



Pavement Seal Coating Practices

An Online Continuing Education Course for Engineers

Course Number: T-5012

Credit: 5 Hours / 5 PDH / 5 CPD

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CHAPTER 1. SEAL COAT INTRODUCTION

Seal coating is a common preventive maintenance activity performed by most cities, counties and rural districts. It involves spraying asphalt cement on the surface of an existing pavement followed by the application of a cover aggregate. The asphalt cement is usually emulsified (suspended in water) to allow for it to be applied without the addition of extreme heat. The cover aggregate is normally either naturally occurring gravel or crushed aggregate such as granite, quartzite or trap rock (basalt).

BENEFITS OF SEAL COATING

The primary reason to seal coat an asphalt pavement is to protect the pavement from the deteriorating effects of sun and water. When an asphalt pavement is exposed to sun, wind and water, the asphalt hardens, or oxidizes. This causes the pavement to become more brittle. As a result, the pavement will crack because it is unable to bend and flex when exposed to traffic and temperature changes. A seal coat combats this situation by providing a waterproof membrane which not only slows down the oxidation process but also helps the pavement to shed water, preventing it from entering the base material.

A secondary benefit of seal coating is an increase in the surface friction it provides. This is accomplished by the additional texture the cover aggregate adds to the pavement. With time, traffic begins to wear the fine material from an asphalt pavement surface. This results in a condition referred to as raveling. When enough of the fine material is worn off the pavement surface, traffic is driving mostly on the coarse aggregate. As these aggregate particles begin to become smooth and polished, the roadway may become slippery, making it difficult to stop quickly. A seal coat increases the pavement texture and increases the surface friction properties.

CONDITIONS CONDUCTIVE TO LONG LASTING SEAL COATS

In most cases, seal coating is done on roadways with low to moderate traffic volumes (up to several thousand vehicles per day). This is due to the increased chance of windshield damage to vehicles during and immediately after construction as traffic volume and speed limits increase. While it is possible to successfully seal coat high speed, high traffic roads such as interstate highways, special precautions must be taken when seal coats are placed on these types of roadways to minimize the chance of problems occurring. Refer to Chapter 9 of this course for more details.

Seal coats are affected greatly by weather conditions, especially during construction. The ideal conditions are a warm, sunny day with low humidity. Humidity and cool weather will delay the curing time and cause the seal coat to be tender for a longer period of time making it more susceptible to damage by traffic. Rain can cause major problems when seal coating. If the asphalt

binder has not cured, it can become diluted and rise above the top of the cover aggregate. After the water evaporates, asphalt may cover the entire surface causing tires to pick up aggregate or track the binder across the surface. Seal coating should **never** be done when showers are threatening. For information on what to do if it begins to rain during construction, refer to Chapter 7 of this course.

Roadways to be seal coated should also be in relatively good condition. This means that there should be little, if any, load related distress such as alligator cracking, rutting and potholes. If these conditions exist, the road should not be sealed unless it is repaired first.

In summary, seal coating is a good maintenance technique for pavements with the following:

- Low to moderate block cracking.
- Low to moderate raveling.
- Low to moderate transverse and longitudinal cracking.
- A smooth surface with low friction numbers.

MATERIALS USED IN SEAL COAT CONSTRUCTION

The two main materials used in seal coat construction are the asphalt binder and the cover aggregate. The asphalt binder is normally an asphalt emulsion. The cover aggregate can be either natural or crushed.

Asphalt Binder

The most commonly used type of asphalt binder for seal coats is an asphalt emulsion. The other type of binder used for seal coating is cutback asphalt. However, their use has declined rapidly due to the costly and harmful solvents used.

Cutback Asphalt

A cutback asphalt consists of asphalt cement dissolved in a solvent, typically kerosene or naphtha (gasoline). The solvent softens the asphalt cement and allows it to be pumped and sprayed at fairly low temperatures. As the solvent evaporates into the atmosphere, only the asphalt cement remains. Once the solvent has evaporated, the cutback has fully cured.

Asphalt Emulsion

An asphalt emulsion consists of the following three components:

- Asphalt Cement;
- Water;
- Emulsifying Agent (surfactant).

The asphalt cement makes up about two thirds of the volume of the emulsion. The base asphalt used to make the emulsion typically has similar characteristics to the asphalt cement used in hot mix production. This is the same range that most asphalt cements used in hot mix production are in. In some cases, latex or polymer modified asphalt is used to make emulsion. These modified emulsions are used to improve early chip retention and seal coat durability.

Water is the second largest ingredient in the emulsion. It provides a medium for the suspension and transfer of the asphalt particles. When the asphalt and water separate from each other, the color of the emulsion will change from brown to black. When this process has occurred, the emulsion is said to have broken. The aggregate chips must be applied and rolled before this occurs, normally only a few minutes after the emulsion is applied.

The emulsifying agent, or surfactant, has two primary roles. First, it causes the asphalt particles to form tiny droplets which are able to be suspended in water. This is accomplished by the surfactant's ability to lower the surface tension between the asphalt and water. Having the asphalt particles suspended in the water allows the asphalt to be applied at much lower temperatures than it otherwise could be. Secondly, the emulsifying agent determines the electrical charge of the emulsion (cationic (+), anionic (-) or nonionic). It is important to choose an emulsion with an electrical charge that is opposite that of the aggregate. Since like charges repel, the emulsion will not bind well to aggregates with the same charge. Since most aggregates have a negative charge, Cationic (+) emulsions, such as CRS-2P, are used almost exclusively.

When an emulsion breaks, the asphalt particles separate from the water. Since the asphalt is heavier than the water, the water will rise to the top and eventually evaporate, leaving only the asphalt cement on the roadway.

Cover Aggregate

The cover aggregate should be clean and dust free, uniform in size and hard so that it provides a tight, durable surface able to withstand the abuse of snow plows and vehicles. As an example, consider the Minnesota Dept. of Transportation. In Minnesota, the gradation of seal coat aggregate is referred to as either FA-1, 2 1/2 or 3. The larger the number, the larger the aggregate. The FA stands for Fine Aggregate. By far, the most commonly used sizes are FA-2 and FA-3. An FA-2 (Figure 1.1) consists mainly of particles smaller than 1/4 inch. An FA-3 (Figure 1.2) consists mainly of the chips smaller than 3/8 inch.



Figure 1.1. Example of an FA-2 Pea Rock (buckshot)



Figure 1.2. Example of an FA-3 Granite

A more detailed discussion of both the asphalt binders and cover aggregate can be found in Chapters 2 and 3 of this course.

EQUIPMENT USED IN SEAL COAT CONSTRUCTION

There are several different types of equipment normally used to construct a seal coat. The exact type and size may vary depending on the situation and roadway width. The list of equipment is as follows:

- Power Brooms;
- Asphalt Distributor;
- Chip Spreader;
- Pneumatic Tired Rollers;
- Haul Trucks;
- Front End Loaders;
- Asphalt Tankers;
- Miscellaneous

Power Brooms

There are two different types of power brooms. In rural settings typically used in urban settings use pneumatic tires to clean any dirt or debris from the asphalt binder to adhere to. They also remove any excess aggregate.

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coats constructed in rural areas those constructed in urban areas use pneumatic tires before the seal coat to clean surface for the brooms are used to



Figure 1.3. Rotary sweeper typically used in rural areas