

technotes

"tech notes" are a product of the State Materials Laboratory to share improvements in design and construction technology gained from WSDOT projects. This issue is from the Pavements Branch discussing coal tar pitch emulsion and asphalt emulsion pavement sealers.

Pavement Sealer Applications

What are pavement sealers?

Coal tar pitch and asphalt based emulsion sealers used by WSDOT are thinly applied mixtures of asphalt or coal tar based emulsion, aggregate, minerals, proprietary chemicals and water spread on new and existing hot mix asphalt (HMA) pavement surfaces.

Why are they used?

Pavement sealers are applied to protect the surface of the HMA from the damaging effects of gasoline, diesel oil, motor oil, and grease that drip or are spilled onto an HMA surface. Sealers also prolong the life of HMA pavements by decreasing oxidation and ultraviolet light bleaching as well as preventing moisture from entering the pavement. The net effect is an extension of the performance life of the new or existing HMA pavement.

What are the types of sealers?

The three types of sealers used by WSDOT include; (1) undiluted coal tar pitch emulsion, (2) asphalt based emulsion or (3) a blend of the two. Aggregates added to the emulsions include sand, mineral filler, or a blend of these. The addition of aggregate to the emulsion helps densify the mixture and provides a friction component to the sealed pavement surface. The three types of emulsions are described as follows:

Coal tar pitch emulsions

Coal tar is a liquid by-product of the distillation of coal and is resistant to attack from petroleum based products. This property makes it ideally suited for parking lots where concentrations of oil and grease leaks are prevalent and has a high resistance to ultraviolet light bleaching. It is stable, homogeneous, easy to apply, and safe to handle¹. Coal tar has traditionally been used at gas stations, truck and bus terminals, airport aprons and taxiways.

Asphalt based emulsions¹

Asphalt emulsions have many of the same beneficial properties as coal tar pitch emulsions except they lack the coal tar emulsion's superior resistance to petroleum, ultraviolet bleaching, and salts. An asphalt emulsion is a mixture of liquid asphalt and water. Manufacturers are adding special chemicals and pigments to the asphalt emulsions to overcome some of their shortcomings, but they are still susceptible to the damage caused by petroleum products.



WSDOT rest area resurfaced with a sealer.



Sealer application applied at a weigh station.



Brooming a sealer along the lane edge during surface preparation prior to placing the prime shot application.

¹ <http://www.pavementpro.org/understanding.htm> - National Pavement Contractors Association



Preparation of shoulder surface by brooming along the shoulder edge after the prime shot has been applied.

Coal tar pitch and asphalt emulsion blends

Undiluted coal tar pitch emulsions were used prior to the mid 1990's, but today all public and private users in Washington are moving towards a blended product of 20 percent coal tar pitch and 80 percent asphalt emulsion. The blended product greatly reduces the release of polycyclic aromatic hydrocarbons (PAHs) into the environment.

How are pavement sealers applied?

The application of a coal tar pitch emulsion sealer is a three step process: (1) surface preparation, (2) prime shot, and (3) sealing. The surface preparation commonly consists of sweeping to remove dirt and debris. The prime shot is an application of diluted emulsion that acts as the catalyst to bond the sealer to the HMA surface. The sealer is applied in two coats. The first coat is a mixture of emulsion and sand. The second coat is a repeat of the first except less sand is used. Traffic is kept off the newly sealed pavement for a minimum of 24 hours to allow the sealer to cure.

The application of an asphalt based emulsion sealer is similar except that the prime shot is not always necessary. The number of applications necessary with an asphalt based emulsion depends on the concentration of solids in the emulsion and the amount of emulsion applied in each application. In limited cases, only one application may be necessary.

Where does WSDOT utilize sealers?

Coal Tar Pitch Emulsions

WSDOT has used coal tar emulsions at several rest areas and weigh stations, one ferry terminal and one park and ride lot. This product was used at these locations to protect HMA surfaces from the gas, diesel, oil, and grease leaked from cars and trucks. The summary of WSDOT use is shown in Table 1.



Resupplying a sealer application vehicle with sealant from delivery tanker.

Table 1. WSDOT uses of coal tar pitch emulsion.

Year	SR	Project	Application	Approximate Gallons Used
1987	5	Gee Creek Rest Areas	Northbound and Southbound, Truck areas only	4,760
1993	90	Adams Co. Line to Spokane Co. Line	Rest Areas Eastbound and Westbound	6,500
1996	82	Selah Creek Bridges to SR-823	Rest Area Northbound and Southbound	5,000
1996	5	I-5 Ridgefield Weigh Station	Weigh Station	8,120
1998	5	SR 12 to Maytown Rd. Oxing	Rest Area Northbound and Southbound	6,156
1999	5	Gee Creek Rest Area Paver	Northbound and Southbound	4,760
2000	5	Stanwood Bryant Vic NB Weigh Station	Weigh Station	706
2003	305	WSF – Bainbridge Island Terminal	WSF Parking Lot	500
2004	90	Adams Co. Line to Spokane Co. Line	Rest Area Eastbound and Westbound	6,500
2004	90	West Lake Sammamish Parkway I/C to 436th Ave. SE	Weigh Station	3,987
2005	90	George East	Park and Ride	500
2005	90	George East	Rest Area Eastbound and Westbound	10,878



View of squeegee system on sealer applicator.

