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ADVANCES IN BRIDGE BLAST CLEANING TECHNOLOGY

Since the publication of Bob Nordlund's article on the management of hazardous waste generated by the blast cleaning of Michigan's steel bridges (MATES Issue No. 50, 1991), a new set of requirements has been developed by the Departments involved. This article provides a brief general background and describes the improved environmental protection techniques now specified for contract bridge painting. For information on the toxicity testing and disposal requirements of blasting residue, please refer to the earlier article.

Prior to 1975, it was common practice to coat the structural steel in bridges with lead-based paints. Since then lead-based paints have been banned due to the adverse effects of lead on human health and on the environment. A problem of considerable magnitude arose during the 1980s involving the safe removal of these lead-based paints during the maintenance repainting of bridges.

Maintenance repainting starts with an abrasive blast cleaning process that generates a large amount of dust and a waste material that includes the paint chips, abrasive particles, dust, and debris removed from the bridge. The dust generated by blasting and the residual material is toxic to both humans and the environment because of the high lead content of the paint being removed. Typically, the total lead content of the waste material will range from 3,000 to 5,000 parts per million (ppm). With some of the more advanced removal techniques involving the recycling of steel grit the amount of waste material generated is greatly reduced but the total lead content of the waste material can be in excess of 50,000 ppm. Any waste with a total lead content in excess of 500 ppm is considered to be toxic to humans.

Joint Task Force Develops Specification

In the fall of 1986 a joint task force was formed with members from the Michigan Departments of Transportation, Natural Resources, and Public Health to devise a system for removing lead-based paints from bridges that would mitigate the problems of human exposure and environmental pollution. At that time the technology available to the industry did not offer a good system for total containment, so the philosopy of "Best Available Control Technology" (BACT) was adopted. This resulted in a specification that allowed some dust and other waste material to escape from the work area when no human exposure would be anticipated adjacent to the structure (a limit of approximately 200 ft). The specification for these bridges required ground cloths (or a barge in the case of a bridge over a waterway) to be placed under the work area to collect the waste materials. Tarpaulins were draped around the work area to limit the amount of dust that would escape. When residential, recreational, or other occupied properties existed within the 200 ft limit, total enclosure of the work area was required. Because of the lead level in the dust generated by blast cleaning within a total enclosure, air-fed blasting hoods were not adequate to protect the workers. Thus, a two-step procedure was developed for the blast cleaning. The first step involved a water-abrasive blast which removed the paint without generating dust. This was then followed by a dry abrasive blast after the steel had adequately dried (usually requiring two to three days). This system was effective but proved to be costly and introduced some new environmental problems in trying to contain the water used in wet-blasting and rinsing the structure.

Environmental Concerns Intensified

During the 1990 construction season all problems associated with the approved 1987 BACT system came to a head when the Department received citations from the Michigan Department of Natural Resources (MDNR) for alleged violations on seven different bridge painting projects. In addition to citing several alleged violations of the hazardous waste management laws, the MDNR was no longer willing to accept the release of dust and the other waste material to the environment, regardless of the proximity of humans to the bridge. Public Act 64 prohibits such releases to the lands and waterways of the State without a permit and the MDNR is not willing to issue such a permit for bridge blast cleaning. This resulted in reconvening the joint task force to develop a new containment approach acceptable to all parties.

The joint task force did a thorough review of the problems associated with the 1987 BACT system as well as the technological advances made by the blast cleaning and containment industries. The task force concluded that the state-of-the-art had advanced to the point where total containment was now available at reasonable cost. Total containment would afford complete protection to the environment and would eliminate the potential for human exposure in proximity to the bridge. A new specification was issued by the Department in February 1991 requiring the use of this new technology.

New Total Containment Technology

The new specification requires that all bridge blast cleaning be performed within a total containment enclosure of the work area regardless of paint type on the steel. The actual design of the enclosure is left to the contractor with the stipulation that it must prevent the release of any dust or waste material to the air, ground, or waterway. Within the enclosure all waste materials must be collected and cleaned up and stored daily.

To protect the blasting operators within the enclosure, the contractor must install air moving equipment capable of creating a "negative pressure condition." The air flow within the work enclosure must be adequate to sufficiently purge the air of dust in order to provide good visibility and a safe working environment for the blasting operators, who must still wear air-fed hoods for protection. This negative pressure (or relative vacuum) within the enclosure also prevents the escape of dust or waste materials to the outside environment. All air exhausted from the work area must be filtered by means of a portable filtering system or bag house. This filtering system affords complete collection of all the dust and waste materials containing lead that previously may have escaped to the environment.

This negative pressure enclosure approach to the problem has been under development since 1987 by several Michigan painting contractors. The feasibility and cost effectiveness of the system have been well demonstrated by the contractors who have used this system in lieu of the two-step wet blast/dry blast system specified in the 1987 BACT system. The equipment involved is now readily available to all contractors who wish to develop the capability of doing negative pressure containment work. The Department is now actively letting bridge painting contracts specifying this method, regardless of coating type on the structure. It is anticipated that the bid prices for the blast cleaning of the steel will increase between 30 to 40 percent for this system. This cost increase is well justified by the environmental protection achieved. The alternative is to not paint steel bridges but schedule their replacement after corrosion reduces the bridges' steel members to the point of obsolescence. This option is unacceptable in most cases and the costs associated with such a program would ultimately be prohibitive.

