Chapter 6
Fog and Rejuvenating Seals

From… Maintenance Technical Advisory Guide (MTAG)

Managers' Overview

From… Maintenance Technical Advisory Guide (MTAG)

Fog and Rejuvenating Seals

- What are they?
- Why use them?
- When to use them?
- Where to use them?

What is a Fog Seal?

A mixture of asphalt emulsion and water applied to the asphalt surface of a road, street or highway. The primary purpose is to seal the road surface and defer surface degradation



Fog Seals - Description

- Light application of diluted slow-setting asphalt emulsion
- Common uses
  - Seal aged surface
  - Improve lane delineation
- Cost: 0.12 to 0.17 $/yd^2

  (0.15 to 0.20 $/m^2)
- Typical treatment life: 1 to 2 years

A Fog Seal Job



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A Fog Seal Appearance



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Why Use Fog Seal?

- An inexpensive way of arresting raveling and adding binder back to aged surfaces
- Fog seals are also useful in chip seal applications to hold chips in place in fresh seal coats to help prevent vehicle damage arising from flying chips
- improve sealing or waterproofing
- improve the surface appearance

When to Use Fog Seal?

- Pavement surface condition – Dry mixes, high air voids, and surfaces showing minor and/or moderate raveling.
- When chip seals are in need to prevent aggregate loss.
- Pavement age – relatively newer pavement (not more than 2 years in service)

Where to Use Fog Seal?

- Pavement surface condition – Dry mixes, high air voids, and surfaces showing minor and/or moderate raveling.
- Pavement surface mix – can be used on dense-, gap-, and open-graded mixes; however, the seal must penetrate.

What is a Rejuvenating Seal?

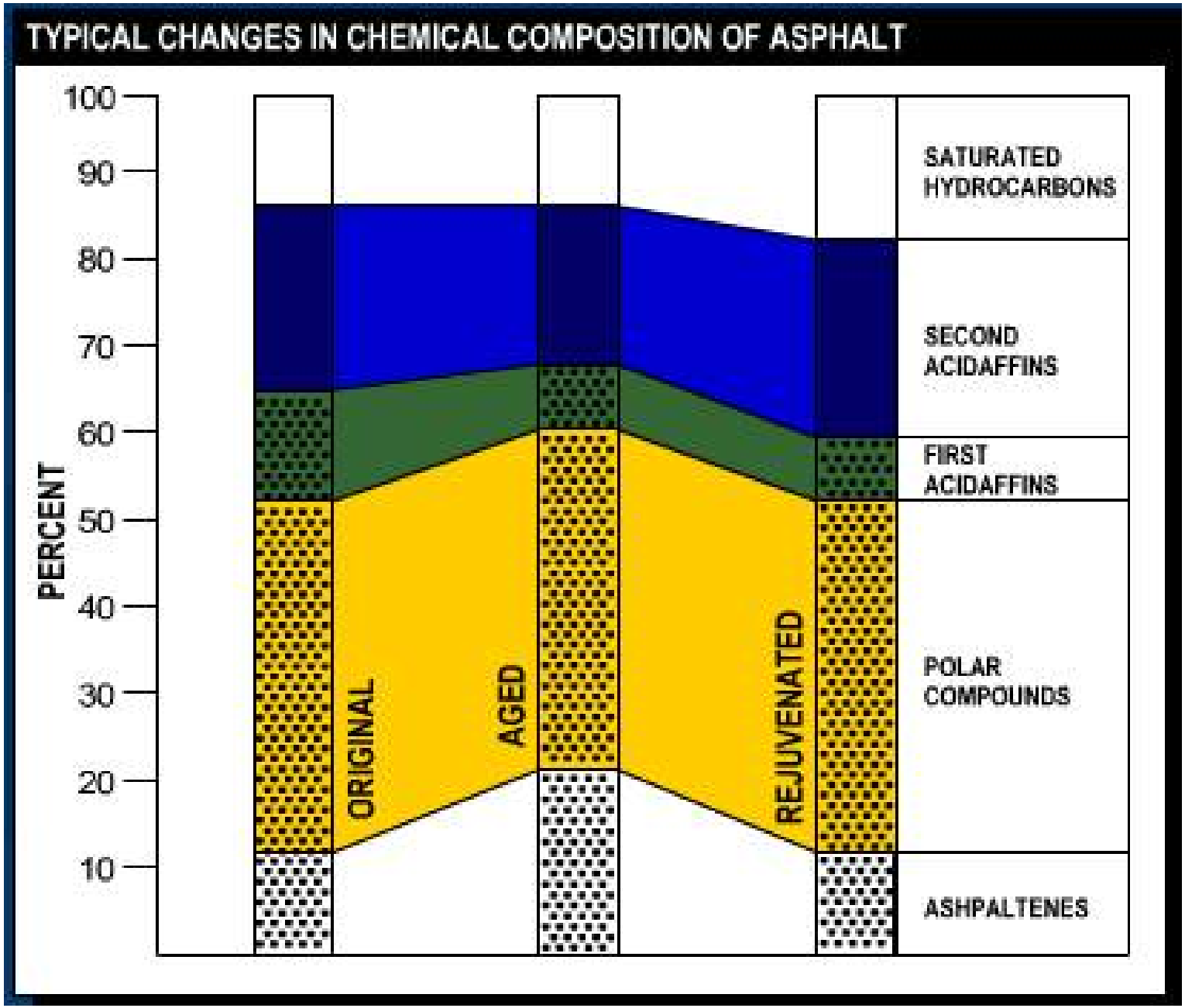
- Are typically cationic emulsions that are a blend of maltenes (light fractions) and possibly modified with asphalt and polymer
- The primary purpose is to soften the stiffness of the oxidized AC pavement surface and flux with the asphalt binder to extend the life of the pavement surface by adjusting properties of the AC mixture.
- Maximum absorbance of the rejuvenator is ideal.

