# Tech Topic

# Flexible Pavement Maintenance and Repair Techniques

Maintenance and repair of flexible pavements can take a number of basic forms and still other variants on those basic themes. This brief introduction is intended as an overview of the techniques that are more typically used in the Delaware region. The reader will detect a recurring theme – the more early and often pavement preservation and maintenance techniques are applied, the lower the life cycle costs for a given pavement section will be and roadway users will be happier because of it. These brief descriptions are intended only to raise awareness for those not immersed in the transportation field; a plethora of information is available from Internet sites for Federal Highway Administration, state departments of transportation, research universities, and professional organizations specialized in these transportation areas.

## Pavement Preservation

Crack Sealing. Rubberized asphalt materials are used to fill cracks that develop in pavement. Crack sealing is appropriate for a broad range of cracks, including centerline and other longitudinal cracks, random cracking, low severity block cracking, and transverse cracking, but is not suitable for high severity cracking such as alligator cracking, which is usually associated with structural deficiencies that crack sealing cannot address. A successful crack seal requires that the crack be free of loose material (usually it is cleaned with compressed air) and dry. Best performance will result from warm weather application.

Figure 1 Crack sealing after several years

Seal Coats and Fog Coats. These types of light applications are somewhat similar to seal coats that are applied to driveways and are suitable only for low volume roads that can be closed to traffic for several hours while the material dries and cures. The benefit of these applications is to minimize water intrusion in pavements that are relatively crack-free and to rejuvenate older pavements that may have oxidized. Care must be taken to avoid the creation of a slick surface that will promote skidding or sliding; sand is sometimes spread lightly before the material dries to create a more skid resistant surface.

Ultra-Thin Lift Hot Mix Overlays. This overlay of typically one inch or less is perhaps the highest form of pavement preservation and is suitable when the pavement is free of structural issues and alligator cracking but has a high degree of other cracking. The intent is to protect the underlying surface material, reduce water intrusion, correct some surface irregularities, and generally extend the pavement life. Their small thickness will allow them to flex more than a typical hot mix layer and its success depends even more than normal on both the design and construction of the material.

# Maintenance and General Repair

Figure 2  Pothole or distress patching

Pothole Patching.  Maintenance patching is usually associated with minor, localized potholes or utility trenches.  In the case of potholes, the repair is typically limited to removal and replacement of the asphalt; if underlying structural problems have developed, a full-depth repair is necessary (see below).  Otherwise, “throw and go” or “throw and roll” techniques are quite often used for surface defects and their effectiveness is predictably poor in terms of longevity.  Significantly greater effectiveness usually results when the area is saw cut, the degraded asphalt and any loose material is removed, the edge of the existing asphalt is treated with tack as a binding material, good quality hot mix asphalt is placed in the saw cut area with a minimum of handling (which segregates asphalt binder and the aggregate), and the area is compacted with at least a plate tamper (preferably a small drum roller).

Utility Trench Patching.  Utility trenches need not create the classic dip or hump most of us are familiar with.  Best construction practices dictate that utility trenches be backfilled free of standing water, with good quality fill in small (usually 8”) lifts that are thoroughly compacted.  Existing hot mix should be cut back from the edge of the trench at least a few inches to stagger the trench joint with the asphalt joint.  As with pothole repair, the edge of the existing asphalt should be tacked and a good quality asphalt should be placed with a minimum of handling and compacted with (preferably) a drum roller.

Chip Seals.  Some call this tar and chip, but that term is more appropriate for old, ineffective techniques involving very little quality control.  Experienced chip seal teams with updated equipment can achieve a surface application that provides protection for an aging asphalt pavement while providing a superior skid resistant surface.  Most often, chip sealing is applied to lower volume, lower speed roads, but proper application is not limited to those circumstances.  A specialized asphaltic binder is applied to the existing dry surface (after sweeping) with a distributor truck adjusted to apply a uniform coating at a specific rate per square yard (often 0.55-0.65 gal/yd$^2$.  Immediately following the distributor truck, a specialized machine called a chip spreader applies a uniform layer of small stone (⅜” typically), again, at a specific rate per square yard (e.g., 14-18 #/SY).  Following close behind the chip spreader, one or more pneumatic (rubber tired) rollers orient and set the chips into the

Figure 3  Finished chip seal on the left, oxidized pavement in the center and hot mix widening on the right, both ready to receive chip seal

asphaltic binder. The binder is usually an emulsion that requires a small amount of time (as little as 20 minutes to perhaps an hour or two, depending upon the weather) to "break" (the process in the curing of an asphalt emulsion by which the globules of asphalt becomes separated from the water; the color of the material will change from brown to black at this point).

