EVALUATION OF THE MACDONALD SCABBLER FOR HIGHWAY USE

by

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SUMMARY

The MacDonald Scabbler is a small, hand held machine suitable for use in cleaning and roughening concrete surfaces. It weighs 308 pounds (140 kg), has 11 cutting heads, and, as a power source, requires a compressor capable of delivering 365 cubic foot of air per minute (cfm) (10.33 m^3/min.) at 100 psi (689.48 kPa). The machine was tested in four operations: bridge cleaning, removal of paint lines from bituminous pavement, removal of epoxy from a bridge deck, and the removal of paint lines from concrete pavement. The results were positive in all of the operations except the removal of paint lines from bituminous pavements. The weather was extremely hot when this operation was performed, and the pavement had become plastic to a degree that the bituminous material fouled the cutting heads of the machine.

The machine is small and easy to transport, relatively inexpensive, simple to operate, can be operated by only one person, and is adaptable for many jobs.

The machine will now be made available to any district that may need it.

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INTRODUCTION

There are many jobs of a cleaning or surface removal nature in highway work that appear to be simple and inexpensive, but upon performance prove to be extremely costly, difficult, and time-consuming. Examples are cleaning concrete bridge decks prior to resealing, removing traffic markings from pavements, and roughening pavements to improve skid resistance. Often these jobs require large numbers of workers who might be badly needed for other duties.

With the objective of achieving economy in the aforementioned tasks, a search was made for a low priced machine that might be used to accomplish them. Since it was thought that no one district would have need for such a machine full-time, the apparatus selected should be easily transportable; and to reduce manpower needs, it should be capable of operation by a few people with a minimum of training.

In a literature search, the MacDonald Scabbler was noted as appearing to be especially well suited for small jobs on concrete. Its apparent capabilities were discussed with the Maintenance and Equipment Divisions, and it was decided that the Maintenance Division would purchase one for evaluation by the Research Council.

DESCRIPTION OF MACHINE

(From "MacDonald Scabblers - The Newest Way to Scarify Concrete," by John MacDonald and Company, (Pneumatic Tools) Ltd., Peel Park Place, College Milton & East Kilbridge, Scotland)

The Type UII MacDonald Scabbler (refer to Figure 1*) weighs 308 pounds (140 kg), is 50 inches (127 cm) in overall length, is 33 inches (84 cm) from the ground to handles, and is 33 inches (84 cm) wide from the outside of the wheels. The machine employs 11 cutting bits $2\frac{1}{4}$ inches (5.7 cm) in diameter with nine point carbide inserts staggered in two rows (see Figure 2) so that the rear 5 heads (bits) overlap the spaces left between the front row of heads. The cutting width is 19 inches (48 cm).

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*All figures attached.

The MacDonald Scabbler is a pneumatic power tool and its sole source of power is compressed air. Each head requires 25 cubic feet per minute (cfm) .7 m^3/ min. at 85 pounds per square inch (586.05 kPa) of compressed air. According to the specifications, the Type UII machine requires a compressor rating of 365 cubic feet per minute (10.33 m^3/min.). The average bit life is rated at 80 hours of operation under normal conditions, and each bit will remove approximately five square yards of surface per hour.

The machine is hand held, relatively simple to operate, and mounted on wheels for easy transportation. While in operation, the wheels rise clear of the working surface and virtually float, enabling them to be manipulated with ease. The handles are designed to give balanced control, and together with the conveniently situated control valve make the machine simple to operate. Two men can easily operate the machine. Since some stress is placed on the operator, the two men can work as a team, while one runs the machine the other can sweep the loose material produced by the machine from the road.

COST OF MACHINE

The machine purchased by the Department cost $3,100 in June 1974. Included with the machine were one set of heads and a one-inch (2.54 cm) hose. Replacement heads cost $56 each or $615 per set.

AUXILIARY EQUIPMENT

The only additional equipment necessary for operation of the scabbler is an air compressor with a minimum rating of 365 cubic feet per minute (10.33 m^3/ min.) at 100 pounds per square inch (689.48 kPa) of pressure (see Figure 3).

PRINCIPLE OF OPERATION

The cutting heads, which require no lubrication and are free to rotate, break the concrete into small particles of a gradation not much larger than sand and cause no damage to the surrounding concrete. The machine works on the principle that concrete is stronger under compression than it is under tension. The concrete is compressed by the hammers and when the pressure is released, small amounts of concrete are expelled from the surface. The machine removes the surface by the number of impacts rather than the force of individual impacts.