A Rejuvenating Seal Job…



Why Use a Rejuvenating Seal?

- A way to soften the hardness of an oxidized asphalt surface, making it less brittle. (increases penetration and corresponding reduction in viscosity)
- The major benefit of a rejuvenating seal is to improve the flexibility of the asphalt binder by restoring oxidized components and to slow down the rate of aging and oxidization.
- Assisting in tightening and densifying the binder (Sunscreen and waterproofing)


TYPICAL CHANGES IN CHEMICAL COMPOSITION OF ASPHALT
PERCENT
100
90
80
70
60
50
40
30
20
10
ORIGINAL
AGED
REJUVENATED
SATURATED HYDROCARBONS
SECOND ACIDAFFINS
FIRST ACIDAFFINS
POLAR COMPOUNDS
ASHPALTENES

When to Use a Rejuvenating Seal?

- Construction seal to new asphalt pavements.
- Rejuvenating seal to pavements in the 1-4 year age to extend pavement life before the use of a wear course seal is required.
- To correct pavements exhibiting minor segregation, raveling, poor compaction.
- A rejuvenating scrub seal would be used on pavements exhibiting more distress than a straight rejuvenator seal could address.

Where to Use Rejuvenating Seal?

- Can be used on dense-, gap- and open-graded pavement surface mixes



Heavily aged, dense-graded HMA



Open-graded HMA

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Rejuvenating Seal Appearance - Before and After



Module 6-1

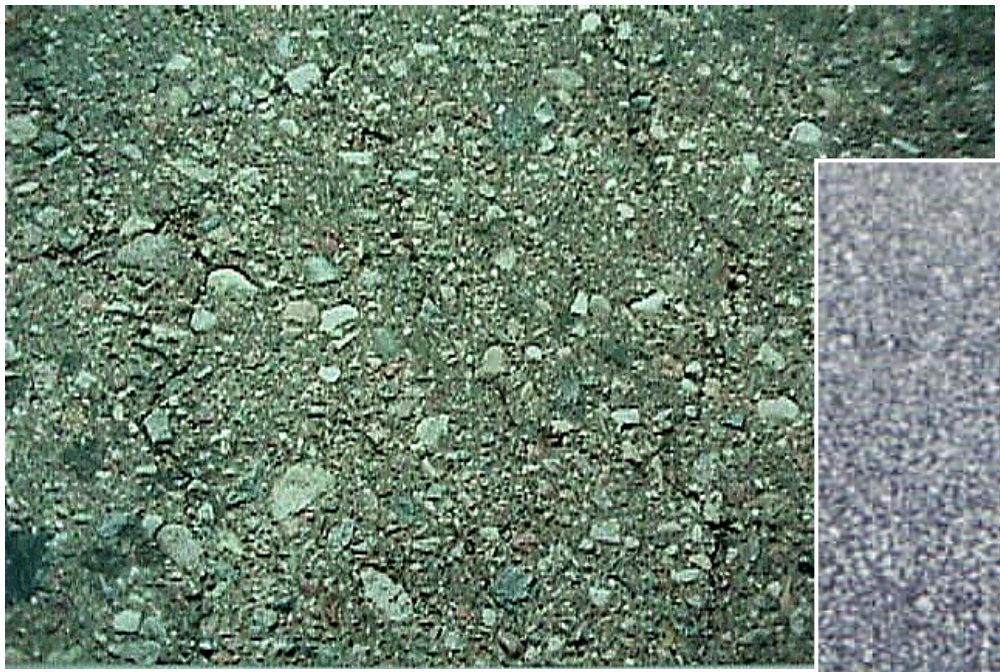
Design, Materials & Specifications

From… Maintenance Technical Advisory Guide (MTAG)

Project Selection – Fog Seals

- Pavement surface condition – Dry mixes, high air voids, and surfaces showing minor and/or moderate raveling. Fog seal can also be used on chip seals to prevent aggregate loss.
- Pavement age – relatively newer pavement (not more than 2 years in service)
- Pavement surface mix – can be used on dense-, gap-, and open-graded mixes; however, the seal must penetrate.

