Kansas
LTAP Fact Sheet

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Pavement Preservation Keeps Good Roads in Good Condition

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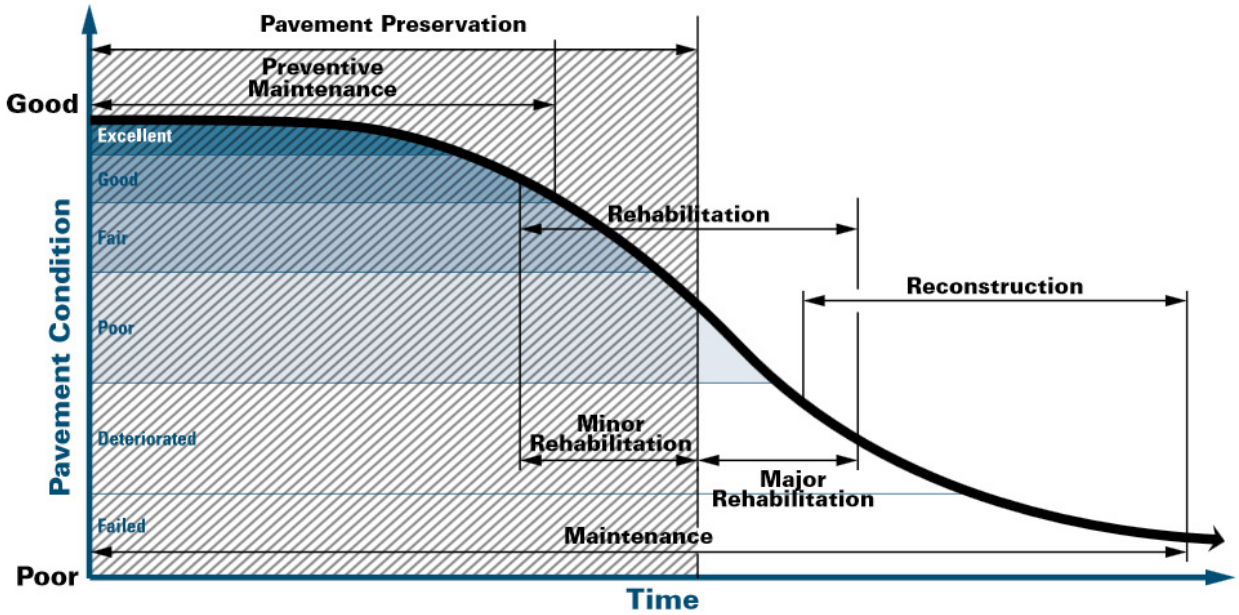
Pavement treatments help maintain the functional condition of roadways. Over the past several decades, pavement preservation tactics have evolved to be more proactive than reactive. Adopting a proactive maintenance approach helps road agencies reduce the probability of costly, time-consuming rehabilitation and reconstruction projects. This article will describe some common pavement treatments and outline the advantages of each treatment. It will also highlight pavement treatment practices and costs outlined in Sedgwick County's Pavement Preservation Plan for 2018.

Common questions about pavement preservation over the past several decades include:
• *What is pavement preservation and how does it differ from rehabilitation?*
• *What is the difference between "pavement preservation" and "preventive maintenance"?*
• *What characteristics make a treatment fit into the "preventive" category?*

Figure 1 helps answer these questions. This graph illustrates that pavement preservation occupies a large portion of the pavement maintenance cycle. According to the Federal Highway Administration (FHWA), pavement preservation is "a program employing a network-level, long-term strategy that enhances pavement performance by using an integrated, cost-effective set of practices that extends pavement life, improves safety and meets motorist expectations." (FHWA, 2017). This goal is achieved in practice through the application of

Figure 1.Representation of definitions of pavement preservation, rehabilitation, and reconstruction (Smith et al., 2014)



preventive maintenance, minor rehabilitation, and some routine maintenance activities.

> "The concept of adopting a proactive maintenance approach enables road agencies to reduce the probability of costly, time-consuming rehabilitation and reconstruction projects." (Smith et al., 2014)

Thus, pavement preservation is a planned system (proactive approach) of maintaining pavements to extend their useful life as cost-effectively as possible.

Why pavement preservation?

Make sure you have the best treatment in place

Grinding down a couple inches of asphalt and then replace it with two inches of new asphalt (e.g., traditional mill and overlay) makes for a good ride and good strength, but it is relatively expensive. Road agencies can find less expensive ways to maintain roads, to maintain more lane miles of roads (stretching their dollars). Some preservation techniques can help keep a road from failing and aging quickly. Pavement preservation techniques (e.g., seal coats) preserve the asphalt layer to delay the need for milling.

