# Field and Laboratory Evaluation of Surtreat TPS Concrete Hardener

**by**

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## EXECUTIVE SUMMARY:

As background for the reader, the aggregate contained in concrete provides both strength and abrasion resistance in a finished floor. The cement paste matrix binds the aggregate in place. The Surtreat TPS treatment reacts with the cement paste, to resist accelerated exposure of the aggregate. Abrasion resistance testing on four inch Portland Cement Concrete (PCC) cores obtained from the Municipal Solid Waste Facility in Concord, NH was performed in accordance with ASTM C 944-99: *Standard Test Method for Abrasion Resistance of Concrete or Mortar Surfaces by the Rotating-Cutter Method.* Testing was done on nine concrete samples that were tested without and with the treatment of a unique concrete treatment system manufactured by Surtreat. Testing data were compared to find the ability of the Surtreat concrete treatment to penetrate a mature concrete surface and protect the surface from abrasive forces. It was determined that concretes treated with only a single Surtreat application showed an increase in hardness by approximately fifty percent when compared to the identical untreated concretes. The use of the Surtreat treatment produces a higher quality, more durable concrete surface when compared to no treatment and its use is recommended for use as a concrete surface hardener of new and existing Municipal Solid Waste Facilities and other related industries requiring higher performance and longer life of their concrete surfaces.

## INTRODUCTION:

The refuse receiving areas of Municipal Solid Waste facilities (MSW") are typically constructed with Portland Cement Concrete ("PCC") floors. These floors are exposed to many harsh substances and forces that cause surface deterioration in the form of acid decomposition, sulfate attack, corrosion of the reinforcement, carbonation and ultimate surface abrasion. This leads to aggregate exposure and the breakdown of the cement paste matrix which results in the decreased load carrying capability and reduced service life of the floor slab. To avoid these problems synthetic treatments are available to improve PCC surface characteristics. This study investigates the ability of one such treatment, Surtreat TPS, to improve the resistance of an industrial PCC floor to physical attack mechanisms.

The MSW Incineration Facility, in Concord New Hampshire, utilizes an industrial PCC floor in the waste receiving area, or tipping floor, where the waste is inventoried and inspected prior to being incinerated. The floor system is exposed to chemical attack from both the waste that comes in contact with the PCC surface and chlorides from winter road deicing. This is compounded with the physical abrasion caused by unloading the waste from trucks, tire forces from trash truck movements and the front-end loader bucket when the waste is transferred from the floor to the pit, which together results in reduced service life and increased maintenance and replacement cost.

PROCEDURE:

Treated and untreated concrete cores were obtained from the MSW waste-receiving floor with a four-inch water-cooled diamond core barrel at various locations. Figure 1 shows the coring apparatus used to obtain the cores. The Surtreat was applied to high traffic floor sections of the tipping floor on April 29, 2002. Samples were taken on August 29th 2002. Observation of treated and untreated areas as shown by Figures 2 and 3 indicates decreased surface wear on the treated surfaces. Such observations are anecdotal and do not take into account the different concretes at the facility that had been placed in different manners and times. The sampling and testing was impacted by uneven usage patterns of the treated concrete surface as well as by the presence of several different concretes.

Figure 1: Coring the concrete tipping floor

Treated

Untreated

Figure 2: Overview of treated and untreated tipping floor areas cored

Treated

Untreated

Figure 3:  Close up view of the treated and untreated tipping floor concrete

To take advantage of having obtained cores from treated and untreated concretes that had actually been in service in an MSW facility and to put the proposed treatment to the ultimate challenge it was decided to test the bottoms of all the concretes before and after treating with the hardener. This procedure under controlled conditions was effective in obtaining additional data to evaluate the hardening properties of the Surtreat system. The testing procedure was as follows:

1. Cut both ends of the concrete cylinder to obtain square faces as shown in Figure 4 below.

Figure 4: Concrete cutting saw cutting sample 1

2. Determine the mass of the specimen to the nearest 0.1 gram.

3. Fasten the specimen securely in the abrasion device so that the bottom face of the concrete cylinder is placed upwards and normal to the drill press shaft as shown in Figure 5.

4. Mount the special rotating cutter device in the drill press shaft.

5. Start the motor and lower the cutter slowly until just in contact with the surface of the concrete cylinder.

6. Continue abrasion with a normal load on the specimen for two minutes after contact between the cutter and the surface. At the end of each two-minute abrasion period, remove the test specimen from the device and clean surfaces with air. Determine the specimen mass to the nearest 0.1 gram. The minimum test schedule as per ASTM requires three two-minute periods conducted with a thrust force of 22 pounds on three separate areas of representative surfaces of the specimen being tested.

