

Seal Coating and Other Asphalt Surface Treatments

Seal coating is a very common and cost-effective preventive maintenance for existing asphalt pavements. It seals and renews a roadway surface that is still in good condition. It should provide five to eight years of additional life to the pavement. Although a seal coat protects the existing pavement, it does not strengthen it. A seal coat may also be applied on unsurfaced roads in certain limited situations.

Other asphalt surface treatments such as fog seals and penetration treatments are beneficial in maintenance as well, and tack and prime coats are useful in preparing for an overlay. This bulletin describes the use and proper application of these common surface treatments.

Seal coat or chip seal

A seal coat or chip seal is a single application of asphalt sprayed on a road surface followed immediately by a single layer of uniform size aggregate. It treats the surface to help prevent surface water from penetrating old, weathered or cracked pavements. The asphalt seals the old surface and the aggregate carries the traffic. This reduces potholes and slows deterioration of old asphalt pavement surfaces.

This treatment also renews the surface at relatively low cost and restores skid resistance to traffic-worn pavement. Old roads can be slippery when excess asphalt bleeds to the surface or when traffic has smoothed the sharp edges off surface aggregates. Applying hard, sharp new aggregate in a chip seal will improve friction.

Selecting the asphalt

In selecting the proper grade of asphalt for a surface treatment, consider: temperature of the surface to which the treatment will be applied, air temperature, humidity and wind, condition of the surface, and type and condition of the aggregate to be applied.

The use of cutback asphalts in Wisconsin is now strictly controlled. Therefore, rapid-setting (CRS-1, CRS-2, RS-1, RS-2) emulsified asphalts are used most often. Emulsions are a mix of asphalt cement, water, emulsifying agent, and additives.

The asphalt is designed to “break,” separate from the water, when in contact with foreign objects (aggregate). When the emulsion breaks it turns from brown to black. Emulsion seal coats are designed to break after the first pass of the roller. Too much dust in the aggregate will accelerate the break time and delay curing.

Additives can control the setting or cure time. Curing requires evaporation of the water. Rapid curing emulsions are designed to cure in approximately 1 to 5 minutes. When the grade of asphalt is correct for the surface treatment it will:

- be fluid enough to spray properly and cover the surface uniformly when applied, yet viscous enough to remain in a uniform layer and not puddle in depressions or run off the crown
- retain the proper consistency after application to wet the applied aggregate
- cure and develop adhesion quickly
- hold the aggregate tightly to the road surface after rolling and curing to prevent dislodging by traffic

The temperature of the asphalt when sprayed will affect the way it flows on the surface (viscosity). Use the temperature ranges in Table 1 for most effective flow.

Heavily shaded pavements can be a problem. The cooler temperatures require quicker application of cover aggregate and final cure is often delayed.

Table 1: Suggested temperatures for spraying asphalt

Type and Grade	Temperature °F
CRS-1	125–185
CRS-2	125–185
RS-1	70–140
RS-2	125–185

Selecting the aggregate

Most hard aggregates such as gravel, crushed stone, and crushed slag can be used successfully as cover aggregate.



The aggregate selected, however, must meet certain size, shape, cleanliness, and surface property requirements. Hard aggregates improve the abrasion resistance and life of a seal coat.

Aggregate should be as close to uniform in size as is economically practical, otherwise the surface treatment will have more than one layer of aggregate. Generally aggregates in the range of $\frac{3}{8}$ inch are used. These provide a smooth, quiet-riding surface.

The ideal aggregate shape is cubical. Flat, small or elongated particles tend to become completely covered by asphalt, failing to increase road surface friction. Rounded particles tend to roll.

It is important that the aggregate be clean. When aggregate pieces are dusty or coated with silt or clay a film forms that prevents proper adhesion between the asphalt and the aggregate. If you can see dust in the aggregate it is likely to be too dirty. No more than 2% of the particles should pass the #200 sieve.

Some aggregates may not be compatible with all types of emulsions. If your experience with a specific aggregate is limited, test compatibility (particle charge and coating).