Use of coal tar pitch emulsions on state owned facilities is relatively small. Rest areas and weigh stations are rehabilitated less often than adjacent mainline roadways (i.e. typically every 20 or more years). When rest area and weigh station rehabilitations are finally performed, the pavement is usually deteriorated to the point where there is no cost-benefit derived from a sealer and complete replacement of the HMA is required.

Coal tar pitch emulsions provide the greatest cost-benefit for newly constructed HMA park-and-ride lots, rest areas and weigh stations. These are facilities where pavement rehabilitations are done infrequently and where the pavement surface is not subject to significant truck or vehicle traffic. These areas usually require additional applications of the product throughout the life of the facility.

Asphalt Based Sealers

In recent years, WSDOT has placed asphalt based sealers at limited locations. South Central Region Maintenance has placed asphalt based products for isolated maintenance projects. WSDOT is currently monitoring performance to compare to coal tar pitch emulsion projects.

How much coal tar pitch emulsion is used by WSDOT?

The use of coal tar emulsions on WSDOT's facilities (see Table 1) is small compared to applications by other public and private entities. The exact quantity of coal tar products used in Washington is difficult to obtain; however, industry estimates are that nearly 400,000 to 600,000 gallons were used in Washington in 2004 by all users, public or private. This figure includes both the coal tar and coal tar blends. Typically, coal tar blends make up 80 to 95 percent of the total. The total estimated use for all WSDOT projects since 1987 is 53,000 gallons, an average of less than 3,000 gallons a year. Thus WSDOT accounts for only 0.5 to 0.7 percent of the total yearly estimated usage. WSDOT's use is minimal compared to the quantities used by other public or private entities for private parking lots or larger parking areas.

What has been WSDOT's performance history with sealers?

Coal tar pitch emulsion use in Western Washington

WSDOT has had a problem with low friction resistance on three recent projects in Western Washington. These low friction resistance measurements have led to the posting of slippery when wet signs at one location, the re-sealing of the coal tar pitch emulsion surface with an asphalt-based product at another location, and the complete removal and replacement of the coal tar pitch emulsion at the third location.

Coal tar pitch emulsion use in Eastern Washington

Problems with low friction resistance have not occurred on projects in Eastern Washington. However, there have been problems with the tracking of the product from parking areas to sidewalks or restrooms at some rest areas. The tracking problem was due to construction delays that caused a reduction in the number of hours allowed for the sealer to cure.



Using sealer applicator.



Hand finishing surface after final application of sealer.



Completed surface prior to curing of sealer.



Completed pavement surface at a weigh station.



Completed pavement surface after sealing.

Asphalt based emulsion use.

Asphalt based emulsions are not as sensitive to existing pavement conditions and construction techniques when compared to the coal tar pitch emulsions. Therefore, there have been very few problems on either side of the state with the application of this type of sealant.

Changes in WSDOT’s sealer recommendations

WSDOT will now be using only coal tar blended emulsions. This is due to the recent problems with low friction resistance on applications in Western Washington and the environmental concerns with the undiluted coal tar pitch products. The blended emulsion applications have better friction resistance, are easier to apply, and are less sensitive to construction techniques. The blends are also less sensitive to the proportioning of aggregates than the undiluted coal tar pitch emulsions. In addition, the blended product can be placed immediately to a newly placed HMA pavement, whereas with the undiluted coal tar product a 30 day cure period is required before the new pavement is ready to be sealed.

An additional reason for the change to the coal tar blended products is to address environmental concerns. While research is still underway on the possible hazards the use of the coal tar pitch emulsions might pose, blended coal tar greatly reduces the potential of environmental pollutants.

Estimates by WSDOT and industry give coal tar emulsions a life span of eight to ten years. The life for coal tar blends is estimated at six to eight years. Asphalt based emulsions typically last four to six years. The loss of pavement life with the blended products is thus minimal.

What is the cost of the coal tar blended product and how does it perform?

Cost and performance data for each of the pavement sealers are listed in Table 2. The cost for undiluted coal tar emulsion is about \$3.00 per gallon. A coal tar blend (20% coal tar emulsion, 80% asphalt based product) is about \$1.80 per gallon. A pure asphalt-based product is typically \$1.65 per gallon. The cost difference between undiluted coal tar and blended coal tar pitch emulsion for a typical 3,000 gallon WSDOT project is about \$3,600.

The performance difference between the blended emulsion and the undiluted coal tar pitch emulsion is estimated to be less than two years. This small difference in the seal life combined with the minimal cost difference between the two products means that the decision to switch to the blended product will not have much of an impact on the overall costs for WSDOT.

Current evaluations of seal coats in Washington

WSDOT is currently assessing the performance of pavement sealers in an effort aimed at improving design and application practices.

Table 2. Cost and performance history of pavement sealers

Product	Cost Per Gallon	Performance History
Coal Tar Pitch	\$3.00	8-10 years
Coal Tar Blend	\$1.80	6-8 years
Asphalt Emulsion	\$1.65	4-6 years

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