Waste Management Developments

Due to the presence of lead and zinc in the paints used on steel bridges, all waste materials generated by the blast cleaning process have the potential of being classified as a hazardous waste. A waste is defined as hazardous by an acid leaching test, not to be confused with the toxic nature of the waste. All waste materials must be tested by the Department in accordance with the U. S. Environmental Protection Agency's "Toxicity Characteristic Leachate Procedure" (TCLP). This test simulates the amount of lead, zinc, or other toxic materials that could be leached from the waste if exposed to an acidic environment such as acid rain percolating through a non-sealed landfill. The strength of the acid solution in the leaching test is equivalent to that in a typical Type II (sanitary) landfill. If the TCLP test reports leachable lead equal to or greater than 5.0 ppm, the spent material is classified as a hazardous waste and must be handled, stored, transported, and disposed of at a licensed hazardous waste facility in accordance with the very complex requirements of Public Act 64. This has been a source for citation of alledged violations in the past and the Department's new specifications are very explicit about the contractor's responsibilities in conforming to State and Federal waste management laws. The contract specifications hold the contractor fully responsible for compliance.

Non-hazardous Waste Measures

A revolutionary development is occurring in the method used to remove lead-based paint by blast cleaning and the resulting waste material. It has been discovered by industry that if steel grit is used in the blasting process, the resulting waste material reliably tests non-hazardous by the TCLP test. Evidently, the leachable lead in the waste combines chemically with the steel. This favorable result is achieved by using either steel grit in total, usually with a recycling process, or by the addition of at least eight percent by weight of steel grit to the mineral abrasives used for blast cleaning. The non-hazardous waste materials are still toxic to humans if exposure occurs, but the storage and disposal costs are much lower. The non-hazardous wastes require disposal at a Type II (sanitary) landfill. And as noted previously, though considered non-hazardous, this waste is still toxic to humans so no other method of disposal is allowed by law.

With the adoption of the total containment system the problems of human health and environmental pollution caused by the removal of lead-based paint appear to have been mitigated. Industry will undoubtedly continue to devise more efficient ways of performing the blast cleaning within a total containment enclosure. Further development of steel grit usage to eliminate the hazardous waste classification for the resulting waste material will greatly reduce the waste management costs and remove a significant load from hazardous waste disposal facilities, which are rapidly approaching the point of overload. The Department has once again advanced to the implementation of the "Best Available Control Technology" for its contract bridge painting program.

-James D. Culp

TECHADVISORIES

The brief information items that follow here are intended to aid MDOT technologists by advising or clarifying, for them, current technical developments, changes or other activities that may affect their technical duties or responsibilities.

PERSONNEL NOTES

Because of the length of the lead articles in the last few issues, we have been unable to recognize our retirees and new employees. Retirement claimed three employees recently; in order of seniority, **Tom Green**, **Darrell Hall**, and **Bob Johnson.** Tom Green was the Division's 'senior citizen' in terms of time in grade, with 42 years. Tom was the supervisor of concrete products control, and our scale certification program, after serving in a number of other positions in the Division. Darrell was the Engineer of Specifications, and was recognized throughout the Department for his care and expertise in this crucial phase of our work. Darrell came to us from the Design Division, and had a total of 35 years with the Department. Bob was an engineering technician in the Testing Laboratory Section, whose duties involved the testing of aggregate and metals. He had a total of 31 years with the Department. These three valued friends and workers thus had a total of 108 years serving the Department and the people of the State of Michigan. Those years of experience cannot be replaced, and their expertise will be missed.

Turning to new employees, we would like to welcome the following new faces to the Division. In the Research Laboratory, **Mike Isola** has joined us as an Engineer in the Structures Research Unit; **Steve Shaughnessy** is a new Laboratory Scientist in the Chemistry and Photometry Unit; and, **Dave Smiley** is the newly appointed Supervising Engineer of the Soils and Bituminous Unit. Three new employees have joined the Testing Laboratory Section: **Bill Redmond** as a Technician in the Aggregates and Metals Unit; **John Staton,** Structural Testing Engineer; and, **Roger Till** as the new Structural Services Supervisinig Engineer. The Geophysical-Geoenvironmental Section welcomes three new members: **Scott Thayer,** Environmental Engineer; **Barb Vetort,** Geologist; and, **James Woodruff,** Environmental Quality Specialist, all in the Geoenvironmental Unit. We look forward to working with these new staff members, and the new perspectives they will bring to their jobs.

NEW MATERIALS ACTION

The New Materials Committee recently:

Approved

Bold Eagle Barrel Harness
Tensar Bituminous Pavement Reinforcement
Conspec 100 Non Shrink Grout
Polyject 1257
Super Cushion RR crossing

Approved for Trial Installation

Exact Tact Tackifier

It should be noted that some products may have restrictions regarding use. For details please contact chairperson of New Materials Committee at (517) 322-1632.

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