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Pavement Preservation Compendium II

Pavement Preservation: Techniques for Making Roads Last

by Tom Kuennen

Pavement preservation is a planned system of treating pavements at the optimum time to maximize their useful life, thus enhancing pavement longevity at the lowest cost.

Typically, pavements perform well under loads until a particular point in their life spans, at which time they deteriorate precipitously and rapidly to failure. Experience shows that spending $1 on pavement preservation before that point eliminates or delays spending $6 to $10 dollars on future rehabilitation or reconstruction costs.

Ideally, pavement preservation can mean maintenance of a pavement even when there is nothing apparently wrong with it. "The number one fault of agencies is that they wait until a problem develops before they address it," said Larry Galehouse, P.E., executive director of the National Center for Pavement Preservation (NCPP) at Michigan State University. "Instead, successful pavement preservation demands a pavement that's not in bad shape to start. If the structure is good, we can keep water out of the pavement, prevent oxidation of the asphalt, and maintain good skid resistance. With pavement preservation techniques, we will improve their performance and extend their life."

That approach is directly opposed to the politically popular road management method of "worst-first," in which scarce maintenance dollars are used to provide band-aid repairs to pavements which have gone too far and are failing. Soon after repairs are made, base or pavement failures are reflected through to the surface and the effort has been wasted.

Strong FHWA Support

In May 2005, the FHWA came out strongly in support of pavement preservation. "Each highway agency faces different challenges in applying pavement preservation treatments and establishing an effective preservation program," said David R. Geiger, P.E., director, FHWA Office of Asset Management. "Preservation involves a paradigm shift from worst-first to optimum timing. Preservation programs must focus on demonstrating benefit, securing commitment of top agency management, convincing the public, and selecting the right treatment for the right pavement at the right time."

According to Tom Deddens of the FHWA's Construction and System Preservation Team, "The goal is to help states assess where they are and provide comments and recommendations on what they can do to further develop and enhance their pavement preservation programs." Those preventive

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maintenance treatments include crack sealing, chip seals, slurry surfacings and hot mix asphalt (HMA) thin overlays that will bolster ride quality, provide surface drainage and friction, and correct surface irregularities.

Preservation with Asphalt Treatments

As NCPP's Galehouse implied, a big part of pavement preservation is keeping water out of pavements, and the water-proofing properties of asphalt surface treatments and liquid asphalt mean they take top billing in pavement preservation techniques.

Such pavement preservation practices include crack sealing, patching, fog seals (a combination of mixing-type emulsion and approximately 50 percent water, used to seal shoulders and patches), rejuvenation (application of a rejuvenator agent in a procedure similar to fog sealing), and chip seals (surface treatment in which the pavement is sprayed with asphalt emulsion and then immediately covered with aggregate and rolled).

Also included are slurry seals (an application of mixing-type asphalt emulsion, sometimes with additives, mineral aggregate and proportioned water, mixed and spread on clean pavement free of dirt and loose gravel); microsurfacing (polymer-modified asphalt emulsion, mineral aggregate, mineral filler, water, and other additives, properly proportioned, mixed, and spread on a pavement); cape seals (application of slurry seal to a newly constructed surface treatment or chip seal); and thin and ultrathin hot mix asphalt overlays (HMA overlay with one lift of surface course, generally with a thickness of 1.5 in. or less).

Three varieties of liquid asphalts are used in conventional surface treatments:

- Liquid asphalt cement is used to construct chip seals in regions that have very hot weather. The asphalt cement is shot at high temperatures where it flows well and accepts chips readily. A fairly warm pavement surface is required so the asphalt does not cool off too quickly before placement of the chips.
- Cutback asphalts are blends of asphalt cement with solvents, which make the asphalt cement fluid for spraying or mixing. The solvents then evaporate, leaving the base asphalt cement in place to bind the rock. Solvents used include gasoline for rapid-curing, kerosene for medium-curing, and diesel fuel for slow-curing cutbacks. The use of cutback asphalts, once common for chip seals, has declined considerably because of environmental restrictions on hydrocarbon emissions from evaporating solvents in specific regions around the county.
- Emulsified asphalts are an emulsion of very small asphalt cement particles held in suspension in water with the use of an emulsifying agent. Like cutback asphalts, emulsified asphalts come in rapid-, medium-, and slow-setting grades for different uses. The various grades are developed through the use of different emulsifying agents and the addition of some solvents. These asphalt particles are either anionic (negatively charged) or cationic (positively charged).

The rapid-setting emulsions are used mostly for chip sealing, while the medium and slow setting grades are used for emulsion mixes or recycling and fog or tack seals. The emulsified asphalt 'sets' or 'breaks' when the asphalt particles precipitate or fall out of the water suspension and coat the aggregates. The emulsion changes color from brown to black during this process.

