

**MICHIGAN DEPARTMENT OF TRANSPORTATION
M•DOT**

**EVALUATING LOW DUSTING ABRASIVES
ON THE BRIDGE CARRYING COVERT
ROAD OVER US 127**

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**Research Laboratory Section
Materials and Technology Division
Research Project 89 TI-1420
Research Report R-1325**

**Michigan Transportation Commission
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Executive Summary

This final report covers the laboratory and field evaluation of two products submitted for use as low dust bridge blasting abrasives. After the products passed a preliminary lab test for profile, they were evaluated in the field for profile, embedment, and dusting characteristics. Both products were blasted by a contractor under a special provision. The dusting characteristics were evaluated by a team of observers who compared each product to Starblast, an approved low dust abrasive.

Garnet Blast and Black Beauty 2550 met all requirements for low dust abrasives and were added to the list of approved products.

Scope

This project (JFRR 33031-29073A, Covert Rd over US 127 in Ingham County) involved the blast cleaning of a small rural bridge using four different abrasives (see MDOT Special Provision -- Appendix A). The first product listed, Starblast, was already approved for use and is the abrasive the majority of the contractors use in dry blast cleaning of bridges. This was included for comparison with the three new products.

Introduction

In many respects, the technology involved in the surface preparation of steel structures has been changing over the past ten years. Concern for the health and safety of blasting operators, for example, has mandated the use of lower dusting materials as blast media. Michigan specifications and special provisions now require a low dusting abrasive with very low quantities of lead. Due to the tight requirements, MDOT's list of qualified products was restricted to only three abrasives. In order to foster competition among manufacturers, as well as to prevent the occasional material shortages that have halted the blasting process during the limited bridge painting season, we encourage the development and submission of new potential products. This experimental project was designed to compare the newly submitted products with one already used successfully.

Preliminary Requirements for the New Abrasives

For approval for use on MDOT projects, the products must meet four basic criteria: blast profile, embedment into the steel, leachable lead content, and dusting characteristics. The three new products were studied in the Materials and Technology Division Laboratory, and the preliminary laboratory results indicated that they met the requirement of a 1 to 2.5-mil blast profile.

Each product was tested separately in the laboratory's blast cleaner and new degreased steel panels were blasted to a near-white cleanliness. After the dust was blown off, a visual inspection of the panel showed the embedment of any particles. The Extra-Coarse Testex Tape was used to determine the profile. All of the products met the requirements for profile and embedment. The compilation of this information is in Table 1B of Appendix B. Product information sheets indicated that the materials contained less than 0.5 ppm of leachable lead, thus satisfying that criterion.

According to the 1989 MDOT requirements (Appendix B), the low dusting abrasives must be approved by the California Air Resource Board or listed as either low or medium dusting abrasive by the Steel Structures Painting Council. Because neither organization had examined these products, it was decided that a field evaluation of these blasting products, using Starblast as a control material, would be conducted to ascertain if the products satisfy the dusting requirement.

Blast Cleaning Operation

The project started May 15, 1990. The contractor received samples from all four suppliers; however, bags of abrasive from Sargent Sand Company were not identifiable, and the documentation did not correspond with the material tested in the laboratory. The producer was notified and asked to provide proper identification within one week, which they failed to do. The contractor was allowed to use Starblast on the remaining 25 percent of the steel area designated for the eliminated abrasive.

The blasters used a No. 8 nozzle with 150 psi at the pot for all abrasives except Black Beauty, which required 140 psi to obtain the proper profile. Each product used in the field testing was evaluated for embedment, profile, and overall dusting characteristics. A visual test with no magnification was used for embedment. Each product was evaluated by the approximate percent of embedment with a maximum of 1.0 percent. These percentages were determined by the two-person inspection. ASTM D 610 shows percent of rust by a dot diagram. A comparison between the dot diagram (Fig. 1) and the cleaned steel surface was used to determine whether or not embedment exceeded 1.0 percent. None of the products exhibited the maximum allowable amount.

The profile was determined by using the X-Coarse Testex Tape (see Table 1 below). Each of the products was in the 1.0 to 2.5 mil profile range with minor adjustments to the pressure at the nozzle.

TABLE 1
PROFILE READING

Testex Tape Reading

#1 (Starblast)	#2 (Black Beauty 2550)	#3 (Gamet)
1.9 2.5 1.9	1.9 2.1 1.9	2.5 2.2 2.5
2.5 1.6 2.2	2.7* 1.9 1.9	1.8 2.2 2.3
1.5 2.0 1.9	2.6* 2.2 1.6	2.3 2.2 2.5
2.5 2.3 2.3	2.6* 1.7 1.9	2.3 2.3 2.0
		2.3 2.7 2.5
2.4 1.9 1.7	2.8* 2.3 2.0	2.0 1.9
2.1 2.0 1.9	1.9 2.4 1.9	2.4 2.2
1.8 2.5 2.2	2.6* 1.6 1.9	2.2 2.2
2.1 2.1 1.5	2.7* 1.3	2.4 2.5
2.2 2.0 2.1		
2.2 2.0 2.3		

*Pressure adjusted to compensate for the slightly high readings.

A rating system of 0 to 10 was developed to compare the dusting characteristics of the new abrasives with the approved material (Table 2). The comparison established the difference between the approved abrasive and total observable dust.

TABLE 2
RATING SYSTEM

<u>Rating Number</u>	<u>Distance (ft)</u>	<u>Clarity (percent dust in air)</u>
10	0	0
9	1	50
8	5	50
7	10	50
6	15	50
5	20	50
4	10	75
3	15	75
2	20	75
1	10	90
0	1	100

The highest rating, 10, would indicate to no visible change in the air quality as a result of blast cleaning. A rating of 9 would indicate a clarity of 50 percent at a distance of 1 ft from the location of the blaster. Consequently, a rating of 1 would signify 90 percent dust particles at a distance of 10 ft from the blaster.