Chip seal construction procedures and considerations

Preparation

Before any work is started, examine the surface thoroughly to determine what repairs are needed and what treatment to use.

If you are reconditioning an old surface, look for potholes, cracked areas, depressions, slick areas, absorbent areas, and any other surface defects. Make repairs and corrections to put the road into sound condition before you begin the surface treatment.

All alligator-cracked and soft areas must be replaced and roadway drainage must be improved to good condition. Fill wide ($\frac{1}{4}$ inch) cracks ahead of time. When you are repairing the surface extensively, such as with patching, allow enough time before you treat the surface to ensure that repairs are properly cured and consolidated.

You must clean the surface after you have made all necessary repairs and just before the asphalt is sprayed. Remove all hardened mud, dirt, and other foreign material and sweep the surface thoroughly with power brooms.

Weather is important to surface treatment success. Hot and dry weather is best. It is common to require the air and pavement temperatures be at least 50°F and rising before operations begin. Warmer temperatures are good insurance against failures (60°F to 95°F are best).

No matter how hot the asphalt is when sprayed, it will cool to the temperature of the road surface in about one minute. Do not start surface treating when the surface has excess water or when the weather threatens rain. The

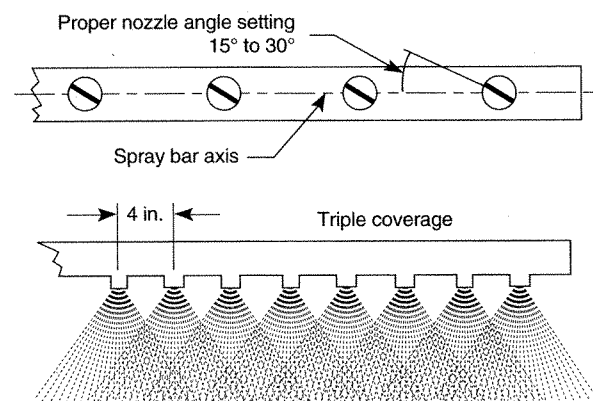
combined actions of water and traffic on a fresh surface treatment will remove cover aggregate.

Spraying asphalt

The asphalt distributor is the most important piece of equipment in chip seal work. It is crucial to good seal coats that you get a uniform spray across the surface and can control the application rate.

Spray bar height and nozzle adjustments are important. The nozzles must produce a fan-shaped spray. They are angled at about 30 degrees to avoid interfering with each other. Adjust the spray bar height to provide double or triple coverage. See drawing.

Uniform coverage is important. Over-application can cause bleeding. Lean areas will cause all aggregate to be stripped away, leaving streaks.



Spray bar height must be set exactly for proper coverage

You must adjust application rates for the condition of the old pavement surface and the size of the aggregate. Rates between 0.25 and 0.40 gallons per square yard are typical (3,000 to 4,500 gallons per mile of 20 foot wide road). Use enough asphalt to seal the old surface and bind the aggregate but not so much that it covers the aggregate and bleeds in hot weather.

Severely weathered surfaces require more asphalt. Larger aggregate also requires more asphalt. Check your spread during construction. It should be within 5% of your design amount. Too much asphalt can not be soaked up by aggregate. Take asphalt samples for analysis if quality becomes a question.

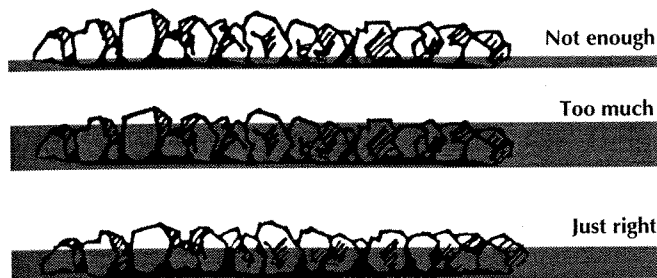
Spreading aggregate

When the distributor moves forward to spray asphalt, the aggregate spreader should follow immediately behind it. The asphalt should be covered within 30 to 60 seconds, otherwise the asphalt will begin to thicken and may not properly wet and bind the aggregate.

