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RE: ASTM D6433-11 INSPECTION STUDY – REQUARTH RD, DARKE COUNTY

SUMMARY

Approximately 1 ½ miles of Requarth Road from Greenville East Corporation Limit to St. Johns Road was paved in 2004 with ¾" 402 Base Asphalt and ¾" 404 Surface Mix. After paving, a ½ mile section from Greenville East Corporation Limit to Jaysville St. was treated with Biorestor, while the remaining pavement was not. The purpose of this study was to determine the Pavement Condition Index (PCI) for the treated and non-treated sections of Requarth Road through the ASTM D6433-11 inspection process and MicroPAVER™ pavement management system (PMS).

ABOUT JG3 CONSULTING

President and CEO James Golden founded JG3 CONSULTING, LLC. (JG3) after 16 years of extensive pavement management and MicroPAVER experience, providing implementation services to private, city, state, township and airport organizations throughout the United Sates. JG3 specializes in all facets of the MicroPAVER pavement management system and ASTM D6433-11 inspection process with 100% of our daily business operations occurring in the field of pavement management.

ASTM D6433-11

The PCI is a numerical indicator based on a scale of 0 – 100 where 0 is considered "failed" condition and 100 considered "excellent" condition that rates the surface condition of the pavement. The PCI provides a measure of the present condition of the pavement based on the distress observed on the surface of the pavement, which also indicates the structural integrity and surface operational condition (localized roughness and safety). The PCI cannot measure structural capacity nor does it provide direct measurement of skid resistance or roughness. It provides an objective and rational basis for determining maintenance and repair needs and priorities. Continuous monitoring of the PCI is used to establish the rate of pavement deterioration, which permits early identification of major rehabilitation needs. The PCI provides feedback on pavement performance for validation or improvement of current pavement design and maintenance procedures. A breakdown of the 7 condition categories and PCI limits is listed below:

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CONDITION CATEGORY	PCI RANGE
Excellent	92 - 100
Very Good	82 - 91
Good	68 - 81
Fair	50 - 67
Poor	35 - 49
Very Poor	20 - 34
Failed	0-19

PCI is generated by inspecting 2500 sf sample locations within a pavement section, documenting the distress type, severity level and quantity. Results are entered into the MicroPAVER™ (PMS) to determine the pavement section's PCI rating. The number of total sample units is determined by dividing the total section area/sample location area (2500 sf). From here, the minimum samples to inspect to follow ASTM D6433-11 can be found by referencing the table below:

TOTAL # OF SAMPLE UNITS IN SECTION	MINIMUM # OF SAMPLE UNITS TO INSPECT
1 - 5	1
6 - 10	2
11 - 15	3
16 - 40	4
OVER 40	10% OF TOTAL SMAPLES

There are 20 possible distresses for asphalt based surface types as indicated below:

1. Alligator Cracking
2. Bleeding
3. Block Cracking
4. Bumps & Sags
5. Corrugation

16. Depression
17. Edge Cracking
18. Joint Reflection
19. Lane/Shoulder Drop
20. L&T Cracking

11. Patching
12. Polished Aggregate
13. Potholes
14. Railroad Crossing
15. Rutting

6. Shoving
7. Slippage Cracking
8. Swell
9. Raveling
10. Weathering

STUDY RESULTS

Requarth Road was split into 2 pavement sections for this study:

- Section 01 from Greenville East Corp Limit to Jaysville St, 2548' in length and treated with Biorestor.
- Section 02 from Jaysville St. to St Johns Rd., 5306' in length and not treated with Biorestor.

It was determined that Section 1 (Treated with Biorestor) had 24 total possible sample units, referencing the table above (4) 2500 sf samples were inspected. After following the ASTM inspection process it was the determined that the calculated PCI rating was a 61, ranking in the "Fair" condition category. A complete breakdown of extrapolated distress type, severity and quantity as well as % of load and climate associated distress is indicated from the calculated PCI screen shot within the MicroPAVER™ PMS below:

The Following image represents the results of the PCI study done on the same section in 2014 vs 2011:

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2011 ASSESSMENT RESULTS - TREATED WITH BIORESTOR

75 PCI in 2011

2014 ASSESSMENT RESULTS – TREATED WITH BIORESTOR

61 PCI in 2014

In comparing the 2 inspection years, the PCI has dropped a total of 14 points since 2011 and is now within the Fair Category.

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It was determined that Section 2 (Not Treated with Biorestor) had 24 total possible sample units. After following the ASTM inspection process it was the determined that the calculated PCI rating was a 53, ranking in the "Fair" condition category. A complete breakdown of extrapolated distress type, severity and quantity as well as % of load and climate associated distress is indicated from the calculated PCI screen shot within below:

2011 ASSESSMENT RESULTS – NOT TREATED WITH BIORESTOR

2014 ASSESSMENT RESULTS – NOT TREATED WITH BIORESTOR

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In comparing the 2 inspection years for section 2, the PCI has dropped a total of 11 points since 2011 and is now within the Fair Category.