TESTS

Because a number of tests were conducted in different locations under different conditions, each site and the prevailing conditions are discussed separately in the following paragraphs.

Site 1 — Bridge Cleaning

The Mill Creek Bridge located on Route 39 in the Town of Goshen had an old, badly deteriorated deck surfaced with a coal tar epoxy. (See Figure 4.) Before any repairs could be accomplished, the deck had to be cleaned. This project afforded an opportunity to test the scabbler.

The deck had a total area of 1,188 square feet (110.4 m^2) and required 3.67 hours to clean with the scabbler, for a rate of 324 square feet (30.0 m^2) per hour. The results may be seen in Figure 5. It was observed that when the scabbler was used on this plastic surface (coal tar epoxy) overlying a rigid material (concrete) rather than breaking the surface into small pieces it loosened the material in a way that allowed it to be removed by a shovel or by sweeping. The total cost of cleaning the bridge was $60 and the cost per square foot was $ .05.

Site 2 — Removal of Painted Markings from Asphalt Pavements

The machine was used to remove paint lines from the bituminous pavement in the northbound passing lane of Route 13 in Northampton County south of Eastville, and in the Town of Painter in Accomac County. In the first work area, the old pavement lines had been covered with a thin layer of asphalt. Here the heads of the scabbler became clogged with asphalt and did not work well. In the second area, Accomac County, the paint lines had been covered with epoxy and the machine functioned better. It should be noted that this experiment was performed during hot weather and the asphalt became very plastic.

A total of 876 feet (267 m) of paint lines were removed at a cost of $280.27, or approximately $ .32 per square foot, at a rate of 70.36 square feet (6.5 m^2) per hour. Refer to Figures 6 and 7 for the operation and the appearance of the pavement after removal of the lines.

Site 3 — Removal of Epoxy from Bridge

The third job on which the machine was evaluated was operational maintenance and consisted of removing a coal tar epoxy from the Route 58 bridge over I-95 in Greensville County. The project was planned and performed by employees at the Emporia Area Headquarters under the supervision of Superintendent Jake Watson. The men from the Area Headquarters had no problem in operating the machine. Since one of the objectives of the study was to obtain a piece of equipment that was relatively simple to operate, this experiment was observed closely. (In prior tests the scabbler had been operated by Research Council personnel.) It was the consensus of the workers and observers that the machine was simple to operate and would not present a problem for regular maintenance employees. The cleaning of 104 linear feet (31.7 m), an area of 1,456 ft^2 (135.3 m^2), require 18.58 hours. The total cost for cleaning the bridge was $407.96 for a cost of $ .28 per square foot. Figure 8 shows the bridge before cleaning and Figure 9 shows the operation under way. Note the men with the shovels removing the epoxy after the machine has loosened it. Figure 10 shows the bridge after cleaning.

Site 4 — Removal of Paint Lines from Concrete Pavement

A small experiment was conducted to determine the capabilities of the scabbler in removing old paint lines from concrete pavements. The cutting heads on the scabbler were extremely worn before this experiment. A total of 992 linear feet (302.4 m) of yellow pavement markings were removed in 5.75 hours at a cost of $128.23. The cost per linear foot was $ .13 and the rate of removal was approximately 173 linear feet (52.7 m) per hour. There is no doubt that had the heads not been worn the rate would have been much greater. Figures 11 and 12 show the pavement markings being removed and the cleaned pavement.

SUMMARY OF EXPERIMENTAL WORK

Table 1 summarizes the work done by the Virginia Highway and Transportation Research Council with the MacDonald Scabbler.

Table 1

Type of Removal	Area Sq. Ft.	Rate Per Hour	Cost Sq. Ft./Cents
Bridge cleaning	1188	324	5.1
Removal of paint lines from bituminous surface	876	70.36	32.0
Removal of epoxy from bridge deck	1456	78.36	28.0
Removal of paint lines from concrete pavement	992	173	13.0

The scabbler performed well in all the tasks except the removal of paint markings from bituminous pavements in hot weather.

CONCLUSIONS

1. The MacDonald Scabbler did an excellent job of cleaning the bridge in the Town of Goshen

2. The machine did less than an adequate job in removing paint lines from bituminous pavements in hot weather, although it did perform the task.

3. The machine removed the coal tar epoxy from the Route 58 bridge over I-95 in Greensville County adequately in a situation where no other feasible method was available. Some of the leading bridge maintenance contractors in Virginia use the scabbler for this purpose and report positive results.

