Fog Seals. Scrub Seals. Rejuvenators
Benefits and Differences

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BENEFITS AND DIFFERENCES

- Overview the concept and reasons for Pavement Preservation
- Understand the role seal coats and fog seal rejuvenators can have in a pavement management and preservation program
- Understand the components of asphalt and its aging process
The 2 Most Important Benefits Underlying Product Use

“Maximizing the Performance of Your Road Inventory”

“Minimizing the cost of ownership of your Road Inventory”
Any agency can implement the use of Seals by simply deferring a small amount of resurfacing.

<table>
<thead>
<tr>
<th>Miles of HMA Overlay</th>
<th>FOR</th>
<th>Miles of Rejuvenator</th>
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<tbody>
<tr>
<td>5 Miles</td>
<td></td>
<td>50 Miles</td>
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<tr>
<td>2 Miles</td>
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<td>20 Miles</td>
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<tr>
<td>1 Mile</td>
<td></td>
<td>10 Miles</td>
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<tr>
<td>½ Mile</td>
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<td>5 Miles</td>
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Why use Fog Seal, Scrub Seal and Rejuvenators

All are valuable pavement preservation tools that can play a vital part in extending the useful life of asphalt pavements.

They are important because of this........
Current Statewide PCI – State of California
Studies by many D.O.T.s show that every $1 spent on Pavement Preservation can save $8-$10 or more in future maintenance and rehabilitation costs.

![Graph showing the cost of timely maintenance over years.](Image)
Look at Avon’s Data
City of Avon, Indiana - Indianapolis

ANALYSIS REVEALS RESULTS OF ROAD PRESERVATION TIMING

- Program started in 1999, budget was limited and maintenance activities were trial and error experiments.
- By 2003, processes were fine tuned and by 2005 results started to look positive.

PASER AVERAGES 1999-2013

- PASER 1999 – 7.29
- PASER 2004 – 7.23
- PASER 2008 – 7.53
- PASER 2013 – 7.71
Hot Mix Asphalts Today

The North America crude market today has many recovered sources of crude. Many are blended to meet current PG or Performance Grade Specifications. Issues with asphalts and asphalt usage can happen with wrong blends for the intended use. Ask your supplier.

Usually issues are noticed with specialty emulsion blending, slurries and sealers such as emulsions mixed with clay and aggregate for parking or driveway sealers.
TERMINOLOGY CLARIFICATION

Aren’t they all the same?

- What is a Fog Seal?
- What is a Seal Coat?
- What is a Scrub Seal?
- What is a Rejuvenator?
There is confusion by many as to the definition of a “fog Seal” as more hybrid products enter the market.

Some agencies refer to it as a spray application of diluted asphalt cement.

Others refer to it as a spray application of a surface treatment.

It gets more confusing as some agencies refer to a “Chip Seal” as a surface treatment.

And now we have scrub seals / Scrub/Cape Seals
FOG SEAL

AEMA’s definition is:

"A light spray application of dilute asphalt emulsion used primarily to seal existing asphalt surfaces to reduce raveling and enrich dry and weathered surfaces. It can also be used as a color coating and as a paint striping surface preparation."

This really doesn’t provide much clarification either.
To simplify, it may be best to define fog seal or a seal coat as:

“the spray application of a liquid agent for rejuvenating and/or sealing a pavement surface.”
This makes sense because both seal coats and rejuvenators are fog seal applications as they are both spray applied.

However, they can differ greatly in chemical makeup.

All fog seals are not the same!

Different fog seals provide different results.
Fog Seal Candidate Criteria

• Overall Good Pavement Condition
• Slows Oxidation (a UV agent or sun screen)
• Fills Some Minor Cracks
• Binds Rock to a degree to stop Raveling
• Common Emulsions: SS-1h, CSS-1h, CQS
What is a Fog Seal applied SEAL COAT?

Seal Coats or Sealers are composed of a thin layer of an asphalt material such as cutbacks, asphalt emulsions, or paving grade asphalt.

Modifiers are often added to the asphaltic liquid mixture and may include rubber, latex, and polymers.

A few Seal Coat products also contain a small amount of rejuvenator additive though not in the same quantities found in the standard rejuvenator products. (Scrub Seal Emulsion)
Gilsonite Added Products

What is it – What are they...
Scrub Seals or “Scrub/Cape Seals”

The Theory

<table>
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<tr>
<th>Adds Asphalt and Seals the Surface</th>
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<tr>
<td>Rejuvenates existing oxidized asphalt</td>
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Scrub Seals Using Modified Emulsions

Used in the western United States since the late 80’s developed as hybrid emulsions originating from the CRF specification or ERA-5 specification.