Fog Seals - Suitable Surfaces



Heavily aged, dense-graded HMA



Open-graded HMA

Fog Seals - Unsuitable Surface



Fog Seals - Before and After





Fog seal over existing chip seal

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Rejuvenating Seals Before and After





Project Selection – Rejuvenating Seals

- Construction seal to new asphalt pavements.
- Rejuvenating seal to pavements in the 1-4 year age to extend pavement life before the use of a wear course seal is required.
- To correct pavements exhibiting minor segregation, raveling, poor compaction.
- A rejuvenating scrub seal would be used on pavements exhibiting more distress than a straight rejuvenator seal could address.

Design Considerations

- The design objective is to determine the application rate and sometimes dilution rate. Standard Dilution is 1:1 with water. The actual application rates may vary during the construction. The use of a ring test kit for determining application should be considered.

Ring Test Kit





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Materials - What is an emulsion?

- Mixture of base oil and/or asphalt, water, and emulsifying agent
- 50 to 75% of mix is asphalt
- “Breaking”—separation of water and base oil or asphalt
- “Curing”—development of the mechanical properties

Materials – General Terminology

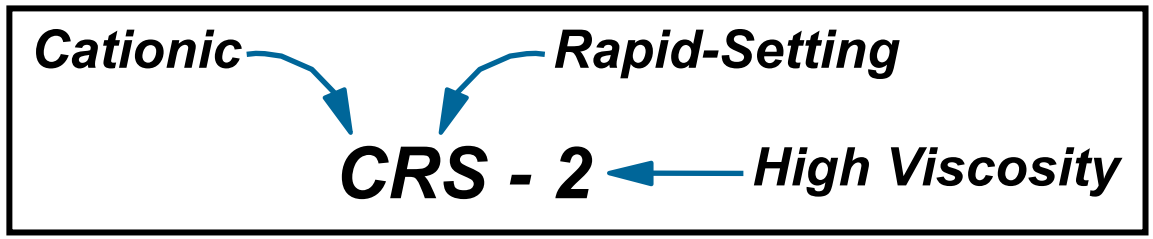
- **Emulsion Concentrate** – A mixture of base oil and/or asphalt and water that contains a percentage of emulsifying agent.
- **Diluted emulsion** – The emulsion concentrate that has been diluted by adding an amount of water usually 1:1 and could be 2:1 (product to water)
- **Residual asphalt content** – In an emulsion containing asphalt - the amount of asphalt remaining on the pavement surface after the emulsion has broken and cured (after all water has evaporated).

Materials – Fog Seals

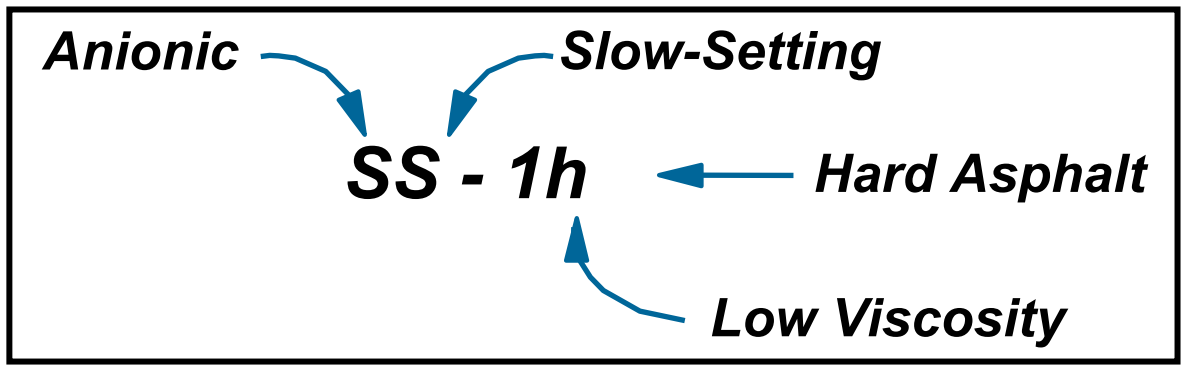
- Usually asphalt emulsion and water. In some cases, the emulsions are made with a range of additives for special purposes.
- Emulsion types - may be
  - Cationic (i.e., a positive surface charge on the asphalt particles), or
  - Anionic (i.e., a negative surface charge on the asphalt particles).
- Primary types used: CSS-1h and SS-1h. In some circumstances, CQS-1h (and LMCQS-1h) will give a faster set.