The goal of using pavement preservation techniques rather than mill and overlay is to keep the pavement's life-cycle cost low while maintaining serviceability and user satisfaction. Studies show that road agencies can preserve nearly five times more lane-miles of pavement with other options such as chip seal or micro surfacing for the same cost as mill and overlay (Galehouse and Sorenson, 2007). Other types of maintenance treatments may extend that figure even further. Without some form of the preventive maintenance program, it's not uncommon for an asphalt pavement to need complete reconstruction after 20 to 30 years. While a regular mill-and-overlay program will extend pavement life just as well as a preventive maintenance program, the life-cycle cost between the two approaches is dramatically different. Pavement preservation can keep road quality high and life-cycle costs low.

Benefits of Pavement Preservation

Here are some of the benefits of pavement preservation treatments:

1. Financial benefits:
Probably the most compelling benefit of pavement preservation is financial. Pavement preservation can extend pavement life to preserve earlier investments, and they are simpler and less expensive than many alternatives. Preservation treatments have more predictable system maintenance costs, fewer bad surprises, and significantly lower life-cycle costs.
2. Environmental benefits:
Pavement preservation techniques require fewer natural resources (petroleum and aggregate), less energy consumption, and greenhouse gas emissions.
3. Customer Satifacation:
A good preservation program provides better overall network condition, reduces vehicle damage and construction delays, and the enhances the professional image of the local agency.
4. Greater predictability:
By extending the life of a road until the time it needs to be more fully rehabilitated, maintenance for that road becomes more predictable. Preventive maintenance allows local governments to better predict their maintenance budget from year to year, which otherwise can vary significantly.

How Do You Do a Pavement Preservation

The most important part of the pavement preservation program is deciding how to select and when and where to apply a treatment(Van and Nieves, 2018). According to Dan Patenaude, there are two keys to the success of the pavement preservation program:
1. fill up your "toolbox," and
2. commit to a Pavement Management Program(PMP).

There are numerous types of pavement preservation or preventive maintenance treatments, for example: asphalt crack sealing, chip sealing, slurry or micro-surfacing, thin and ultra-thin hot-mix asphalt overlay, concrete joint sealing, diamond grinding, dowel-bar retrofit, and isolated, partial and/or full-depth concrete repairs to restore functionality of the slab; e.g., edge spalls, or corner breaks. Road agencies need more that one or two tools to do the job right.

The PMP helps you assign the right treatment to the right road at the right time, and also helps you maximize roadway network's overall pavement condition with allowable funds. Using a pavement preservation approach to maximize roadway conditions is essential to doing more with less.

Road agencies can use the Pavement Condition Index (PCI) (ASTM, 2011), developed by the Army Corps of Engineers, which is generally accepted as the industry standard for scoring pavement condition (Shahin, 1997). The index provides a relatively simple, rational basis for calculating deterioration rate. The data can be used in conjunction with a pavement management program to develop a plan for pavement preservation.

There are numerous types of pavement preservation or preventive maintenance treatments

Figure 2, from Andrew Hipolit's presentation in the 14th Annual Public Works Continuing Education Conference (Hipolit, 2018), displays the asphalt deterioration curve and illustrates the type of treatment that is right for each stage of the pavement life. If it is a new road, you will want to use seal treatments to protect the wear surface of that road. If the road is in the middle part of its life, other treatments might make sense to prolong its life. When a road approaches failure, treatments become more involved and more expensive. Looking at the rate the road degrades helps to predict when the next treatment is going to be needed and added to a maintenance plan.

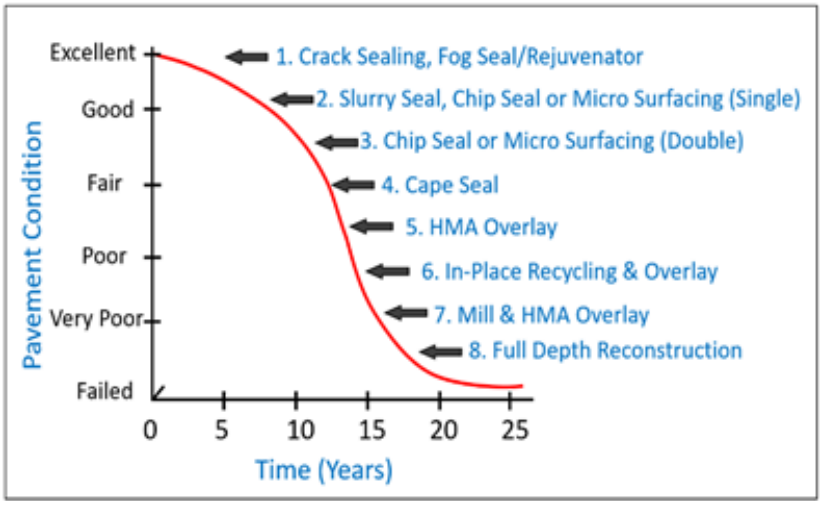


Figure 2. Asphalt Deterioration Curve, Adopted from (Hipolit, 2018)

Table 1 shown on the next page shows more detail on when to use each treatment, based on a study by Wilde et al. (2014) using 200 projects from six states. The table also shows the extended service life created by each treatment.

