate the project and, 5)
determine the performance of the unit/chemical stabilizer in providing a non-hazardous waste that is disposed in a Kentucky landfill, and provide KYTC with recommendations for any future revisions/actions necessary for routine implementation of this process.

2. METHODOLOGY

KTC first sought interpretation of hazardous waste regulations from the Kentucky Energy and Environment Cabinets’ Department of Environmental Protection (KEEC-DEP) and industry sources. To be classified as non-hazardous, waste must contain less than 5 ppm of leachable lead per the U.S. Environmental Protection Agency’s Toxicity Characteristic Leaching Procedure or TCLP analysis. Environmental regulations imposed stringent environmental constraints on parties attempting to treat/stabilize hazardous waste once it had been generated and stored outside the work area. For treatment/stabilization to be practical for KYTC, it had to occur within defined conditions within the work area (i.e. prior to First Storage). If debris could not be treated prior to First Storage, it would be necessary for the contractor to blend the paint debris with stabilizer after First Storage. While this might work, it still had several drawbacks: that operation was regulated as a treatment, requiring a greater degree of stabilization (a permitted TCLP leachable lead value of 0.75 PPM), KYTC personnel would have to monitor the operation, workers involved in mixing the stabilizer/waste would have additional lead exposure, the mixing site would need to be environmentally monitored, the operation would entail additional costs that might offset some savings and additional testing might be necessary to ensure consistent stabilizer/waste mixing. The interpretation of “First Storage” by the KEEC-DEP was that waste from the surface preparation operation was in “First Storage” when placed in any container after separation from reusable abrasive.

This definition of “First Storage” requires that all waste streams be brought to one stream and stabilized prior to containerizing. Currently available recycling equipment varies somewhat but in all cases produces multiple waste streams. KTC sought an equipment supplier to provide the necessary equipment. As part of a previous bridge painting project, Advanced Recycling Systems (ARS) of Lowellville, OH developed a dosing system for its recycling unit that measured the amount of waste coming from each waste stream and automatically mixed the appropriate amount of chemical stabilizer into the waste prior to expelling it into storage drums (Figure 1). ARS agreed to participate in an experimental field trial for the subject research project.

Several commercially available chemical stabilizer products were identified but a complex phosphate product, FESI-BOND™, produced by Forrester Environmental Products INC., of Meredith, New Hampshire was chosen for use on this project. Other chemical stabilizers had been evaluated previously (op. cit. 1).

KTC developed a draft “Special Note for Experimental Waste Stabilization” for KYTC review and inclusion in a KYTC bridge painting project. In general terms, the Special Note required that the contractor would partition the bridge into three sections. Section One comprising ±10% of the surface area would be abrasive blast cleaned with no stabilization to
assess the existing lead levels. Section Two would be abrasive blast cleaned and the suppliers recommended dosage of stabilizer would be added to the waste stream. Section Three would be abrasive blast cleaned and 150% of the suppliers recommended dosage of stabilizer would be added to the waste stream. The Special Note did not specify the type of recycling equipment, but did require that the equipment combine all waste streams into one stream with metered addition of stabilizer. The resulting stabilized waste must then be mixed into a homogenous stream prior to “First Storage”.

The Special Note specified the use of FESI-BOND™ as the stabilizer. FESI-BOND™ was chosen because other chemical stabilizers had been used in a previous study and results of that study indicated that when dosed and mixed properly, those materials would stabilize the lead waste. The use of FESI-BOND™ would give KYTC another potential stabilizer option.

The Special Note also addressed other details such as abrasive media and handling/storage/transport of the waste. The full text of the Special Note is provided in Appendix A.

3. FIELD WORK

KYTC accepted bids on a project to clean and paint bridges on Interstate 275 in northern Kentucky in July 2009. Two of the bridges were selected to be the field trial for KYSPR 09-378. The bridges (B0005L and B0005R) are located at mile point 11.43 on Interstate 275 in Boone County. They are approximately 111 feet long and each comprises approximately 10,000 ft² of steel. The bridges were selected because the existing paint contained significant amounts of lead and were in a relatively obscure location that had minimal traffic impact. Hence any delays associated with the experimental work would have less project impact than a site with high traffic volume.

The contract was awarded to a contractor with an aggressive approach to production. KTC had discussions with the contractor and ARS to determine the availability of equipment and the retrofit needed to meet project specifications. When cleaning and painting work was scheduled for bridges, ARS and the contractor could not coordinate schedules to complete the experimental work in a timely manner. Due to the impact of this large project (20 bridges) on KYTC District 6 traffic and work load, the potential delays were deemed unacceptable and KYTC deleted the experimental lead stabilization from the bridge painting project.