Consists of a polymer modified rejuvenating emulsion which is scrubbed into the existing surface followed by an application of rock or texture aggregate.

California and Arizona have developed generic specifications for the product.
Theory of Scrub Seal/Rejuvenator Benefit

**Theory:**
Rejuvenator Drops Out And Mingles with asphalt binder

**Reality:**
Rejuvenator is blended with the PG Asphalt binder and polymer in the base then emulsified adjusting viscosity of finished cationic Emulsion.
Generally a little slower break or cure provides workability with the broom - ”emulsion wave” than The CRS, CQS Generics

Good Storage Life and Handling
Advantages

No Crack Filling may Required
Can be applied at both low and high temps

(40° F to 120° F)

High Flexibility – Rejuvenator Adjusts Viscosity – Relatively Stable

(3.5 % Polymer)

Although generic specs. Have reduced %

Will work with dirty chips
Drag and Scrub Methods from the Past
BREAKING THE CYCLE
PRESENT METHOD IS ...........

• Pave
• Re-Pave
• Pave
• Re-Pave
• Possibly Chip or Slurry or Scrub Cape Seal
• Grind or Mill and Re-Pave

Treat the Symptom - Not the Cause
What is a REJUVENATOR?

What are those “maltenes”?

I think they’re found in milk shakes...
Asphalt Rejuvenators

Similar Concept to treating a fence to preserve and at about the same interval.
Asphalt Rejuvenators Can Give you This
Instead of this...

Except they look like this.......
- And This.......
Instead of this...

And this... Tennessee

TREATED

UNTREATED

SR62 Rejuv Test - 05-30-03

SR62 Rejuv Test - 052903 - Close-up
What are Rejuvenating Seals?

They are engineered cationic emulsions containing maltenes, saturates (light fractions)

Reclamite® is a known and proven product with a 50 plus year history of product use.

It is colored coded to view absorption

The purpose is to soften the stiffness of the oxidized AC pavement surface and co-mingle or hydrate with the asphalt binder to extend the life of the pavement surface by adjusting properties of the AC mixture.

Maximum absorbance of the rejuvenator is expected and desired.
Asphalt consists of two main fractions: “asphaltenes” which are the hard brittle component, insoluble and not affected by oxidation and the highly reactive sub-fractions: “maltenes” These maltenes are oily and resinous in appearance.
Components of Asphalt

Petroleum Asphalt is comprised of two fractional components: Maltenes and Asphaltenes.

Petroleum Maltene Rejuvenator – No Asphaltenes
Maltenes must penetrate into the pavement co-mingle and flux with the binder.
**Sealers** contain some maltenes + Asphalt BUT Do Not Penetrate the Binder

**Rejuvenators** contain Maltenes Fractions in Balance & Penetrate the Binder
Reactive Components Deteriorate causing an Imbalance with the Asphaltenes

The loss of the liquid asphalt oils or maltenes in the upper 3/8'-1/2” of the asphalt pavement begin the deterioration process
The constant UV ray exposure and heating effect from the sun cause the maltene fractions to be baked or oxidized from the pavement’s AC.
This is why a new pavement looks like this........
a one year old pavement looks like this.........
a 15 year old pavement looks like this........
and a 20 year old pavement looks like this!
Fog Seal REJUVENATORS

Non-maltene coal tar based products marketed as rejuvenators include:

PDC, Rejuvaseal, WD-2000

These products are more often used around airports due to the coal tar’s resistance to damage from fuel oils. Many agencies now shy away from the use of these products on parking lots or roadways due to their coal tar PAH content.

Generally most have never noticed newer 737, A-320 or commuter jets leaking oil parked on the tarmac or gate. Not the issue it once was. Similar to new vehicles
Fog seal “COATINGS”, often referred to as Sealers, Seal Coats and/or Bituminous Seal Coats are emulsions used for a variety of applications, including:

- **Sealing** of dense mix HMA from water and air infiltration,
- **Re-coating** of raveling open-graded mixes,
- **Adhering** loose aggregates on freshly applied chip seals
- **Stoppage of raveling** on older HMA pavements.
Fog Seal COATINGS are also sometimes used to provide:

- Colored contrast delineation of paved shoulders,
- Temporary cosmetic “new black” appearance for some streets.
- SS-1h would be a well known fog coating
The escalated cost of asphalt and resurfacing have prompted the introduction of various new products marketed as rejuvenators.