Pavement PreservationTechniques in Sedgewick County, Kansas

Penny Evans and Randy Downs (2017), bridge engineer and chief of inspection, respectively, from Sedgwick County, stated that the Sedgwick County uses various pavement treatments. Their goal is to be proactive in maintaining their existing roads.

Besides extending pavement life, they can reduce delays for the traveling public and provide improved safety and mobility (MNLTAP, 2014). Sedgwick County road officials have learned that the true benefits of pavement maintenance are realized when there is a consistent schedule.

The treatments used in Sedgwick County are:

- Ultrathin bonded asphalt surfacing (UBAS),
- Thin overlays,
- Latex-modified slurry seals,
- Hot-in-place asphalt recycling, and
- High-density mineral bond (HA5) combined treatment.

In the County, aside from crack treatments, all of those treatments leave the pavement with a new wearing surface that can extend the service life of the pavement for at least five years. To apply right treatment to the right place and at the right time, the County uses a 5-year cyclic approach combined with a 5-point road grading system (5 is good condition and 1 is a poor condition). This approach allows the agency to address pavements while they are still in good condition and before the onset of serious damage. The approach also helps ensure the agency

Pavement Preservation Techniques	Reason for use							Extended Service Life (Years)
	Friction	Raveling	Rutting	Potholes	Cracking			
					Low	Med	High	
Crack Treatments								
Crack Sealing					x	x		0-4**
Crack Filling						x	x	2-3
Full-depth Crack Repair							x	5*
Surface Treatments								
Fog Seal		x						4-5**
Seal Coat	x	x						3-6*
Chip Seal	x	x						3-8**
Slurry Seal	x	x						4-7**
Micro Surfacing	x	x	x					3-8**
Thin Hot-mix Overlay		x	x					3-23**
Pothole and Patching Repair								
Cold-mix Asphalt				x				1
Spray Injection Patching				x				1-3
Hot-mix Asphalt				x			x	3-6
Patching w/Slurry or Micro Facing Material				x			x	1-3

Table 1.Asphalt Maintenance Techniques, Adopted from (Wilde et al., 2014)
*(Wilde et al., 2014) **(Wu et al., 2010)

evaluate a specific mile of road at least every five years. Sedgwick County selects types of treatment based on the condition rating of the road and whether it is hot or cold mix.

Hot mix maintenance strategy

Sedgwick County is maintaining its hot mix asphalt roads through contract work. Although they continually experiment with new processes and surface treatments, such as rubberized seals and cold mix recycling, the heart of the pavement preservation program is a combination of latex-modified slurry seals, ultrathin bonded asphalt surfaces, and hot-in-place asphalt recycling.

Slurry seals are applied to roads rated 4 or 5 on the County grading system; they are in very good to good shape with some small thermal cracking. This is often the first maintenance treatment after construction or reconstruction and is an effective and a low-cost treatment. Sedgwick County typically experiences around a 5-year service life from their latex-modified slurry seals.

Ultrathin bonded asphalt surfacing is used on roads that typically are rated 3 or 4. The pavement may have somewhat larger cracks, but it is still in good condition and is structurally sound. The emulsion membrane seals the existing surface and produces high binder content between the existing roadway surface and the gap-graded ultrathin hot mix, all in one pass. This treatment works well for the County on higher-traffic areas because of the single-pass process and the ability to reopen the road quickly after application. Ultrathin bonded has a service life of between 5-10 years. Rounding out the preventive maintenance treatments is hot in-place asphalt recycling.

The process recycles in-place asphalt with a single machine by performing a multi-step process of heating, scarifying, applying an asphalt recycling agent and thoroughly remixing and reshaping the old asphalt surface as a leveling course. This is immediately followed by a minimum one-inch virgin hot mix asphalt overlay placed over the recycled leveling course. This type of treatment corrects many types of surface distresses, and the additional aggregate provides increased strength. This process is typically reserved for roads with a grade of 1 or 2, and is the most expensive preservation

treatment. On traffic loads, this treatment has a service life of anywhere from 5-10 years in Sedgwick County.
The County also uses HA-5 High Density Mineral Bond Seal in combination with the hot in-place asphalt recycling.