Figure 5:  Sample secure and normal to drill press shaft

7. Additional testing may be required for concrete that is highly resistant to abrasion testing.  Doubling the applied time should provide more comprehensive information on such concrete

Note:  For this testing the abrasive testing cycles were run five times for each sample do to abrasive resistant concrete

This testing procedure was first done on the nine untreated concrete cylinders.  To test the nine cylinders with treatment the cylinders were cut again, to take off the grooving that had resulted from the previous testing of the untreated samples, and make a smooth testing surface.  Figure 6 shows typical grooving on a samples surface after abrasion testing has been completed.


Figure 6:   Abrasion surface grooving of sample 1

The abrasion inhibiting surface treatment was then applied, as per specification by manufacturer, and allowed to sit over night in a dry laboratory at room temperature. The abrasive testing was done on the treated samples following procedure 2 through 7. All testing was run for five cycles of two minutes with a 22 lb axial thrust load normal to the drill press shaft, which connected with the abrasive cutting blade mechanism.

RESULTS:

Each concrete cylinder sample was tested in the untreated and treated state so comparable data could be observed as to whether or not the surface treatment resulted in better abrasive resistance characteristics as observed anecdotally. The nine samples were individually compared and an overall averaged comparison was made between untreated and treated samples. All cases showed the treated concrete surface had higher resistance to abrasion deterioration.

Samples one through nine all show the benefit of treating the concrete with the hardener. There is an unquestionable improvement in abrasion resistance, validating the anecdotal observations. Individual graphs comparing untreated and treated results are presented in the appendices. The individual data were averaged so as to show the general trends of treating the different concretes. These data are presented in figure 7.

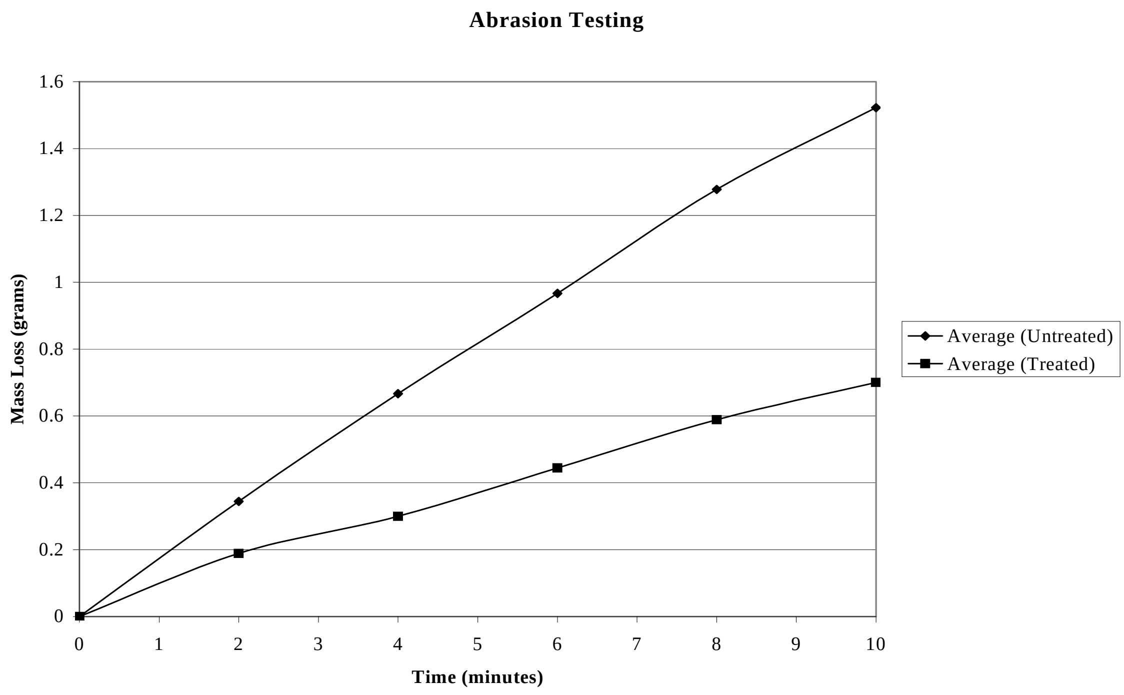



Figure 7: Average abrasion testing data

These data show an approximate fifty percent reduction in abrasion loss as the direct result of treating the surfaces of the concretes.