It is also important to spread aggregate uniformly and at the proper rate. Since aggregate only sticks one particle thick, it is useless and wasteful to apply more than a single layer. Twenty to 30 pounds of aggregate per square yard is



normally used (120 to 175 tons per mile of 20 foot wide road). Self-propelled spreaders make excellent control possible. Check your rate during construction. It should be within 5% of design.



When properly applied, asphalt covers two-thirds of the aggregate.

Coordinate material delivery so there are no delays after work starts. If the aggregate source is not nearby, use enough trucks to ensure a continuous supply of material or stockpile enough aggregate in advance near the job site. Aggregate should be on the job before asphalt application begins.

Rolling

Rolling seats the aggregate in the asphalt, promoting the bond necessary to resist traffic stresses. Two self-propelled rollers are usually required for each aggregate spreader. Rubber-tired rollers are recommended. They force the aggregate into the liquid asphalt and do not crush it. Steel-wheeled rollers compact only the high spots, leaving loose aggregate in the low spots.

Rolling must begin immediately after aggregate is distributed and continue until the aggregate is properly seated in the asphalt. This usually doesn't take more than twenty minutes. Several passes are recommended and rollers should travel at no more than five miles per hour.

Begin rolling at the outer edge of the treatment and proceed lengthwise, working toward the center of the road. Each trip should overlap the previous trip by about one-half the width of the roller's front wheels. As soon as the asphalt has a definite set or hardening, stop rolling to avoid breaking the bond between the asphalt and the aggregate with the roller.

Loose aggregate usually stays on the road surface after rolling. Aggregate that does not stick is picked up by tires of fast-moving vehicles and sprayed against following vehicles, often damaging headlights, windshields, and finish. You can remove loose aggregate by lightly brooming with a rotary power broom during the cool of early morning after the asphalt has completely set.

Traffic control

Traffic control is important to high-quality work and must be maintained throughout the job. High speed traffic over a fresh surface treatment displaces the aggregate and

produces a very slick surface. Traffic should be detoured, or allowed only in the lane not under construction.

When work is completed and initial asphalt set has occurred, slow-moving traffic, less than 25 mph, may be permitted on the new surface. Warning signs and flaggers are a minimum safety precaution. Occasionally, a pilot vehicle leading traffic past the work may be necessary.

Extend traffic control to the hauling equipment. Route aggregate hauling trucks to the aggregate spreader to minimize truck traffic on the fresh seal. It is customary to apply the seal coat toward the aggregate stock pile. This prevents trucks from being turned on the freshly placed surface. Require all truck turns to be made away from the new work.

Multiple seal coats

Extra protection and a longer lasting seal coat treatment can be provided by applying multiple seal coat layers. Procedures are the same except aggregate size must vary. A larger aggregate is used on the first (bottom) layer. The second seal coat should use aggregate one half the size of the first layer. This allows the seals to be "nested" and creates a tight waterproof surface. For best results all layers should be made the same year.

Asphalt application rates are adjusted so that in a double seal 40% of the total asphalt (applied to both seals) is used in the first layer and 60% in the second. The life of a multiple seal coat should be approximately three times that of a single seal. This can be achieved only if the base or underlying pavement is in very good condition.

Pre-coated aggregate

Pre-coating the aggregate with 1% asphalt will improve adhesion and lower the amount required. It also provides a uniform black surface and eliminates dust complaints. Excess aggregate should be removed as usual and can be reused. While slightly more expensive, it can be helpful in reducing dust and loose aggregate complaints in urban areas.

Summary of seal coat procedure

- Treat surfaces during the warm, dry summer months when weather is most conducive to success.
- Apply the aggregate immediately after the spray application while the asphalt emulsion is still brown-colored to ensure maximum imbedding in the asphalt.
- Use clean, hard, uniform-size, angular aggregate for best durability and traction.
- Roll with rubber-tired rollers as soon as possible. This imbeds the aggregate and orients the particles to the most stable position while the asphalt is still fluid.
- Provide traffic control. Rapid acceleration, high speeds, and braking action will continue to dislodge the chips until the asphalt is fully cured.
- Broom off excess aggregate after final set.



