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Preventive Maintenance – Part 2 Types of Treatments

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This is the second part in a three part series about preventive maintenance for pavements. We practice preventive maintenance in our everyday lives and possibly with municipal equipment such as dump trucks and backhoes, but when it comes to maintaining our roadways, most agencies will always defer repairs until the pavements have failed, resulting in very expensive repairs. This part will discuss the different preventive maintenance techniques that are available.

PM Alternatives

There are many different types of preventive maintenance treatments available that include techniques such as sand seals and fog seals. This article will be limited to a discussion of the four most common types of treatments in the Mid-Atlantic region:

- | | |
|--------------------|-----------------|
| 1. Chip Seals | 2. Slurry Seals |
| 3. Micro-Surfacing | 4. NovaChip |

1. Chip Seal

A chip seal is commonly referred to as “tar and chip” or “oil and chip.” In the past, this had been by far the most popular surface treatment used in Delaware, especially below the C&D canal. However, due to changes in the type of asphalt binding agent which has negatively affected the performance of chip seals plus the fact that more “city folk” who want “higher quality” road surfaces are moving to lower Delaware, the popularity of chip seals has decreased considerably. Chip Seals can still be a cost-effective treatment if properly designed and constructed.

Materials

The basic components of a chip seal are asphalt emulsion and aggregate. The emulsion acts as a binding agent (glue) that holds the aggregate to the pavement surface. Typically, the aggregate is uniform in size with minimal fines. The stone should be placed in a single thickness. For example, if one quarter inch stone is used, the layer should be one-quarter inch thick. Actually, multiple stone thicknesses will actually reduce the quality of the treatment. If a thicker surface is desired, a second application of chip seal should be performed (referred to as a double application). The stone size for the second layer should be smaller than the first layer so that it can “nest” in between the stones in the first layer to provide for better stability.



Figure 1 – Stone Chips embedded in the Emulsion – Single Stone Thickness

Applications

Chip seals are used to place a new surface on aged pavements to slow down the oxidation process and to seal out water.

Application Techniques

Asphalt emulsion is applied to the pavement surface using a distributor truck with a spray bar. After the emulsion is applied, it is immediately covered with a layer of aggregate. The aggregate is then immediately embedded in the asphalt emulsion before the emulsion breaks. This should be accomplished by a pneumatic-tired (rubber) roller. Timing is imperative, each step in the process should occur within 30 to 45 seconds after the previous step. Sweeping is typically required to remove loose stone. This should be done carefully to minimize damage to

the new chip seal. Depending upon the quality of the application, two or more sweepings may be necessary over the next few months.



Figure 2 – Asphalt Distributor Truck

Common Problems

The three main reasons that people are dissatisfied with chip seals:

1. Poor construction techniques. A good chip seal does not happen by accident. Although chip seals appear to be simple to construct, there are many factors that can affect how well a chip seal will perform. If the chip seal is not properly constructed, it will not perform as expected.
2. Improper application. In situations where the road serves heavy duty traffic, has extensive bleeding or if the existing pavement has significant structural damage, a chip seal should probably not be used.
3. Unrealistic expectations. The purpose of a chip seal is seal the surface and to improve the anti-skid qualities of the pavement. It will not provide structural improvement or correct uneven surfaces.

2. Slurry Seals

A predecessor to micro-surfacing, slurry seals were first used in the 1930's in Germany. Different from chip seals, the asphalt



emulsion and fine aggregates are applied to the surface at the same time. This is because the aggregate and emulsion are mixed together to create a slurry-like mixture.

Materials

Although there are modified slurry mixtures, the basic slurry seal consists of fine aggregate and emulsified asphalt. The emulsion serves as a binder material that glues the aggregates together. Because unmodified (or straight) emulsions do not provide some of the positive benefits such as improved bonding and curing characteristics that micro-surfacing enjoys, modified emulsions are starting to be specified for use in slurry seals.

Application Techniques

The slurry mixture is made and applied to the road surface using a mobile mixing unit similar to the micro-surfacing unit. The machine contains several compartments that store the aggregate, emulsion, water. All the ingredients are carefully metered to assure that the proper quantities are mixed together. The materials are mixed together in a pug mill while the machine is traveling down the road. The material is placed using a “one-stone” thickness.



