"Cost Effective Alternative Methods for Steel Bridge Paint System Maintenance"

Contract No. DTFH61-97-C-00026

Report VI:
Abrasive Blasting Using Torbo® Wet Abrasive Blasting System

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TECHNOLOGY INTRODUCTION

Torbo® blasting involves mixing water and abrasive in a pressurized blast pot to produce a slurry material. This slurry material is forced through the blast hose to the nozzle using compressed air, similar to the method used to move dry abrasive through hoses in conventional abrasive blasting operations. However, the Torbo® system allows the blast operator to control the following directly at the nozzle: abrasive mixture quantity, air pressure and nozzle on/off. The composition of the slurry is typically 80% abrasive to 20% water. The use of this slurry media reduces airborne dust, which could possibly reduce the containment requirements compared to dry abrasive blasting. Torbo® can be used for complete coating removal or spot repair scenarios. The Torbo® Wet Abrasive Blasting System will impart a profile on steel. The depth of the profile is dependent on the size and type of abrasive used as well as the air pressure. Depending on the type of abrasive media, spent abrasive maybe reused without filtering or cleaning. A wide variety of abrasives may be used such as sand, plastic, glass, slag, bicarbonates and other man-made abrasives.

TECHNOLOGY OBSERVATION

During a site visit to an ongoing project in Henryetta, Oklahoma, Corrpro Companies, Inc. observed slurry blasting utilizing the Torbo® Wet Abrasive Blasting System. This work was done on a bridge carrying Interstate-40 over Wolf Creek. The contractor performing the work was PbX and consisted of a crew of five men: one foreman, two blasters, and two helpers. The contractor used two Torbo® units, one 18 cubic foot unit and one 22 cubic foot unit. Each unit was able to accommodate one blaster.

The paintable area of the bridge was 8,351 square feet. During the site visit, approximately 2,000 square feet were blasted to a SSPC SP-10 surface cleanliness. The pressure used was 150 psi at the source. Since the abrasive was wet, some abrasive and paint residue remained on the surface after blasting, which required subsequent rinsing for removal. This was done using the Torbo® Wet Abrasive Blasting System, which allowed the blasters to turn off the abrasive and use only low-pressure fresh water. The contractor also used a rust inhibitor in the slurry to lower the potential for flash rusting on the cleaned steel.

The contractor incorporated a scaffolding system that was connected to and rolled along the bottom flanges of the bridge beams. The containment consisted of water impermeable tarps on the ground and to the sides of the scaffolding. The ground tarps collected the slurry and the sidewalls contained each span of the three span structure.

The blast media used was a blend of silica sand and 20% abrasive admixture by weight. The abrasive admixture is a proprietary additive used to render lead in waste non-leachable. The abrasive admixture is not considered a treatment by the Resource Conservation and Recovery Act (RCRA) and therefore does not require special permits.

RESULTS

Table 1. Productivity Data

AREA PREPARED	2000 ft^2
TIME	22 man-hours
PRODUCTIVITY	91 ft^2/man-hr

The productivity results of the observation are shown in Table 1. The Torbo® system achieved an SSPC SP-10 surface cleanliness with a productivity of 91 ft^2/man-hour/nozzle. Since each Torbo® unit supports one blast nozzle, two units and two abrasive blasters were used. Corrpro measured the surface profile of the cleaned steel at greater than 2 mils.

Torbo® claims that its system decreases abrasive usage by up to 50%. For the I-40 bridge painting project, abrasive consumption was reduced from an assumed average of 10 lb/ft^2 for once-through dry abrasive blasting to 3 lb/ft^2, a 70% decrease. This decrease in abrasive usage also resulted in decreased waste production. The water consumption rate was 0.08 gal/ft^2, which is approximately 1 pint per minute as advertised by the manufacturer.

The waste was collected in barrels and transported to a nearby cement kiln for disposal. The waste was tested for leachable lead using the Toxicity Characteristic Leaching Procedure (TCLP), EPA Method 1311, 40 CFR 261. The waste had a leachable lead concentration of 0.32 ppm, far below the 5 ppm EPA limit for classification as hazardous.[1]

Initially apparent advantages are the reduction in dust, which increases visibility and in-turn, productivity. With the decrease of airborne dust, worker lead exposure is also decreased. The decreased lead exposure is a significant advantage over dry abrasive blasting. Less containment requirements are also a significant advantage of the Torbo® system. As a contractor gains more experience with the equipment, productivity improves, lowering costs.