- Do not use too much aggregate, as chips will only be retained one stone deep. Excess chips act as grinding agents and loose chips can pose a safety hazard.
- Control quality and workmanship by using specifications in Sect. 408 of the Wis. D.O.T. **Standard Specifications for Road and Bridge Construction**.
- Pay attention to detail. The process is simple as long as you don't make mistakes. Problems lead to failures.
- Prepare the surface with necessary repairs and thorough cleaning.

Other asphalt surface treatments

Slurry seal is a mixture of asphalt emulsion, fine aggregate, and mineral filler spread on an existing pavement surface. It is used to fill cracks and scaled (pocked) areas of old pavements, to restore a uniform surface texture, and to seal the surface to prevent moisture and air intrusion into the pavement.

Slurry seals are used in applications similar to chip seals. They have the advantage of not requiring cover aggregate as the aggregate is already mixed with the emulsion. Eliminating excess chips is often an advantage in urban areas. Slurry seals tend to cost slightly more initially than chip seals.

The slurry is applied approximately 1/8 to 1/4 inch thick by a traveling mix plant. A spreader box squeegees the slurry onto the surface. The road or one lane must be closed to traffic until cure is complete. Weather restrictions similar to chip sealing apply.

The International Slurry Surfacing Association has developed specifications for various types and applications. Aggregate size and application rate increases as traffic volume and the need for leveling increases. Special mixes can provide "quick setting" or thicker application for rut filling ("micro-surfacing").

Since a range of types and applications exists, you must select the appropriate type and specifications. Construction quality should be monitored in cooperation with the contractor/supplier.

Fog seal is a light spray application of slow-setting asphalt emulsion diluted with water. It is sprayed directly on old asphalt surfaces to renew and seal them. It will help to waterproof an open texture pavement surface. The emulsion is usually diluted with an equal part of water to ensure penetration. It is not considered a replacement for a full seal coat.

Take care to avoid excess asphalt which can produce a slippery surface. Typical application rates range from 0.1 to 0.15 gallons per square yard.

Prime coat is an application of slow setting emulsion or asphalt cement to an aggregate base before an asphalt surface course is laid. It improves adhesion to the surface course and helps waterproof and strengthen the base. This is advantageous if there is a time lag between base preparation and paving. Typical application rates range between 0.1 and 0.3 gallons per square yard.

Tack coat is a very light application of slow-setting asphalt emulsion diluted with water and applied to an existing asphalt or portland cement concrete (PCC) surface. Used before an overlay it improves the bond between the existing surface and the overlay mat.

A very thin uniform film of asphalt is the objective. Using too much tack may be a bigger problem than using none at all. It is not always necessary to use tack between two asphalt surfacing layers. However, a tack coat is very desirable when overlaying asphalt on PCC pavements. Application rates are normally between 0.05 and 0.15 gallons per square yard.

Penetration or dust control coat is a dilute application of slow-setting emulsion to the surface of unpaved roads. It can be helpful in settling dust, can provide some waterproofing, and can help stabilize the surface. However, it has a limited life. Consider using it only on low volume roads. Typical application rates are between 0.1 and 0.5 gallons per square yard.

References and Resources

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- Basic Asphalt Emulsion Manual*, M519, Asphalt Institute (\$18)
- Asphalt Surface Treatments—Specifications*, ES-11, Asphalt Institute (\$6).
- Asphalt Surface Treatments—Construction Techniques*, ES-12, Asphalt Institute (\$7)
- Standard Specifications for Road and Bridge Construction*, Department of Transportation (Wisconsin).
- Specifications and Construction Guidelines* by International Slurry Surfacing Association, 1101 Connecticut Ave. N.W., Washington D.C. 20036-4303.
- Video**
- From TIC catalog; borrow through county Extension office:*
- Asphalt Chip Seals*, FHWA, #16650
- Single and Multiple Surface Treatments*, IRF, #16357.
- Seal Coat Applications*, #17162.

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