"COST EFFECTIVE ALTERNATIVE METHODS FOR STEEL BRIDGE PAINT SYSTEM MAINTENANCE"

CONTRACT NO. DTFH61-97-C-00026

REPORT VII:
THE USE OF ADMIXTURE BLENDED ABRASIVES AND LIQUID APPLIED PRETREATMENTS IN THE REMOVAL OF LEAD-BASED PAINT

WRITTEN FOR THE FEDERAL HIGHWAY ADMINISTRATION
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TECHNOLOGY INTRODUCTION

Costs for hazardous waste disposal are more than double that of non-hazardous waste disposal costs.[1] This, combined with the liability involved with hazardous waste disposal has brought other options to the forefront in the bridge painting industry. Two relatively new solutions to the hazardous waste problem in bridge painting are the use of admixture blended abrasives and liquid applied pretreatments.

The admixture is a fine, dry material that is blended with the abrasive used. The liquid pretreatment is a liquid material that is sprayed on the painted surface at a specified thickness, allowed to dry, then blasted off with the underlying lead-based paint. These products are intended to reduce the amount of leachable lead in the waste produced during blasting operations as indicated by the Toxic Characteristic Leaching Procedure (TCLP) test. Each user of these products must perform the correct testing to determine if the waste is hazardous. It is important to note that lead is still present when these products are used and that the requirements for environmental containment and Personal Protection Equipment (PPE) required are not reduced.

TECHNOLOGY OBSERVATION

During a site visit to an on-going project in Omaha, Nebraska, Corrpro Companies, Inc. observed abrasive blasting utilizing liquid pretreatment for lead-based paint abatement. The existing coating system on the structure was a brown topcoat (~3 mils) and a red lead primer (~3 mils). The liquid pretreatment did not need to be applied evenly over the entire surface and therefore less time was needed to apply the liquid pretreatment versus a permanently installed coating. The liquid pretreatment appeared to be a frail temporary coating, and therefore did not hinder the productivity of the blasting operations.

The contractor, Lindner Painting, Inc. of Lincoln, Nebraska, was using liquid pretreatment for the first time. The process by which the liquid pretreatment was applied was the same as painting and therefore required no learning curve by the painters.

According to the manufacturer of the liquid pretreatment, the drying time is usually under one hour, depending on environmental conditions. The average coverage is 80 ft^2/gallon at the recommended WFT of 20 mils. Airless spray is recommended for application, though brush, roll and conventional spray are acceptable. The manufacturer also recommends a tip size of .045 to .050. The tip size used by the contractors was .047.

According to the MSDS, the liquid pretreatment contains 2.46 lb/gal VOC's. These VOC's are Toluene, VM & P Naphtha, and Acetone.

While visiting a site in Henryetta, Oklahoma, Corrpro Companies, Inc. observed slurry blasting using an admixture blended abrasive. The bridge carries Interstate 40 over Wolf Creek. The project entailed slurry blasting of the bridge using the Torbo® Wet Abrasive

[1] Prices quoted from Environmental Waste Specialists, Inc., Chantilly, Virginia

Blasting System. The contractor performing the work was PbX of Tulsa, Oklahoma. The crew consisted of five men: one foreman, two blasters, and two helpers. The abrasive material used was silica sand with an admixture pre-blended. The blend ratio was 15% admixture/85% abrasive by weight. Since the blended abrasive was used in a slurry blast system, airborne dust during blasting was kept to a minimum. A rust inhibitor was used to reduce or eliminate flash rusting.

During a site visit in Rock Island, Illinois, Corrpro Companies, Inc. observed dry abrasive blasting using an abrasive admixture. The project involved removing old red lead primer and black coal tar epoxy from the government bridge crossing the Mississippi River from the US Army's Rock Island Arsenal to Davenport, Iowa. The coating on this bridge had an average DFT of 34.4 mils and was tightly adhered in some areas. The contractor was MPG Construction from Tarpon Springs, Florida who used a coal slag abrasive blended with the admixture to clean the bridge. The ratio of abrasive to admixture was not obtained. The contractor's crew consisted of four blasters, two helpers, and two foremen/supervisors. The crew used two eight ton abrasive blast pots.

The manufacturer of the admixture guaranteed their product by refunding the cost of the admixture if the waste produced tests hazardous for lead. (The blended abrasives must be used, sampled, and tested in compliance with all Technical Data sheets and Technical Bulletins, according to the manufacturer in order to be in compliance with their guarantee).

RESULTS AND DISCUSSION

Liquid pretreatment was used for the project in Omaha. It was applied at an average thickness of 20 wet-mils over the surface to be blasted. During the site visit, an application rate of ~4135 ft^2/hr was observed with one painter applying the liquid pretreatment.