Ever Popular Chip Seals

Chip seals have been used for decades to preserve riding surfaces. A chip seal is a surface treatment in which the pavement is sprayed with asphalt and then immediately covered with aggregate and rolled. Chip seals are used primarily to seal a pavement with non-load-associated cracks, and to improve surface

friction. They also are common as a wearing course on low volume roads.

The asphalt binder can be modified with a blend of ground tire or latex rubber, or polymer modifiers, to enhance the elasticity and adhesion characteristics of the binder. A variant of the chip seal is the fog seal, a light application of slow-setting asphalt emulsion diluted with water, and without the addition of any aggregate applied to the surface of an asphalt pavement. Fog seals are used to renew aged asphalt surfaces, seal small cracks and surface voids, or adjust the quality of binder in newly applied chip seals.

A cape seal is a combination of a chip seal and a slurry surfacing or seal. For paved roads, the chip seal is applied first and, between four and 10 days later, the slurry seal is applied. For unsurfaced roads, an application of MC-70 or SC-70 cutback asphalt is applied first as a prime coat, followed about two days later by a chip seal and about two weeks later by a slurry seal.

Joints, Cracks and Potholes

In advance of any surface treatment, pavements are prepared by sweeping and sealing the joints and cracks. "It is critical that all necessary preparation work such as crack filling, pothole repair, patching, leveling, and dig-outs be done prior to surface treatments being placed," reports the California Department of Transportation (Caltrans).

Caltrans says crack filling and sealing is its first line of defense in roadway maintenance. Caltrans urges that cracks 1/4 inch or wide be filled or sealed before rainy seasons or before the application of maintenance surface treatments such as fog seals, sand seals, slurry seals, chip seals or maintenance overlays.

Potholes are bowl-shaped holes of various sizes which are associated with pavement fatigue and poor drainage. Highway departments can minimize potholes by keeping water out of the base material. Water weakens pavement support and contributes to frost heave and cracking.

A long-term study that began under the Strategic Highway Research Program, and continued under FHWA's Long-term Pavement Preservation program, found that for patching potholes, quality of materials is more important than method or machine. The use of quality, even premium, materials is the utmost variable in effective pothole patching. The throw-and-roll technique proved as effective as the semipermanent procedure in most situations and is more cost-effective, making it a good choice, so long as quality materials are used.

Rejuvenating Pavements

Pavement rejuvenators are applied to existing aged or oxidized HMA pavements in order to restore pavement surface flexibility and to retard block cracking. Emulsified sealers, binders and rejuvenators are used in pavement preservation to protect oxidized asphalt surfaces or actually penetrate and rejuvenate them.

The oxidative aging of pavements begins at the time of construction and continues throughout a pavement's life. However, most aging occurs within the first two to four years of service life. This results in the top half-inch or so of the pavement surface becoming more brittle than the underlying material due to the actions of water and environment. This can result in raveling and/or premature cracking, which begins at the pavement surface.

Rejuvenators are formulated to penetrate into the pavement and then enhance the properties of the asphalt binder of the existing pavement. These treatments are most commonly used in the western states where ultraviolet exposure appears to promote greater oxidation. Treatments can begin immediately after construction but more typically occur many years later when some form of distress is observed.

Slurry Surfacings

A slurry surfacing, also known as a slurry seal, is not the same as a chip seal. Instead, it is a mixture of aggregates dispersed in an asphalt emulsion and applied in a slurry state. It is usually a mix of polymer-modified emulsion and fine crushed aggregate that is spread simultaneously in one pass over the street at a particular thickness. The slurry cures as the water evaporates, leaving only the asphalt to coat the aggregate.

Slurry surfacings are designed in a lab, are proportioned by a slurry machine, and laid down and cured so the asphalt-to-aggregate ratio is maintained at the optimum value to assure uniform aggregate coating and adhesion. Such friction courses use very large fractions of fine material, giving a very high surface area and a lot of microstructure, leading to a sandpaper surface and a high skid resistance while maintaining a smooth finish.

A variant of the slurry surfacing is microsurfacing, which is a mix of polymer-modified asphalt emulsion, mineral aggregate, mineral filler, water, and other additives, which is proportioned, mixed, and spread on a paved surface. Microsurfacing differs from slurry seal in that it can be used on high volume roadways to correct wheel path rutting and provide a skid-resistant pavement surface.

HMA as a Preservation Treatment

For severely distressed surfaces, thin HMA overlays will provide a like-new surface, prolong pavement structure life, and make a pavement stronger for only an incrementally higher expenditure than competing surface treatments like chip seals or slurry surfacings.

For many roads and streets the best preventive maintenance strategy may be a thin HMA overlay. This thin (0.5 to 1.5 inch) surfacing combines the best attributes of HMA's strength and smoothness with a low cost that makes maintenance dollars go farther. Aesthetically, the overall impression is of a brand-new road, at the price of a thin overlay. Other benefits include HMA's trademark quiet pavement and smooth ride.

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