DIGITAL IMAGES

Treated:

Image clearly shows lighter weathering, longitudinal cracking and alligator cracking

Not Treated:

Image clearly shows accelerated weathering, further defined and development of longitudinal cracking and alligator cracking

CONCLUSION

In comparing the two pavement sections through the ASTM PCI evaluation it has been determined that the section treated with Biorestor is at a slower rate of deterioration vs. the section that was not treated. The PCI difference between these two sections is currently 8 PCI points. When looking at rates of deterioration, the section treated with Biorestor is now dropping on average just 3.9 points per year while the non-treated section is at a 4.7 PCI point drop per year. Furthermore, we can see that the load associated distress on the non-treated section is accounting for 82% of the total distress while the treated section is at just 67%.

In comparing the two sections (treated vs untreated) we can see that section 1 is just now in the Fair condition category which is where section 2 (un-treated) was 3 years ago. The section treated with Biorestor also yielded less longitudinal cracking and paving separation/cracking compared to the untreated section. This is proof that over a 10 year period the Biorestor treatment has provided an additional 2-3 years of extended life.
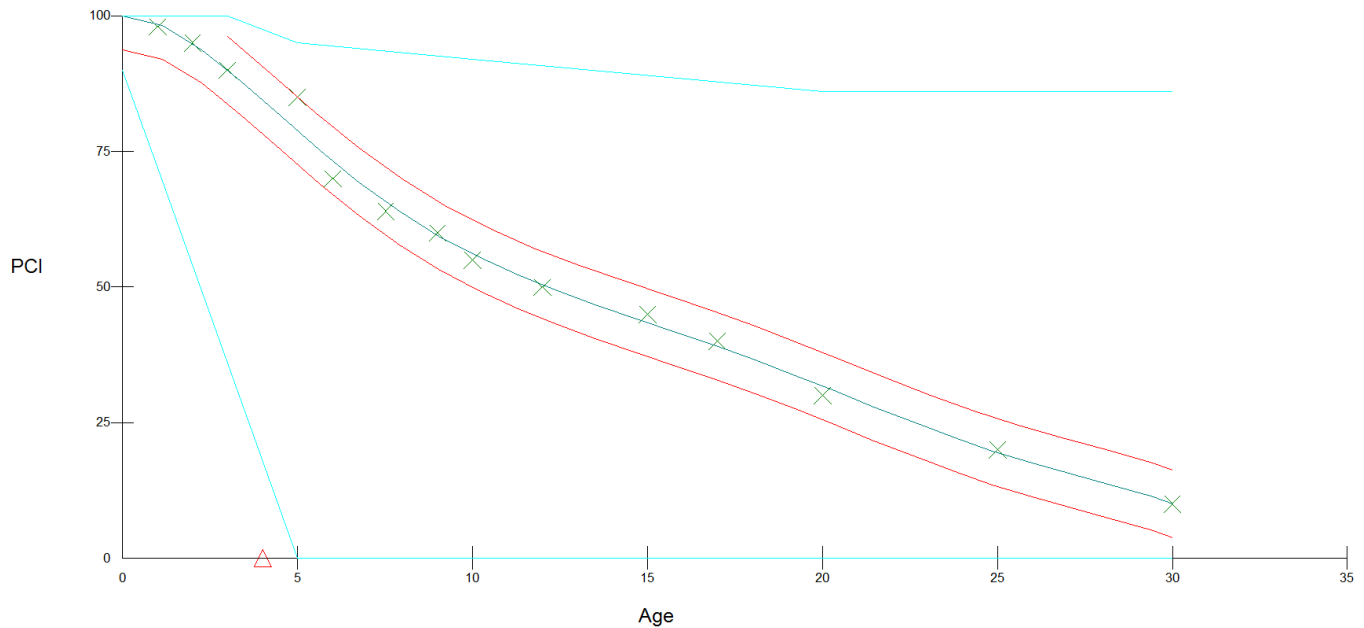
The following deterioration curves were developed based on pavement age, maintenance and inspection data to show performance/life expectancy of the treated vs. non-treated sections:

TREATED
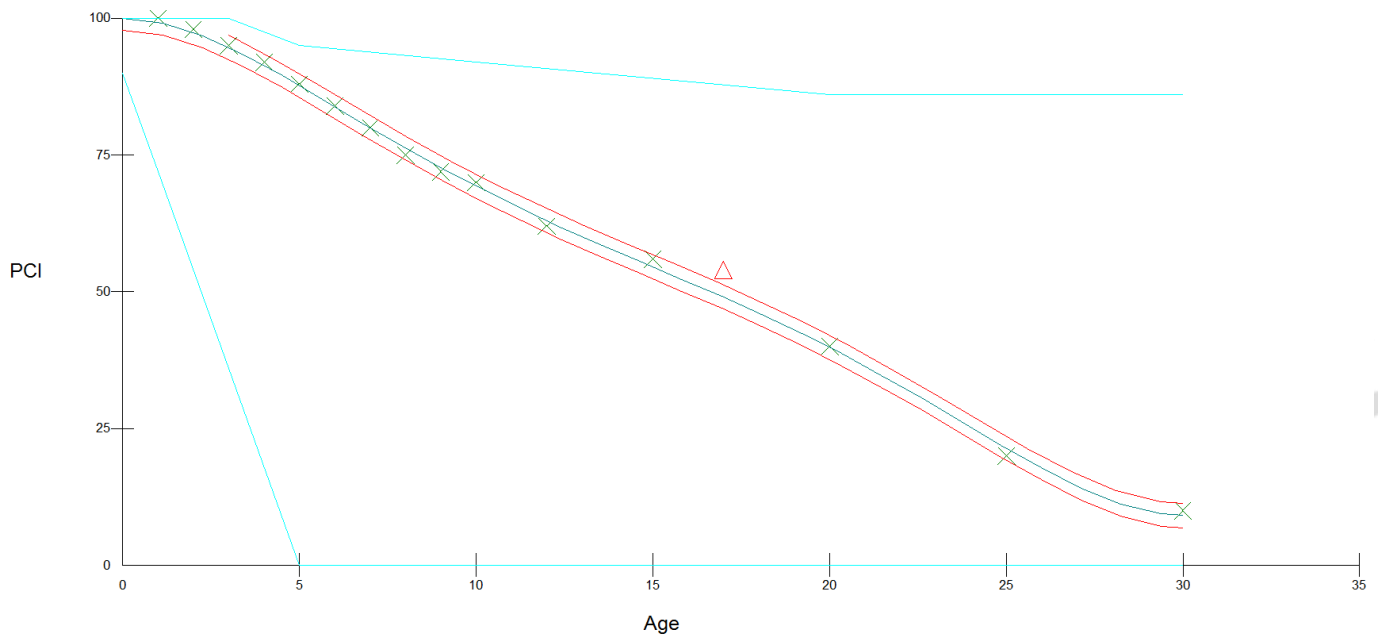
NOT TREATED

The percentage of load associated distress and climate related distress within each pavement section were very similar, however the severity levels and quantities were higher in the section not treated. Looking at Alligator cracking, a load associated distress, ASTM D6433-11 defines it as follows:

Alligator or fatigue cracking is a series of interconnecting cracks caused by fatigue failure of the asphalt concrete surface under repeated traffic loading. Cracking begins at the bottom of the asphalt surface (or stabilized base) where tensile stress and strain are highest under a wheel load. The cracks propagate to the surface initially as a series of parallel longitudinal cracks. After repeated traffic loading, the cracks connect, forming many sided, sharp-angled pieces that develop a pattern resembling chicken wire or the skin of an alligator. The pieces are generally less than 0.5m (1.5 ft) on the longest side. Alligator cracking occurs only in areas subjected to repeated traffic loading, such as wheel paths.

In the case of the treated section, alligator was just beginning to develop as fine hair line thin cracks located within the wheel paths of the section, and occurring in a start/stop pattern. In the non-treated section, these cracks were beginning to open approximately ¼" in width with a network pattern developing moving from the light severity level to the medium severity level. Because alligator cracking is a load associated distress it has a high deduct value highly contributing to the 8 point difference in PCI between the treated and non-treated sections.

Another contributor to the 8 point PCI difference can be found with the climate related distress weathering. ASTM D6433-11 defines weathering as follows:

The wearing away of the asphalt binder and fine aggregate matrix. As used herein, coarse aggregate refers to predominant coarse aggregate size of the asphalt mix. Surface wear is normally caused by oxidation, inadequate compaction, insufficient asphalt content, excessive natural sand, surface water erosion, and traffic. Weathering occurs faster in areas with high solar radiation.

Both treated and non-treated sections indicate weathering, however the PCI study shows a significantly higher acceleration of this distress by approximately 25%.

Based on my experience with asphalt based surface types, rates of deterioration and the ASTM inspection methodology, it is clearly evident that the product Biorestor inhibits the oxidation process while providing for increased flexibility and a longer lifespan of pavements treated after paving.

James Golden
President

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