The dusting characteristics were determined by using Table 2. Table 2B, in Appendix B, gives the dusting characteristics of the three products. Each of the products was in an acceptable range compared with the standard.

Conclusions and Recommendation

All the products tested in the field will meet Michigan Department of Transportation requirements for low dusting. Product No. 3, Black Beauty 2550, showed some problems with embedment and high profile when the pressure at the nozzle was higher. Lowering the pressure resulted in a slower cleaning process. Product No. 2, Garnet Blast, performed as well or better than our currently approved product No. 1, Starblast. Both of these products showed excellent results at the 150 psi nozzle pressure.

Recommendation

It is recommended that Garnet Blast and Black Beauty MSG be added to our list of approved blasting abrasives.

Reference

1. Steel Structures Painting Manual, Good Painting Practice, Vol. 1, p.52.

APPENDIX A

MICHIGAN
DEPARTMENT OF TRANSPORTATION
BUREAU OF HIGHWAYS

SPECIAL PROVISION
FOR
BLAST CLEANING ABRASIVES FOR BRIDGE PAINTING

CD/JDC

1 of 1

06-23-89
JFRR 33031-29073A

This painting project involves the experimental evaluation of new low-dusting abrasives. The Contractor is required to use each of the four abrasives listed below on approximately 25 percent of the steel area to be blast cleaned as directed by the Engineer. No other type of abrasive shall be used.

1. Starblast - DuPont, Wilmington, Delaware 09898
2. GMA Garnet Blast, Grade ROM (3060)
Barton Mines Corporation
Blast Media Division
1658 Cole Blvd., Ste. 190
Golden, Colorado 80401
3. Sandblast Slag
Sargent Sand Company
7690 W. M-116
Ludington, Michigan 49431
4. Black Beauty, Grade 2550
Reed Minerals
8149 C. Kennedy Ave.
Highland, Indiana 46322

APPENDIX B

MICHIGAN DEPARTMENT OF TRANSPORTATION
Requirements for Approval of Low Dust Abrasives

1. It shall be listed on a generic basis as a medium or low dust abrasive in the Steel Structures Painting Manual, Volume 1, it is certified by the California Air Resources Board (CARB) on a trade name basis, and/or a field evaluation.
2. It shall have a gradation such that the abrasive will produce a uniform profile of 1 to 2.5 mils, as measured with the extra course Testex Replica Tape.
3. It shall contain less than 0.5 ppm leachable lead.
4. Technical information regarding the above requirements, Materials Safety Data Sheet, and 100 lb sample shall be submitted to:

MDOT-Materials & Technology Division
 Research Laboratory - Coatings Systems
 Secondary Governmental Complex
 8885 Ricks Road
 Lansing, Michigan 489009

5. The material will be evaluated by the Department to test its dusting characteristics, embedment into the steel, and the surface profile. If the product is judged to perform satisfactorily, it will be approved for the Qualified Products List.
6. Products may be deleted from the Qualified Products List by the Department any time they fail to meet any of the above requirements.

TABLE 1B
LABORATORY PRODUCT PROFILE AND EMBEDMENT RESULTS

<u>Product</u>	<u>Profile (a)</u>	<u>Embedment (b)</u>
Starblast (Approved for use)	Ave. 1.9 mil	Low
Black Beauty MSG	2.2 mil 2.2 mil 2.7 mil	Medium-Low
Nickel Slag	1.9 mil 2.2 mil 2.1 mil	Medium-Low

Garnet

1.7 mil
2.1 mil

Low

- (a) The profile is determined by blast cleaning a A36 steel panel in a blasting cabinet. The pressure at the nozzle is 100 psi and the panel is blasted at an angle of 60° from the horizontal surface to the nozzle.
- (b) Embedment is determined by a visual inspection and 10X microscope with comparison to the low standard Starblast. Ratings are low (0.3% or less), medium-low (1.0%), medium (3.0%), medium-high (5.0%), and high (>10%).

TABLE 2B
DUSTING CHARACTERISTICS OF PRODUCT NO. 1 (STARBLAST)

<u>Date/Time</u>	<u>Rating #1</u>	<u>Rating #2</u>	<u>COMMENTS</u>
5/15/90 1:40 pm	6	6	None
2:10 pm	5.5	6	None
2:40 pm	5	4	None
3:10 pm	5	5	None
3:40 pm	5	5	None

DUSTING CHARACTERISTICS OF PRODUCT NO. 2
(BLACK BEAUTY MGS)

<u>Date/Time</u>	<u>Rating #1</u>	<u>Rating #2</u>	<u>COMMENTS</u>
5/21/90 1:30	5.0	5.0	Some areas of high profile; adjusted pressure to correct excess dust while changing the number of blasters
2:00 p.m.	4.5	4.5	
2:30 p.m.	4.0	4.5	
3:00 p.m.	4.5	4.5	
3:30 p.m.	5.0	5.0	
4:00 p.m.	5.0	5.0	
4:30 p.m.	5.0	5.0	

DUSTING CHARACTERISTICS OF PRODUCT NO. 3 (Garnet)

<u>Date/Time</u>	<u>Rating #1</u>	<u>Rating #2</u>	<u>COMMENTS</u>
5/22/90 1:15 p.m.	7.0	6.5	None
1:45 p.m.	6.5	6.0	None
2:15 p.m.	6.5	6.0	None
2:45 p.m.	6.0	6.0	None
3:15 p.m.	6.5	6.0	None
3:45 p.m.	6.0	6.0	None