The contractor was able to apply the liquid pretreatment on the area to be blasted at the end of the day. This allowed the liquid pretreatment time to dry. The following day, the structure was abrasive blasted with silica sand to an SSPC SP-6 Commercial Blast Condition. The blasters were able to achieve this with a productivity rate of ~280 ft^2/hr. The waste was tested for leachable lead using the Toxicity Characteristic Leaching Procedure (TCLP), EPA Method 1311, 40 CFR 261. The TCLP result supplied by the Nebraska Department of Roads is shown in the first row of Table 1.

Admixture blended abrasive was used for the Henryetta, OK project. The surface preparation production rate achieved by the contractor was ~91 ft^2/man-hour using the Torbo® Wet Abrasive Blasting System. The abrasive consumption rate for this project was ~3 lbs/ft^2. Due to the use of slurry blasting airborne dust was qualitatively reduced to a much lower level then that when dry blasting is used. The waste was tested for leachable lead using the Toxicity Characteristic Leaching Procedure (TCLP), EPA Method 1311, 40 CFR 261. The TCLP results supplied by the Oklahoma Department of Transportation and the contractor, PbX, are shown in Table 1.

The admixture blended abrasive used for the Rock Island Arsenal project yielded a production rate for surface preparation of ~92 ft^2/man-hour. The contractor felt that this production rate was low because of the existing thick paint (34.4 mils). Abrasive consumption was reported between 3 and 6 lb/ft^2. The contractor stated that the blast pots need to be emptied and cleaned after each night's work in order to keep the admixture from becoming wet. When the admixture becomes wet, it hardens similar to cement. The waste was tested for leachable lead using the Toxicity Characteristic Leaching Procedure (TCLP), EPA Method 1311, 40 CFR 261. The results supplied by the US Army Quality Assurance representative and the contractor, MPG Construction, are shown in Table 1.

Table 1. TCLP Results

	Lead (PPM)
Nebraska w/ liquid pretreatment	0.32
Oklahoma w/admixture	<0.2 BDL
Illinois w/ admixture	<0.2 BDL

BDL-Below Detectable Limits

Table 1 shows that both liquid pretreatments and admixture blended abrasives can reduce the amount of leachable lead in a waste stream to a level below 5 ppm; the EPA limit for non-hazardous disposal in a landfill.

Since abrasive dry blasting with coal slag inherently produces a certain amount of dust, the contractor at Rock Island used a dust suppressant additive from the start of the project. Therefore, the contractor had no basis to ascertain any increase in dust levels from the admixture.

The main advantage of either liquid pretreatments or admixture blended abrasives is the elimination of the hazardous classification for waste disposal. Though there is a large difference in the cost of hazardous disposal and non-hazardous disposal, additional material costs counter much of the cost savings. One must consider the relationships between these costs to determine the net cost savings for the entire project. An example scenario is discussed later in this report.

One notable disadvantage of using liquid pretreatment is the extra application step. Additional time and labor is required to apply the liquid pretreatment to the surface prior to blasting. In addition, the material needs time to dry. The liquid pretreatment used in Nebraska typically takes one hour to dry. If the liquid pretreatment is applied during mobilization or while blasting is taking place in other areas, the drying time becomes less of a concern for productivity. Since the liquid pretreatment needs to be applied prior to blasting and allowed time to dry, additional lane closures may be necessary, increasing costs and inconveniencing the travelling public.

One of the main constituents of the admixture reacts with moisture like Portland cement. When the admixture is used in conjunction with wet blasting systems, the admixture blended abrasives can 'cake' in the blast pot causing it to clog. To avoid this, the contractor must clean the blast pot on a daily basis. This also makes clean up of the spent abrasive/admixture very important. Any admixture left on the surface may harden if exposed to moisture, at which point it is difficult to remove without hand scraping.

The productivity of a dry abrasive blast appears to be minimally affected when the admixture is used. Technical information provided for the admixture states that the hardness is greater than 6 on Moh's Hardness Scale, which is similar to that of common abrasives. The friability of the admixture material has also been investigated by the United States Army Construction Engineering Research Laboratory (USACERL) in a report entitled "Modified Abrasive Blast/Chemical Stabilizer Admixtures for Deleading Immersed Steel Structures Coated With Lead-Based Paint." In this report, USACERL investigated the effect of the admixture on productivity by mixing it with an abrasive blast media and using this mixture to prepare steel for painting. They concluded that the admixture exhibited good cutting characteristics and that the angularity and friability of the material was acceptable for general use.

The USACERL report also states that most coating systems are completely compatible with the admixture blended abrasive, except for systems containing red iron oxide. It was concluded that an additional sweep blast with non-blended abrasives after the admixture blended abrasives were used was sufficient to remove the residual admixture from the surface and apply a coating containing red iron oxide.

USACERL also conducted research investigating the long-term stability of the admixture treated wastes. This research consisted of several TCLP, back-to-back TCLP's, and Multiple Extraction Procedures (MEP). From their results, USACERL concluded that there was no long-term effect on the stability of the admixture/waste; even after the pH buffering effect of the admixture had been eliminated. Research sponsored by the Federal Highway Administration[2] reached a similar conclusion. In this study, leachable lead levels remained below regulatory limits after an 11 cycle MEP.