Figure 3- Slurry Surfacing Truck

Applications

Slurry seals are mainly used to seal the surface of aged pavements to slow down the

oxidation process and to seal out water. Since it is only one stone thick, similar to chip seals, this technique cannot be used to fill small depressions. It will reflect any irregularities in the existing surface.

3. Micro-Surfacing

Probably the most versatile of all the different types of surface treatments available, micro-surfacing can be a cost-effective maintenance solution to a wide variety of maintenance problems. Micro-surfacing is basically a “high-tech” slurry seal that starts with the same ingredients as a slurry seal, however, higher quality materials are used.

Micro-surfacing was developed in the late 1960’s and early 1970’s by German scientists trying to fill narrow ruts on the Autobahn by using multiple layers of traditional slurry seals. Through experiments, the scientists found that using high quality materials, polymers and other special additives allowed the modified mixture to be applied much thicker than conventional slurry seals. Also, the new mixture had better performance characteristics. Today, micro-surfacing is used for a variety of reasons on a broad range of pavements such as low volume residential streets, high volume interstates, and runways for airports in many parts of the world including the United States, Europe and Australia.

Materials

The composition of micro-surfacing consists of aggregate, polymer-modified asphalt emulsion, water, mineral filler and other additives that are carefully mixed together. Polymer additives are used to increase the stiffness of the mix and improve the adhesion of the binder while reducing the temperature susceptibility. By reducing the temperature susceptibility of the binder, it can resist higher temperatures in



the summer (before it softens) and resist lower temperatures in the winter (before it cracks). Mineral fillers such as portland cement are used to reduce aggregate segregation and to help control the rate at which the mixture breaks.

Application Techniques

The modified slurry mixture is made and applied to the road surface using a mobile mixing unit that is specially designed for micro-surfacing (see Figures 2 and 3). The machine contains several compartments that store the aggregate, mineral filler, emulsion, water and additives. All the ingredients are carefully metered to assure that the proper quantities are mixed together. The materials are mixed together in a pug mill with dual shafts while the machine is traveling down the road. The mixed material then flows into a spreader box and is applied in a thin layer, typically at an application rate of 20 to 25 pounds per square yard.



Figure 4 - Micro-Surfacing Machine

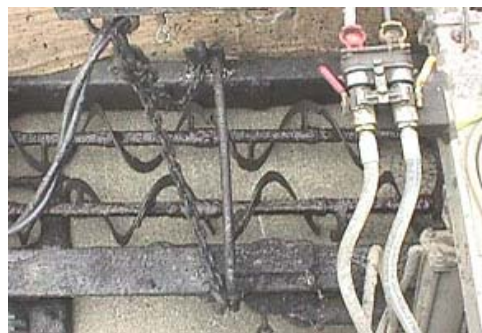


Figure 5 – Special Spreader Box

For pavements with depressions, a scratch coat is applied to fill in the low spots. This is accomplished by using a steel strike-off box that is set to make contact with the high points on the road surface. The scratch coat should be allowed to properly cure before a second layer is applied. Areas with excessive depressions may require a hot mix asphalt scratch coat be placed.

In order to prevent premature breaking in hot weather, the pavement should be pre-wetted using a spray bar placed in front of the spreader box. The water also serves as a lubricant that helps the slurry-like mixture to be spread more easily onto the road surface.

Applications

Much like other surface treatments, the main use of micro-surfacing is to seal the surface of aged pavements to slow down the oxidation process and to seal out water. As stated above, micro-surfacing was developed for rutting on the Autobahn. As such, micro-surfacing is an excellent rut filling material in many situations. Since micro-surfacing is very impermeable, in many cases, it will provide excellent performance as a surface coat placed on asphalt or chip sealed pavements that are experiencing severe levels of bleeding (or flushing). Additionally, micro-surfacing provides excellent skid resistance.

Curing Process

Unlike other types of paving materials, micro-surfacing cures through an electro-chemical process which ejects the water from the slurry mixture. Since the micro-surfacing hardens through a curing process (similar to concrete), it does not require compaction. This is a great benefit because compaction problems seem to plague many other road maintenance techniques.