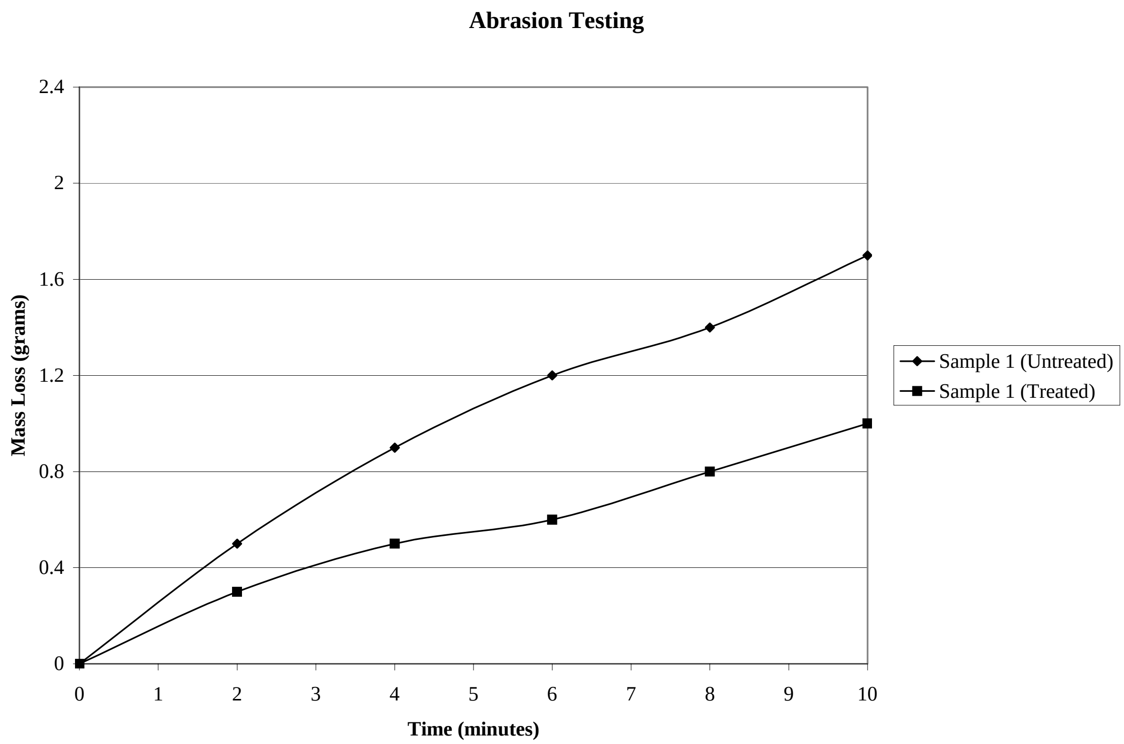
CONCLUSIONS:

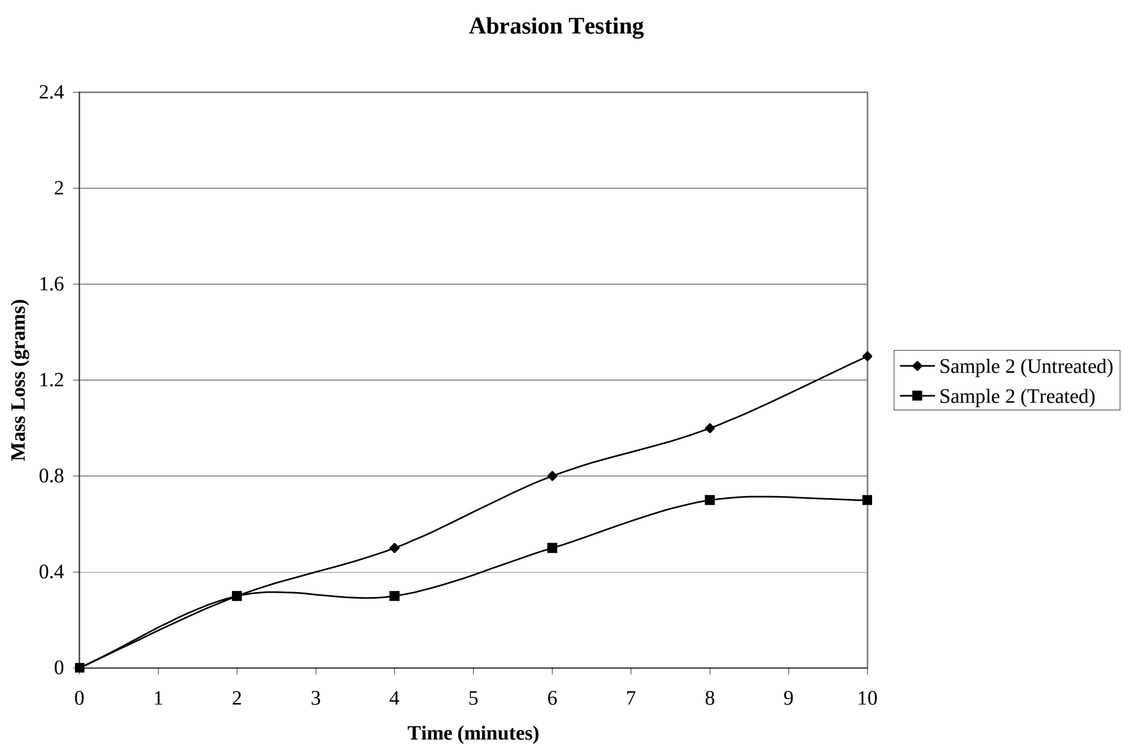
It was observed that concrete treated with Surtreat showed twice the resistance to abrasive forces than untreated concrete. Individual samples showed losses of mass were one to five times greater in untreated samples than in samples treated with Surtreat. Such improvement would be expected to increase the service life of MSW and related industrial floors. The material also would be expected to have a major affect on lowering the permeability of the concrete, which would result in major improvements in many physical properties such as chemical resistance to acids and sulfates.