Cold mix maintenance strategy

Sedgwick County has an extensive history of using cold mix asphalt. It has traditionally been used as the first step when upgrading a gravel road to a paved road. The strength added by the cold mix asphalt allows time to incorporate a road reconstruction project into the Capital Improvements Program (CIP).

The County maintains over 290 lane miles of cold mix asphalt roads, with County forces. These roads are not rated, but when needed, they will be patched and skim coats will be applied to reduce aging, restore serviceability, and add strength. Typically, a chip seal is applied later in the same year for further protection.

Conclusion

Pavement preservation represents a proactive approach to keep good roads good, and a critical investment strategy for optimizing infrastructure performance. Regardless of the type of treatment used, asset management and timing are critical to the success of pavement preservation. Having a pavement preservation program in place helps roadway agencies bear the burden of severe funding cuts without sharply reducing the quality of the road network.

2018 Pavement Preservation Project Plan for Sedgwick County

Asphalt Overlays
2-inch BM-2 Surface Course.
In-House Crews: $ 90k per mile ($100k per mile, 2-1/2 inch)
Contract / Bid out: $180k per mile (over good base or existing Chip Seal)
1-1/2 inch BM-7 (1-inch in place) (2014)
In-House Crews: $ 65k per mile Better binder on good base – 24 ft wide.
Hot–in-Place (HIP) Recycle (2-inch) including HA-5 Seal* (Dustrol) Heaters, Milling and Paver Train – 650 feet long – straight line jobs, Contract: $75k per mile (10 miles).
Spray Paver – 1-inch overlay Dense Graded HMA (Bond Tekk), Contract: $78k per mile (10 miles)
1-inch Mill / Recycle and 1-inch BM-1 Overlay (Cutler)
4-lane with Curb and Gutter, minimum rise in profile 1-inch (manholes), Contract: $115k per mile
Chip Seals
Single Layer Chip Seal and Fog (not including base preparation) (3-4 years).
In-House Crews $17k per mile (Rate 0.35 gallons per square yard, 3/8-inch chip, includes Fog Seal).
Double Chip Seal (not including base preparation).
In-House Crews: $17k per mile (Rate 0.35 gallons per square yard with ½-inch chip, wait 30-days, 0.27 gallons per square yard ¼-inch chip) (1/4-inch chip has less windshield damage and less citizen complaints).
Chip Seal Maintenance layer
In-House Crews $6.5k per mile (One layer ¼-inch chip over existing chip seal (Rate 0.27 gallons per square yard)).Nova Chip (coated chips) (7-9 years) (5/8-inch thick), Contract: $ 70k per mile (6 miles).
HA-5 High Density Mineral Bond Seal (black spray sealer) (Andale Construction), Contract: $40k per mile (10 miles)
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Notes on Some Common Pavement Preservation Treatments

Crack Sealing: Used for pavements that primarily have working cracks (greater than 1/8-inch annual movement). Crack sealing should be applied as needed whenever cracks are observed. Cracks should be sealed as soon as possible to prevent moisture from entering the pavement structure. The correct sealant type should be used for specific applications. The sealant should be applied in clean, dry cracks. Do not fill wet cracks, overheat the sealant material and make wide overhand. When used in conjunction with a sound asphalt maintenance plan, crack sealing can slow the progression of cracks, help maintain a safe surface, and extend the longevity of the pavement.

Chip Sealing: Chip seals are used to provide a new wearing surface on roadways that are intended to eliminate raveling, retard oxidation, reduce the intrusion of water, improve skid resistance and seal cracks. They can last on average about 7 years and are typically applied on low volume roads. Chip seal can be applied to the pavements early in life. Generally within the first four years. Only on structurally sound roadways and should be swept as soon as possible. Do not apply chip seals in September or later. Do not leave extra rocks on roadways more than one day, do not use a chip seal to try to hold a deteriorated pavement together.

Micro-surfacing / Slurry Seal: Like a chip seal, micro surfacing can be used as a blanket cover on pavements suffering from loss of skid resistance, oxidation, raveling and surface permeability. In addition, micro surfacing can be used to fill ruts and improve ride ability by removing minor surface irregularities. This treatment can last on average 8 to 9 years. It is also suitable for all traffic levels. General recommendations include not working too late in the fall (i.e., later than September), only applying the micro surfacing slurry at a rate to produce a thickness of the diameter of one aggregate particle, and not to allow a careless application of the materials of one aggregate particle.

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