There were a few obvious disadvantages to the Torbo® Wet Abrasive Blasting System. As with any abrasive blasting system, maintenance requires a great amount of time and manpower.

- The reliability of the electronic switches, that turn the nozzle on and off and meter the abrasive, may be an issue in a wet environment. These controls malfunctioned several times during the on-site visit. The cause of the malfunction

[1] FHWA Study, "Cost Effective Alternative Methods for Steel Bridge Paint System Maintenance", Report VII: The Use of Admixture Blended Abrasives and Liquid Applied Pretreatments in the Removal of Lead-Based Paint, Corrpro Companies, Inc.

is not known and Torbo® is currently working on an acceptable resolution. Since an admixture blended abrasive was used, the contractor had to clean the blast pots daily or the abrasive could harden in the pots, creating clumps that would clog the system.

- The wet abrasive needed to be cleaned from the surface. Since the abrasive is in a slurry, it tends to stick to the blasted surface and must be washed off prior to painting. The additional washing step is conducted using the Torbo® equipment and is similar to an air blow down with traditional abrasive blasting equipment. Rust inhibitors are typically used to reduce or eliminate flash rusting on the cleaned steel. The rust inhibitor is subsequently applied to the blasted surface and does not require a rinse.

ECONOMIC DISCUSSION

Many factors must be considered when determining the economic impact of a technology on a bridge maintenance painting project. The cost for maintenance painting project can be broken down into four main areas:

I. Mobilization/Demobilization
II. Coating Removal
- Productivity
- Equipment Cost
- Worker and Environmental Protection
- Waste Disposal

III. Painting
IV. Staging/Containment

In order to validate a technology one must first compare it to the current state of practice. The current state of practice in this industry is dry abrasive blasting with expendable abrasives, which cleans ~100 ft^2/hr/blaster to an SSPC SP-10 Near White Metal condition, while providing a negative pressure, sealed containment, PPE for workers, and hazardous disposal of all waste. The Torbo® Wet Abrasive Blasting System can clean ~91 ft^2/hr/blaster and requires less stringent containment and less PPE than dry abrasive blasting. The Torbo® system also requires less abrasive material per square foot, so abrasive materials costs will also decrease.

To compare the two surface preparation technologies, a cost model built for this FHWA study was used. A productivity rate of 91 ft^2/hr/blaster was assumed based on actual field data collected during a prior site visit. This cost model estimated the cost of using Torbo® Wet Abrasive Blasting System to fully remove lead-based paint from bridges ranging in size from 5,000 ft^2 to 200,000 ft^2. The results are shown in Table 2 below.

Table 2. Cost per square foot

	'once through' dry grit ($/ft^2)	Torbo® System	Torbo® with admixture blended abrasive
5,000 ft^2	$13.18	$10.72	$10.65
200,000 ft^2	$6.23	$4.27	$4.27

This shows a 19%-31% decrease in price for Torbo® blasting compared to dry abrasive blasting. The main reasons for the large difference in costs is the decrease in abrasive media usage and the reduction in waste generation and disposal. Material costs are 26% lower for Torbo® blasting as compared to dry abrasive blasting. Disposal costs are decreased by 68% for Torbo® blasting as compared to dry abrasive blasting.

CONCLUSIONS

1. Torbo® blasting can result in cost savings by the reduction in abrasive compared to dry abrasive blasting with expendable abrasives, therefore reducing waste disposal. Through the use of admixture blended abrasives that render lead non-leachable, disposal costs can be reduced further.

2. Each Torbo® unit can facilitate only one blaster so a contractor must invest in additional units to add more blasters. This may only be desirable for a contractor if future work is planned for the additional units. In contrast, most dry abrasive blasting systems used for bridge painting allow multiple blasters.

3. When the Torbo® System is compared to once-through dry abrasive blasting, the advantages are:
    - Decrease airborne in dust
    - Decrease in containment and PPE needed
    - Decrease in waste generation and disposal.

    Similarly, the disadvantages of the Torbo® System are:
    - Reliability of electronic controls in a wet environment
    - Higher maintenance requirements
    - An extra step is needed to rinse abrasive off the surface.

4. Using the Torbo® system can provide a sufficient surface profile. The profile is dependant upon abrasive size and type as well as the output pressure of the slurry. The Torbo® Wet Abrasive Blasting System can utilize any abrasive that will not be negatively effected by water. Some abrasives and additives require the Torbo® units to be cleaned daily to prevent clogging.