4. Although the cutting heads were dull, the machine did a creditable job in removing paint markings from concrete pavements.

RECOMMENDATIONS

It is recommended that the scabbler be made available to any districts that need it for the tasks described in this report and for any similar tasks. The scabbler can certainly be used to bushhammer small areas of concrete pavements to increase their skid resistance, and it has many potential uses. The author will be glad to consult with district personnel on the use of the machine.

The advisability of buying other machines can be determined only by the demand and usage in the districts.

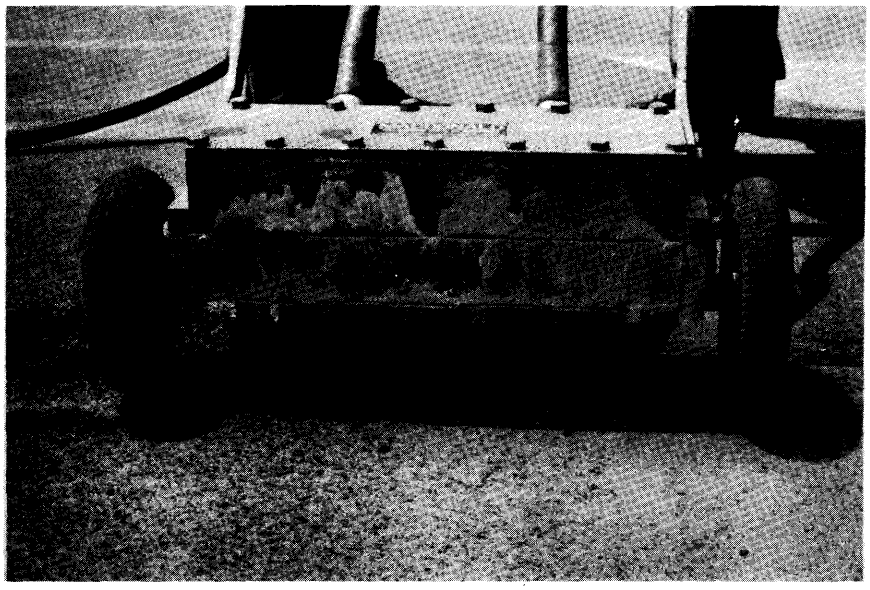

Figure 1. Type UII MacDonald Scabbler.

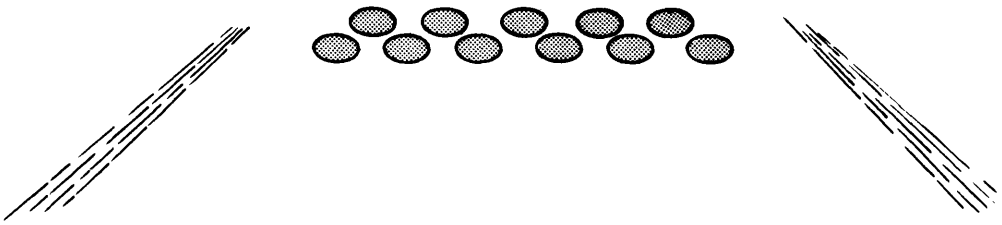

Figure 2. Arrangement of cutting heads for scabbler.

Figure 3. The 365 cfm, truck-mounted air compressor used in the evaluation.

Figure 4. The Mill Creek Bridge before cleaning.

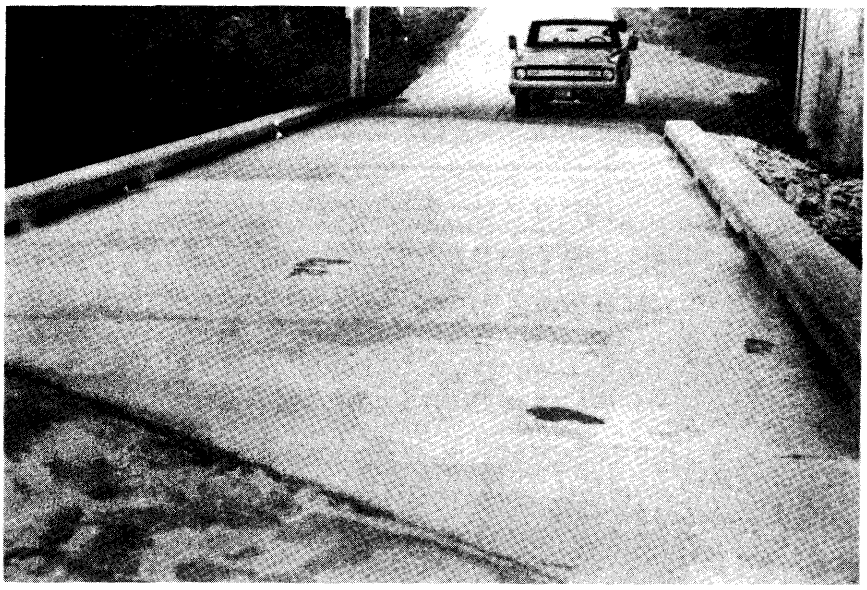

Figure 5. The Mill Creek Bridge after cleaning.