4. FIELD SAMPLES

As part of monitoring the project in 2010 construction season, nine samples of the recycled paint/abrasive debris from three bridge painting projects were obtained to get some baseline data. The samples were collected from three different waste streams (Figure 2) from the equipment separating reusable blast abrasive from paint debris at each project. The separating equipment uses mass and particle size as separating factors, thus the different streams could be expected to
produce debris with different physical and chemical properties. The samples were sent to Microbac Laboratories, Inc. in Louisville, Kentucky for total lead and TCLP analysis. Nine lead containing residue samples were collected and analyzed for this study. Three samples were analyzed for total lead, three were analyzed for hazardous waste determination (TCLP), and three were analyzed by each method. All samples analyzed for total lead indicated that relatively high amounts of lead were present, ranging from 16,000 to 70,000 mg/Kg. The 6 samples analyzed for TCLP indicated all were below the 5 mg/L regulatory limit and only one, (4.3 mg/L), exceeded 1.0 mg/L. The Microbac Analytical Report is summarized in Table 1.

5. SUMMARY

KTC conducted the preliminary research to understand the regulatory requirements, to identify equipment needs and potential suppliers, and to identify and select a chemical stabilizer to accomplish study objectives. KTC worked with KYTC to develop Special Notes to accomplish the study objectives and to include those Notes in an appropriate field bridge painting project. Due to unforeseen factors, the experimental portion of the bridge painting project was deleted and the feasibility/effectiveness of stabilized lead waste could not be assessed. Limited field sampling of lead containing residue from three KYTC maintenance bridge painting projects was accomplished. Those samples were tested for TCLP and total lead content.

6. CONCLUSIONS

KYTC currently uses recycling as a means of dealing with lead containing residue from bridge painting projects. While that is the best option at this time the fact that there is only one recycling facility places KYTC in a tenuous position. A regulatory action against the recycling facility or a drastic cost increase could remove the recycling option. If recycling was not an option, KYTC would be forced to resume the “cradle to grave” liability of hazardous wastes produced by bridge painting projects using abrasive blasting surface preparation. Not only does the liability exist but the total cost of handling the waste would increase.

Results of the field sample tests alone might lead one to assume that lead levels in maintenance bridge painting residue is not a concern but previous testing reported by Hopwood and Palle (1) clearly indicates that some residue streams can exceed the regulatory limit and fall into the “hazardous waste” category if not handled as a recyclable material.

While this research project did not accomplish testing of the equipment/chemical stabilizer on this experimental project, some field samples for baseline data were obtained. This along with KTC’s previous research and “state of the industry” findings leads researchers to conclude that the chemical stabilization of lead containing residue/debris from abrasive blast bridge cleaning operations may be a viable option for KYTC. Additional work to include a field demonstration testing should be done to confirm or deny the viability of chemical stabilization. The stabilizing materials and the equipment for processing are available in the industry.
7. RECOMMENDATIONS

It is recommended that KYTC sponsor two experimental field trials using automated chemical stabilizers to treat lead paint residue from bridge maintenance painting projects. Currently there are two firms willing to provide such equipment. This would create a more competitive environment allowing paint contractors to choose equipment from several sources should KYTC need another waste disposal option for lead paint residue and in-situ stabilization promises to be significantly less expensive than recycling.

8. REFERENCES

Figure 1. Test results for TCLP and total lead in samples collected from three KYTC maintenance painting projects in 2010.

<table>
<thead>
<tr>
<th>Sample#</th>
<th>Total Lead (mg/kg)</th>
<th>TCLP (mg/l)</th>
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<tbody>
<tr>
<td>1</td>
<td>&lt;0.10</td>
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</tr>
<tr>
<td>2</td>
<td>&lt;0.10</td>
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</tr>
<tr>
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<tr>
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<tr>
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<tr>
<td>9</td>
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</table>

Figure 2. Collecting paint residue samples from a recycling unit. Note the multiple residue sources.
9. APPENDIX A

SPECIAL NOTE FOR EXPERIMENTAL WASTE STABILIZATION
MP 008 0275 B00055L and B00055R 11.43

Surface preparation at this bridge involves the use of an experimental additive introduced into the abrasive recycling process. The purpose of the additive is to render the surface preparation waste non-hazardous. In order to evaluate the effectiveness of this process, a portion of the structure (standard process area) will be abrasive blasted with no addition of the experimental additive to the waste stream. Surface preparation of the standard process area will be completed before the experimental process area. The standard process area will comprise approximately 10% of the total structural steel surface area of the bridge. Approximately 45% of the total surface area (experimental area I) will be abrasive blast cleaned and the manufacturers’ recommended dosage of additive will be added to a homogenous mix of all waste streams. The remaining surface area (experimental area II) will be abrasive blast cleaned and 150% of the manufacturers recommended dosage will be added to the homogenous waste.