There appears to be no independent research or test study results for some of these new products, or at least any that are readily accessible.

Without such reports being available, agencies should use caution if deciding to use any product that has no time proven or tested performance results. Those would include many of the bio blends using citrus d-limonene or methyl esters as the carrier.
IMPACT ON SKID RESISTANCE

Fog seal rejuvenators and sealers will lower skid numbers.

Experience has shown that the maltene base rejuvenators cause a shorter lasting and often less reduction in skid numbers.

Fog seal coating products have shown to cause a much longer lasting and sometimes permanent reduction in skid numbers.

Temporary application of sand at 1 to 2 lb./sy. can normally improve skid resistance.
IMPACT ON SKID RESISTANCE

Problems some agencies have experienced in the past were attributed to the use of unqualified contractors who had little or no experience in the application of fog seal rejuvenators or sealers.

As a result, some agencies have either halted use of fog seals or have declined to use them in light of other agencies problems they been made aware of.
The proper application of these products is best performed by contractors that have received adequate training and solely specialize in the application of the products.

A qualified contractor will know what pavements it can or cannot treat and what application rates and mixtures will provide satisfactory and safe results.

A qualified contractor will shy away from treating any questionable pavement.
IMPACT ON SKID RESISTANCE

Excessive application rates of Seal Coatings can cause unacceptable skid numbers and is sometimes difficult to correct.
Which roads make GOOD rejuvenator candidates?

- Aged dense graded HMA showing aggregate loss
- Chip seals (lose of rock)

![Open Grade HMA](image)
High Speed Roadways or Expressways

- Interstate, expressway or other high speed roadway traffic lanes should generally not be considered for treatment.

(They could be treated under specially controlled conditions.)
Which roads make BAD rejuvenator candidates?

Tight Surface
Not suitable

Rich Surface
Not Suitable
PAVEMENTS NOT SUITABLE FOR REJUVENATOR AND SEAL COAT APPLICATION

Roadways with excessive amounts of pavement distress.

- Pavements with numerous areas of base failure.
- Pavements with excessive amounts of alligator cracking unless these areas are repaired prior to the fog seal application.
Paved Shoulders are excellent candidates for fog seal Rejuvenators and/or Seal Coats.
Residential streets are excellent candidates for fog seal Rejuvenators or Seal Coats.
Sanded and Swept
Arizona

Frank Lloyd Wright, Scottsdale
Arizona

Osborn Road, Scottsdale, Arizona October 2013  No requirement to re stripe immediately
Seal Coats

Pavements selected for treatment with seal coat products should be in fair to good to condition to provide maximum life extension.

Typically pavements from 7 to 10 years of age are excellent candidates and can benefit from these products abilities to enrich and/or fill voids left from severe raveling of surface aggregates and ability to provide minimal filling and sealing of cracks.
Weather Limitations

AMBIENT TEMPERATURES

- Rejuvenators -

Maltene based rejuvenators are normally best applied when ambient temperatures are in the range of 50° F and rising.

Higher temperatures allow these products to penetrate quicker into the pavement.

Lower temperatures slow penetration times, however, as necessary these products can be heated as a means of getting faster penetration in lower temperatures.
Weather Limitations

AMBIENT TEMPERATURES

Seal Coats

Depending on the type of sealer being applied these products normally are best applied when ambient temperatures are in the range of 50° F and rising.

Maximum ambient temperature limits of 75°- 80° F may be necessary in areas with humidity levels greater than 50% in order to obtain acceptable cure times and minimize the time required for lane closures.
Weather Limitations

PRECIPITATION

Both rejuvenators and seal coats require dry pavement conditions for proper application.

Application of both rejuvenators and seal coats should be avoided when there is more than a 50% chance of rain in the weather forecast.
REJUVENATORS

Maltene based rejuvenators work by changing the chemistry of the asphalt cement binder by replenishing the lost maltenes back into the asphalt cement restoring its asphaltene to maltene ratio back to nearly new levels.

This in turn softens the pavement surface restoring its flexibility and resistance to cracking.