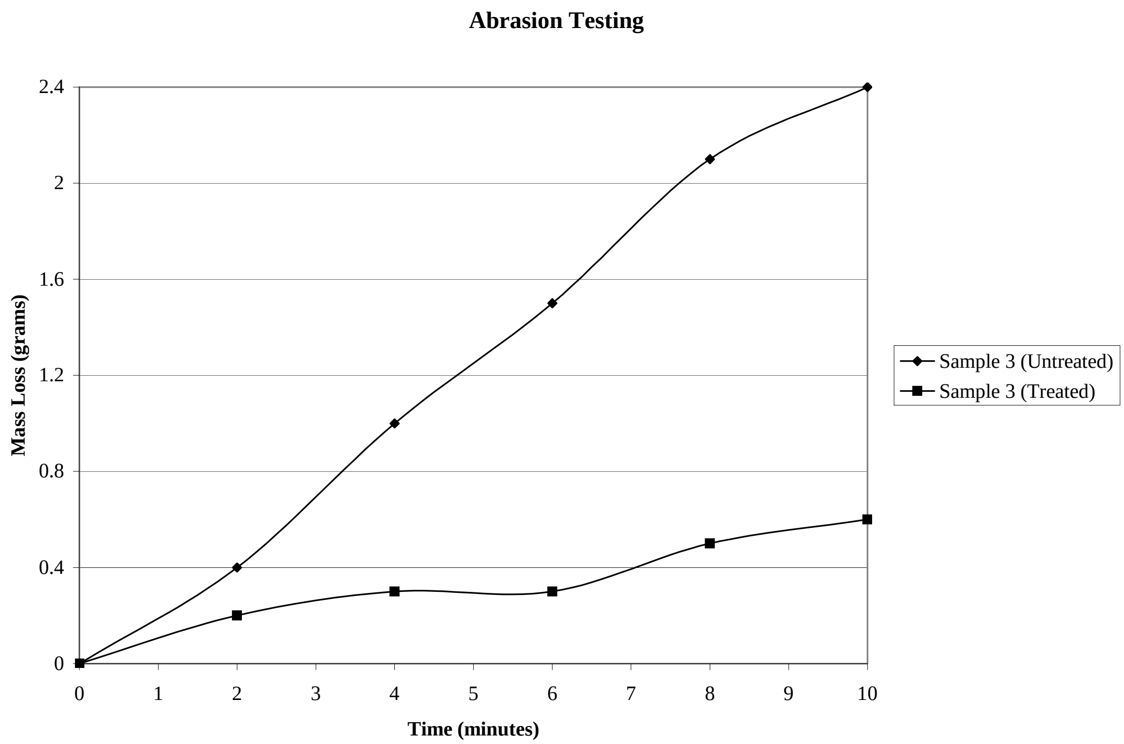
RECOMMENDATIONS:

It is recommended that consideration be given to specifying Surtreat for future industrial floor projects to achieve extended service life and overall lowered maintenance and replacement costs.

# Appendix


Abrasion Testing
2.4
2
1.6
1.2
0.8
0.4
0
Mass Loss (grams)
0
1
2
3
4
5
6
7
8
9
10
Time (minutes)
Sample 1 (Untreated)
Sample 1 (Treated)


Abrasion Testing
2.4
2
1.6
1.2
0.8
0.4
0
Mass Loss (grams)
0
1
2
3
4
5
6
7
8
9
10
Time (minutes)
Sample 2 (Untreated)
Sample 2 (Treated)



Abrasion Testing
Mass Loss (grams)
2.4
2
1.6
1.2
0.8
0.4
0
0
1
2
3
4
5
6
7
8
9
10
Time (minutes)
Sample 3 (Untreated)
Sample 3 (Treated)