All waste streams will be combined into one waste stream for mixing with the experimental additive. The contractor will provide equipment capable of remixing the waste streams into one homogenous stream and automatically adding the experimental additive at a consistent and verifiable rate. The experimental additive must be uniformly mixed into the waste. Mixing will occur within the abrasive recycling system prior to first storage of the waste.

The Contractor will provide appropriate U.S. DOT 55 gal drums that are made or lined with materials which are compatible with hazardous waste in accordance with 401 KAR 35:180, Section 3. All waste will be stored in the 55 gallon drums.

All waste collection, handling, transportation, and disposal are the responsibility of the contractor.

Use of the experimental additives for this project DOES NOT reduce or obviate any worker safety regulations.

Abrasive media
Use clean, dry, uniformly graded recyclable steel grit abrasives for blast cleaning that are free of oil, soluble salts and other similar substances which could contaminate the blasted surface. The abrasive will meet the SSP-AB 2 “Cleanliness of Recycled Ferrous Metallic Abrasive” standard.

FESI-BOND® in a suitable proportion to produce surface preparation wastes with Toxicity Leaching Procedure Test (TCLP) values less than 5 mg/l per U.S. Environmental Protection Agency Publication SW-846, Test Methods for Evaluating Solid Waste, Physical/Chemical Methods; Method 1311. The mix proportion (FESIBOND® to abrasive) must be as recommended by the Forrester Environmental Services, 78 Tracy Way, Meredith, NH 03253, phone (603) 279-3407, Fax (603)-279-5162 and email infor@fesi.net.
Temporary storage – standard process area
All waste produced during surface preparation of the standard process area will be handled, stored, transported, and disposed of as a hazardous waste (see D. COLLECTION, HANDLING, STORAGE, TRANSPORT AND DISPOSAL OF HAZARDOUS AND INDUSTRIAL WASTES of the SPECIAL NOTE FOR SURFACE PREPARATION AND PLANT APPLICATION). The storage area for this hazardous waste will be appropriately marked and kept separate from the area designated for the experimental area surface preparation waste.

Temporary storage – experimental area
All waste produced during surface preparation of the experimental area will be handled, stored, transported, and disposed of as an industrial waste. Note that the waste contains lead and must be handled as a hazardous material. All waste will be collected at least daily and placed in appropriate containers at the temporary waste storage site. The contractors’ QC inspector will notify the Engineer when the waste is collected. A temporary storage site will be identified by the contractor and approved by the Engineer.

The temporary storage site may be on Department right-of-way or on private property. If the temporary storage site is on private property, the contractor must obtain a “consent and release agreement” with the property owner. Store the waste at that site in a secured six-foot high chain-link fence enclosure. Notify the Engineer that accumulated waste is ready for sampling. The Engineer will make a waste determination within 5 days and will provide the contractor with the test results. The Engineer will also inform the contractor whether the waste is an industrial waste or a hazardous waste and provide him with TCLP test results. If the waste determination should indicate a hazardous waste, the contractor will handle, store, transport and dispose of the waste as a hazardous waste. Otherwise, the contractor will handle, store, transport and dispose of the waste as an industrial waste.

Transportation/disposal of industrial waste produced from the experimental area
The contractor will select a registered municipal solid waste transporter for transportation of the industrial waste and a licensed contained (Subtitle D) landfill capable of accepting the waste for disposal (should it prove to be non-hazardous). The contractor will provide the necessary bulk storage/transportation containers (e.g. roll-offs) or obtain them from the municipal solid waste transporter. The contractor will prepare any waste-related documentation required by the landfill. The contractor will arrange for the pick-up of the containers filled with approved industrial waste by the transporter and for hauling to the landfill. The contractor will supply the Engineer with all landfill weight tickets for surface preparation waste disposed as industrial waste. Additionally, he will provide the Engineer with all costs related to Fesi-Bond/abrasive purchases, waste containers (drop fees and demurrage), waste transport, and waste disposal. Final partial payment of 15% for the project will not be released until the Engineer receives those documents.