ECONOMIC DISCUSSION

The costs involved with waste disposal stem from the type of waste generated. If the waste is hazardous, it must be disposed of as such, which can cost double that of non-hazardous disposal. To render lead-based paint waste non-hazardous, solutions such as admixtures and liquid pretreatment can be used. When using these products, there are additional costs involved, including the price of materials and additional labor needed to use them. In the case of an admixture, a certified blender blends the material with the

[2] FHWA-RD-94-100, "Lead Containing Paint Removal, Containment, and Disposal", February 1995, pages 80-82.

abrasive blast media. Material costs for abrasive and additives are shown in Table 2 below. Tables 3 relates the disposal costs.

Table 2. Material Costs

	$/ton*
Grit	$60.00
Grit with admixture	$148.00
Liquid pretreatment	$49.88
Liquid pretreatment + Grit	$109.88

*Based on an average abrasive usage rate of 10 lb/ft^2 and a liquid pretreatment usage rate of 80 gal/ft^2; every ton of abrasive will require 2.5 gallons of liquid pretreatment to be used.

Table 3. Disposal Costs**

	$/ton
Hazardous	$180
Non-Hazardous	$60

**Prices quoted from Environmental Waste Specialists, Inc., Chantilly, Virginia.

The additional cost of labor for applying the liquid pretreatment is the hourly rate of the painter and any helpers he may have. This additional cost is minimal at about $0.01/ft^2/man, or $0.98 per ton of abrasive.

To exemplify this, consider a typical bridge with 5,000 ft^2 of paintable area. According to a cost model, built for this FHWA study, the amount of grit required to abrasive blast the bridge using expendable abrasive would be 25 tons. The cost for abrasive without additives would be $1,500. When an admixture is used, the cost for abrasive material increases to $3,700. When liquid pretreatment is used in conjunction with the abrasive, the total cost for the materials is $2,715. The additional labor cost to apply the liquid pretreatment is precisely quantified as the time it takes one sprayer to apply the material plus the time for the spray pump helper. However, the impact to the project may be as significant as adding an additional day's labor for the entire crew, as other job operations may be delayed while the liquid pretreatment dries.

Disposal costs for such a project would be $9,687.75 for expendable abrasive without additives. When the abrasive admixture is used, disposal costs are decreased to $6,629.25, a decrease of 31% from the original disposal cost. Disposal costs for the liquid pretreatment are slightly higher than the admixture at $6,704.78 because the liquid pretreatment adds some volume and weight to the waste, yet still yields a cost reduction of approximately 31%. While these decreases in the disposal cost may seem significant, the overall cost savings to the project are about 3.3%. Table 4 summarizes this example.

Table 4. Cost savings using admixtures and liquid pretreatments based on 5,000 ft^2 of paintable area

	Material	Disposal	Total: Material Plus Disposal	Savings Over Grit
Grit	$1,500	$9,687.75	$11,187.75	-------
Grit + admixture	$3,700	$6,629.25	$10,329.25	$858.50
Grit + liquid pretreatment	$2,715	6,704.78	$9,419.78	$1,767.97

As can be seen from the previous example, both the admixture and liquid pretreatment can reduce maintenance painting costs. Other factors that are not considered by the cost model, are liability and availability. Both the owner of the structure and the contractor who generated the actual waste are responsible for the waste until it is properly treated and disposed. These methods of hazardous waste elimination can reduce this liability, which makes them an attractive option. The other factor, availability, refers to the location of the jobsite to a distribution center for the materials. Liquid pretreatment can be purchased and shipped rather easily, similar to paint. Admixtures on the other hand must be purchased from a certified blender, which may be a long distance from the work site.

CONCLUSIONS

1. Admixture blended abrasives are generally more expensive than liquid pretreatments due to its higher material costs. Both the admixture blended abrasive and liquid pretreatment cost more than expendable abrasive, however, those increases are less than the disposal cost savings realized. These cost trade-offs result in a small overall savings for the project.

2. The use of admixture blended abrasives did not seem to affect the contractors productivity with the Torbo® Wet Abrasive Blasting System. Since it was used in slurry, it cannot be determined if the admixture material significantly impacts the amount of airborne dust generated. Liquid pretreatment did not significantly increase the amount of dust generated.

3. If the contractor plans the application of liquid pretreatment into the blasting process, downtime due to drying is minimized. Admixtures do not interfere with the contractor's productivity and do not cause any application downtime because they are pre-blended in the abrasive.

4. Since the admixtures react like Portland cement when exposed to water, it is imperative that the blended abrasives be kept dry and all spent abrasive is removed from the bridge steel immediately to avoid expensive hand scraping and repairs. In addition, contractors must take care to clean all equipment and remove the admixture material from blast pots to avoid equipment damage.