It also restores the cohesive ability of the asphalt cement to retain aggregate, thereby preventing further raveling.
Benefits of an Asphalt Rejuvenator

1 Increases penetration value of the asphalt cement in the top portion of the pavement which extends the pavement’s lifecycle.

2 Seals pavement against intrusion of air and water, thereby slowing oxidation, preventing stripping and raveling and protects the pavement in-depth.

3 Increases the durability of the asphalt in the top portion of the pavement by improving the chemical composition of the asphalt cement.
BENEFITS & RESULTS

REJUVENATORS

Densifying the binder, reducing water permeability
Seal coats seal a pavement’s surface and provide a temporary blackening of pavements.
These sealers work to fill the voids in a raveled pavement’s surface, lock in remaining surface aggregate and seal minor cracking. They seal the surface and help to prevent oxidation and further loss of maltenes. They do not replenish maltenes.
These sealers work to fill the voids in a raveled pavement’s surface, lock in remaining surface aggregate and seal minor cracking. They seal the surface and help to prevent oxidation and further loss of maltenes. They do not replenish maltenes.
Generally reduce skid numbers by a minimum of 10%-25%

If applied to a tight pavement surface, more severe reduction of skid numbers can result.

Due to the void filling by the seal coats, the lowered skid resistance can last several months or longer and the pavement may not be a candidate for subsequent retreatments.

Depending on the product used and temperature and humidity levels, the cure time for seal coats can be 4-5 hours or longer.

Seal Coats cover up pavement striping and markings resulting in the need and cost for restriping.
CONCERNS

REJUVENATORS

Generally reduce skid numbers by a minimum of 10%-25%

If used on tight, impermeable pavements, the oil may remain on the surface, leaving a surface that may exhibit poor skid resistance. This is normally corrected if sand or slag is applied over the treated surface at 1 to 2 lbs./SY.

The lower skid numbers typically return to normal or acceptable levels within 3-4 days, much quicker than the lower skid numbers associated with seal coats.

Tracking of residue typically occurs onto untreated surfaces. However, the tracking normally wears and fades away within 2-4 weeks.
Longer cure times require that traffic be kept off the treated pavement for longer periods than a rejuvenator treated pavement.

Dark tracking from any tacky, uncured surface can occur. This is a particular problem if it is tracked onto concrete driveways and other untreated surfaces as the tracking can last several weeks or longer.

This is more of a problem in areas with humidity levels over 50% and can sometimes be addressed by limiting applications to times when high temperatures are below 75-80 F.
The “new black pavement” color typically only last from several months up to a year or so as the coating material is quickly worn off the exposed aggregate in the pavement surface.

As such, the new pavement look and color delineating affect for treated shoulders goes away fairly soon.
COST OF APPLICATION

SEAL COATS

Depending on the type of sealer used, the geographic area and the size of the project, the average cost for labor, equipment and materials is approximately:

$0.55 - $1.00 Per SY YD

or

$11,000 Per 2 Lane Mile (24 ft. wide)
COST OF APPLICATION

REJUVENATORS

Depending on the geographic area and the size of the project, the average cost for labor, equipment and materials is approximately:

$1.00 - $1.20 Per SQ YD.

or about

$15,000 Per 2 Lane Mile (24 ft. wide)
COST OF APPLICATION

Scrub Seals

Depending on the geographic area and the size of the project, the average cost for labor, equipment and materials is approximately:

$2.50 Per SQ YD.

or about

$35,000 Per 2 Lane Mile (24 ft. wide)
Rejuvenators and seal coats are both Fog Seal applied products but are not the same.

Maltene based Rejuvenators work by changing the chemistry of the asphalt HMA back to new or nearly new condition.

Rejuvenators seal the pavement’s surface, restore its flexibility and restore the asphalt cement’s cohesive ability to act as a glue and retain aggregate.
Seal Coats or Sealers are asphalt based products, generally in emulsified forms.

There are various brands and types of Seal Coat products available.

Seal Coats work by enriching a pavement’s surface with a new coating that fills voids and lock remaining aggregate in place.

Seal Coats seal a pavement’s surface and help prevent further oxidation and loss of maltenes.
REFERENCES

“FHWA/FP2 Sealer/Binder Study”, 2007, Gayle King, Project Manager, GHK, Inc.

“Asphalt Rejuvenators - Fact or Fable”, August 2000, Robert Boyer, Asphalt Institute.


Thank You – Questions Welcome

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