4. NovaChip®

NovaChip is the most high tech of the surface treatments. Initially developed in France during the mid-1980's and widely used throughout Europe, it was brought to the United States in the early 1990's. NovaChip is an ultra-thin hot mix asphalt paving process that places a thin layer of open-graded hot mix over a special asphalt membrane.

Materials

NovaChip consists of a polymer modified asphalt emulsion, open graded aggregate and a special asphalt membrane called NovaBond. The open graded aggregate means that there are very few fines, and as such, has many more voids in the aggregate structure. Also, the aggregate must be of high quality that is wear resistant and provide a high level of skid resistance. The binding agent is a polymer modified asphalt cement that provides excellent strength and flexibility to the material. NovaBond is a polymer modified emulsion that provides excellent bonding to the existing surface, when exposed to the hot mix asphalt, it expands and creates a membrane that seals the surface.

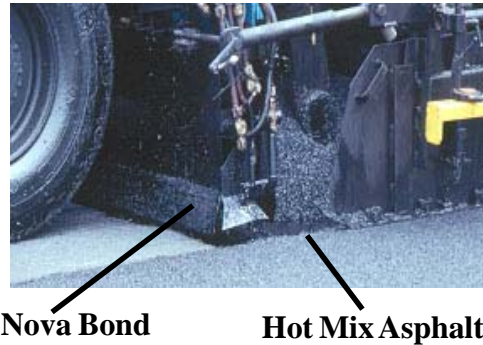


Figure 6 - NovaPaver

Application Technique

NovaChip is applied with a specially designed paving machine referred to as a NovaPaver. The paver is similar to a hot mix paver in that it has a receiving hopper, augers and a vibratory screed. Additionally, the paver contains a large emulsion tank and has a spray bar placed directly in front of the paving screed that applies that NovaBond tack coat just before the hot mix asphalt is placed on the surface. This location ensures that the

NovaBond is not damaged prior to placement of the asphalt.



Nova Bond

Hot Mix Asphalt

Figure 7 – NovaBond applied directly in front of the Paver Screed

Applications

Unlike other open-graded materials, the NovaBond asphalt membrane seals the surface. Additionally, NovaChip will fill in minor depressions in the surface, similar to micro-surfacing. However, unlike any other surface treatment, the open-graded aggregate structure of NovaChip will reduce truck spray and hydroplaning.

Emulsified Asphalt

Emulsified asphalt is liquefied asphalt that is produced by breaking the asphalt cement into very small droplets with a high-speed, high-shear mechanical device and mixing it with an emulsifying agent.

The emulsifying agent keeps the asphalt droplets dispersed in the water until the emulsion is used. When the emulsion is applied to a road surface, it starts to cure (harden) as the water evaporates.

The curing process allows the emulsion to revert back to asphalt cement regaining all its characteristics including adhesion (binding action) and water-resistance. As a result of the emulsion curing, the asphalt separates from the water and forms a continuous film which adheres to the road surface.

Polymer Modified Emulsion

An asphalt emulsion that is modified with a styrene block copolymer or natural latex in order to improve the performance of the emulsion



12th Annual Roadway Management Conference

Set for the University of Delaware

Delaware will host the 12th Annual Roadway Management Conference on March 22-24, 2004 at Clayton Hall on the University of Delaware campus in Newark. This conference is sponsored by the T² Centers in DE, MD, PA, VA, and WV. We expect more than 300 participants from all levels of government, consultants, and suppliers.

Each Roadway Management Conference deals with issues that you face every day. Here is a sampling of the sessions we will present:

- **Better Communications**
- **Innovative Equipment and Purchasing**
- **Work Zone Safety**
- **Sign, signal, and pavement marking changes required by the new MUTCD**
- **Pavement Reclaiming and Recycling**
- **Chainsaw Safety**
- **No Risk Roads**
- **Roadway Safety Best Practices**
- **Winter Maintenance**
- **Intersection Safety**
- **Preventative Maintenance**
- **Email Etiquette**

We will start one new feature this year: a bus tour of construction and maintenance projects underway in northern Delaware. This will take the place of on-site demonstrations we have done in the past. We will have about 30 vendors displaying their products at Clayton Hall.