Figure 4 Slurry Seal

Slurry Seals. This surface treatment is often used over chip seals but can be used on older asphalt pavements or other surfaces also. It is a homogeneous mixture of emulsified asphalt, water, well-graded fine aggregate, and mineral filler with a creamy, fluid-like appearance. These components are usually mixed in a specialized truck body and transferred to a spreader box that augers the material evenly and thinly across the surface. Slurry seals do not increase the structural strength of the roadway; their primary purposes are to seal out water intrusion and provide a somewhat smoother ride in comparison to other surfaces.

Micro-Surfacing. This treatment is an outgrowth of the slurry seal technology. It is a mixture of asphalt emulsion, water, and mineral fillers, together with polymers and other additives. The technique allows the application of multi-stone thicknesses, whereas slurry seals tend to be applied in a thickness equal to the stone sized used; as such, micro-surfacing is well suited for addressing wheel rutting and other distresses. Its suitability for feathering also makes it a versatile thin overlay. As with chip seals and slurry seals, the asphalt emulsion "breaks" and changes color from a chocolate brown to black, indicating that the material has set.

## Rehabilitation and Reconstruction

Full-Depth Subgrade Repairs. When surface distress suggests that a localized structural deficiency exists (e.g., there is settlement at the surface), the simple patch technique described above is insufficient. In this case, the area should be saw cut as before and the existing asphalt removed, but the underlying material that is poorly graded, wet, unconsolidated, or otherwise unsuitable should also be fully removed; it is not unusual for the depth to extend 12-16". The excavated area is then backfilled with graded aggregate base or other suitable subbase material (in no more than 8" layers) and thoroughly compacted. As with the patching described above, the repair is completed with a quality hot mix asphalt layer joined to the existing asphalt with tack. While all patches can benefit from crack sealing upon their completion, full-depth patches are particularly good candidates, given their history for subgrade deterioration.

Mill and Overlay. When larger areas of pavement distress are evident, milling (typically 1-2½") the surface asphalt and replacing with new hot mix asphalt may be more economical and effective. The milling operation also can provide an opportunity to establish a 2-3% cross slope if one does not already exist, which should eliminate standing water in the roadway (thereby minimizing safety concerns with icing and reducing future pavement distresses associated with water intrusion). Milling and overlay can extend the useful life of a roadway for many years, but only if constructed correctly. There are many critical components (e.g., consideration of drainage impacts, fully swept surface before paving, proper tack application, selection of suitable hot mix design, good paving techniques, compaction, etc.) and best construction practices should be insisted on, enforced with qualified inspectors.

**Figure 5 Pavement overlay of a milled surface**

Pavement Recycling and Reclaiming. These techniques take on many forms, ranging from cold in-place recycling of the surface asphalt to full depth reclamation of the surface and subbase with or without augmentation, such as soil-cement. Their application depend upon the circumstances, the distresses present, the economics, and other factors. For example, cold in-place recycling can be helpful to reduce hauling costs and the use of virgin materials. Full-depth reclamation using soil cement can be effective where the roadway has lost its structural strength over an extended area.

<u>Suggested Further Reading and References:</u>
This Tech Topic is sufficient only to raise awareness of different techniques. There are many more such techniques available and volumes of detail to help choose techniques for specific situations and achieve a high quality product, only a few of which follow.

- Pavement Preservation Toolbox: http://www.pavementpreservation.org/toolbox/start.html
- Delaware Department of Transportation (DelDOT) pavement specifications: http://www.deldot.gov/information/pubs_forms/manuals/standard_specifications/index.shtml
- Pre-Overlay Treatment of Existing Pavements: http://onlinepubs.trb.org/onlinepubs/nchrp/nchrp_syn_388.pdf
- Pavement Maintenance (Cornell Local Roads Program): http://www.clrp.cornell.edu/workshops/pdf/pavement%20_maintenance-web.pdf
- Optimal Timing of Pavement Preventative Maintenance Treatment Applications: http://onlinepubs.trb.org/Onlinepubs/nchrp/nchrp_rpt_523.pdf
- Minnesota $T^2$/LTAP Best Practices Handbook on Asphalt Pavement Maintenance: http://www.lrrb.org/PDF/200004.pdf

The Delaware T² Center's full-time Engineer position was established with the primary mission of providing transportation advice and technical assistance to Delaware municipalities. Contact Matt Carter at matheu@udel.edu or at (302) 831-7236 for assistance.