Figure 6. Removal of paint markings from bituminous pavements on Route 13 in Accomac County, Virginia.

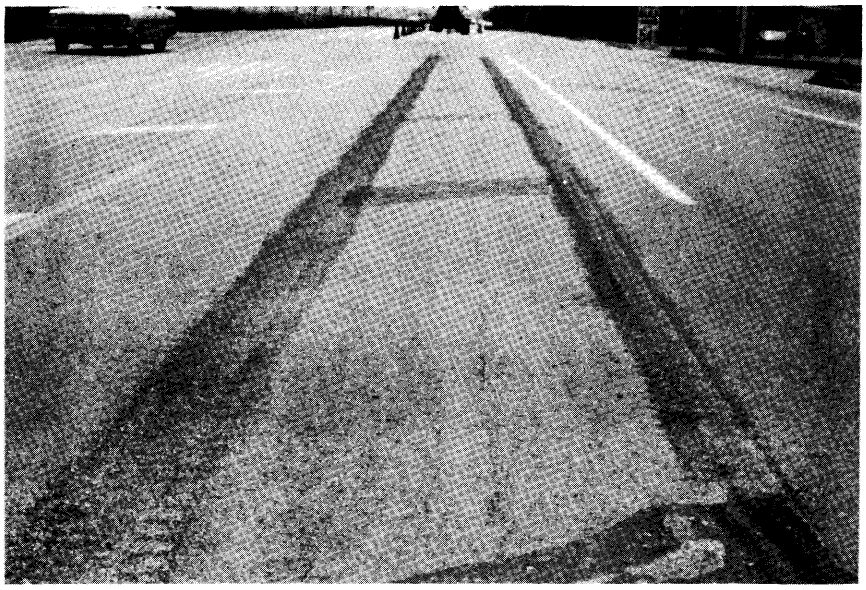

Figure 7. Accomac County pavement after removal of paint lines.

Figure 8. Route 58 bridge before cleaning.

Figure 9. Cleaning operation on the Route 58 bridge. Note that the loose material must be removed with a shovel.

Figure 10. Route 58 bridge after cleaning.

Figure 11. Paint markings being removed from concrete pavement.

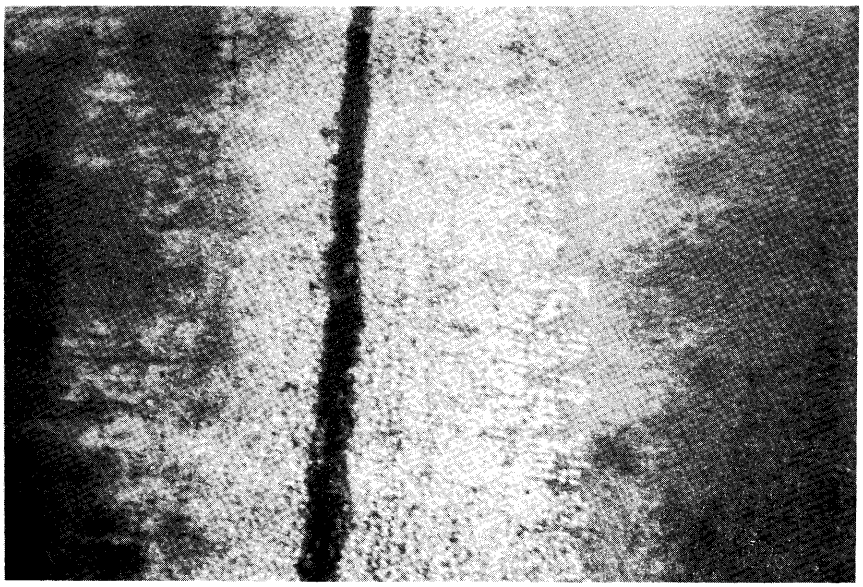

Figure 12. Concrete pavement after removal of paint lines.