Alan Kercher, Delaware T² Consultant, will be a speaker at the conference as will George Ostensen, Associate Administrator for Safety at the Federal Highway Administration. Mr. Ostensen spent two tours of duty at the Delaware FHWA office in Dover earlier in his career.

We have set the conference fee at \$150. It includes all sessions, the bus tour, a reception, and other meals. Those in most of Delaware and surrounding counties in Maryland, Pennsylvania, and New Jersey can save hotel expenses by making day trips to Clayton Hall.

You will receive a detailed conference announcement in early February 2004.



Calendar of Events

T² Center Events

1. Alkali Silica Reactivity Workshop - January 30, 2004, Del Tech, Dover
2. Geometric/Traffic Operations Workshop - February 23-26, 2004, Del Tech, Dover
3. Project Management Workshop -February 27, 2004, Perkins Student Center - U of D, Newark
4. Equipment Maintenance Management System (MEMS) - March 9, 2004, Del Tech, Dover
5. Roadway Management Conference - March 22-24, 2004, Clayton Hall - Newark, DE
(see related article)

University of Delaware Engineering Outreach Courses

1. Ground Improvement Technologies and Systems - January 22-23, 2004
2. Mechanically Stabilized Earth Walls and Reinforced Soil Slopes - February 19-21, 2004
3. Slopes and Embankments - April 1-3, 2004.

For more information on Engineering Outreach courses, go to www.engr.udel.edu/outreach.

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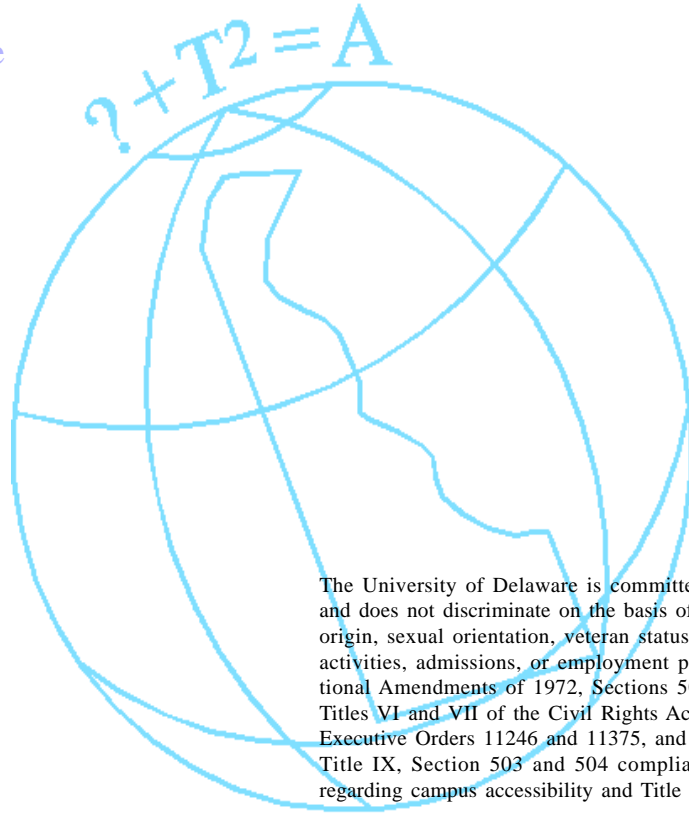
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Delaware T² Center

The Technology Transfer (T²) Program is a nationwide effort financed jointly by the Federal Highway Administration and individual state departments of transportation. Its purpose is to interchange the latest state-of-the-art technology into terms understood by local and state highway or transportation personnel.

The Delaware T² Center Travel-Log is published semi-annually by the Delaware Technology Transfer Center at the University of Delaware. T² Center articles also appear semi-annually in the TransSearch - the newsletter of the Delaware Center for Transportation. Any opinions, findings conclusions or recommendations presented in this newsletter are those of the authors and do not necessarily reflect views of the University of Delaware, Delaware Department of Transportation, or the Federal Highway Administration. Any product mentioned in the newsletter is for information purposes only and should not be considered a product endorsement.

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