Asphalt Emulsions

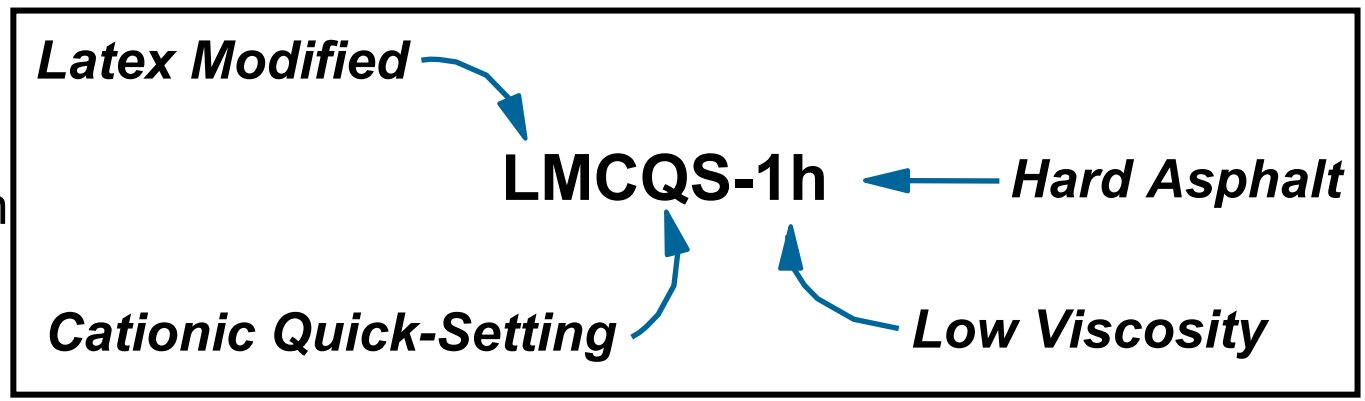
Chip Seal Emulsion



Tack Coat



Slurry Emulsion



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Emulsion - Classification

Emulsion Type	Slow Setting	Medium Setting	Rapid Setting
Anionic	SS-1 SS-1h	MS-1 MS-2 MS-2h HFMS-1 HFMS-2 HFMS-2h HFMS-2s	RS-1 RS-2 HFRS-2
Cationic	CSS-1 CSS-1h	CMS-2 CMS-2h	CRS-1 CRS-2

Materials – Rejuvenating Seals

- They may be emulsions of rejuvenating additives and may include asphalt, polymers, and other additives
- Types of products commonly used in California (Branded)
  - Reclamite
  - PASS
  - Topein C
  - Styraflex
  - CRF®
  - ERA-25, ERA-75

Materials – Rejuvenating Seals

- Reclamite - Emulsified rejuvenating oil formulation of light binder fractions – maltenes, acidifins, saturates. Does not contain asphalt binder
- PASS – Emulsified mixture of recycling agent, polymer and asphalt
- Topein C – Emulsion mixture of tall oil pitch, asphaltene resin, and asphalt
- Styraflex – Emulsified mixture of recycling agent, polymer and asphalt
- CRF – Restorative Seal – Emulsified rejuvenating oil formulation of light binder fractions and contains a softer asphalt binder.

Specifications

- Fog Seals - NSSP 37-050
- Rejuvenating Seals - NSSP 37-600

Module 6-2

Construction and Inspection

From… Maintenance Technical Advisory Guide (MTAG)

Fog Seal Construction

1. Confirmation of Site Conditions
2. Surface preparation
3. Material preparation
4. Emulsion application
5. Sand blotter and sweeping (if necessary)

Confirmation of Site Conditions

- Consideration of site conditions is essential to proper curing
- Little or no chance of rain
- Temperature conditions
  - Air: 5 °C (40 °F)
  - Pavement: 15 °C (60 °F)
- Traffic control

Pavement Surface Preparation



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Equipment Inspection

- Broom
- Spray distributor
- Sand spreader
- Trucks
- All equipment

Materials Preparation

- Slow setting emulsion recommended
- Check compatibility of water used to dilute the emulsion
- Dilute emulsion no more than 24 hours before application

Emulsion Application





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Emulsion Application—Distributor Calibration

- Pre-construction
- Pump rate
- Application rate
- Coverage test



Emulsion Application

- Application rate: 0.45 to 0.70 l/m^2 (0.10 to 0.15 gal/yd^2)
- Spray temperature range: 20 to 70 °C (70 to 160 °F)

Emulsion Application (gal/yd2)

% Original Emulsion	Dilution Rate	Tight Surface* (gal/yd²)	Open Surface** (gal/yd²)
100	0	0	0
50	1:1	0.03 – 0.11	0.09 – 0.22
40	1.5:1	0.04 – 0.12	0.11 – 0.29

Always dilute the emulsion prior to application

Distributor Truck — Spray Bar Height

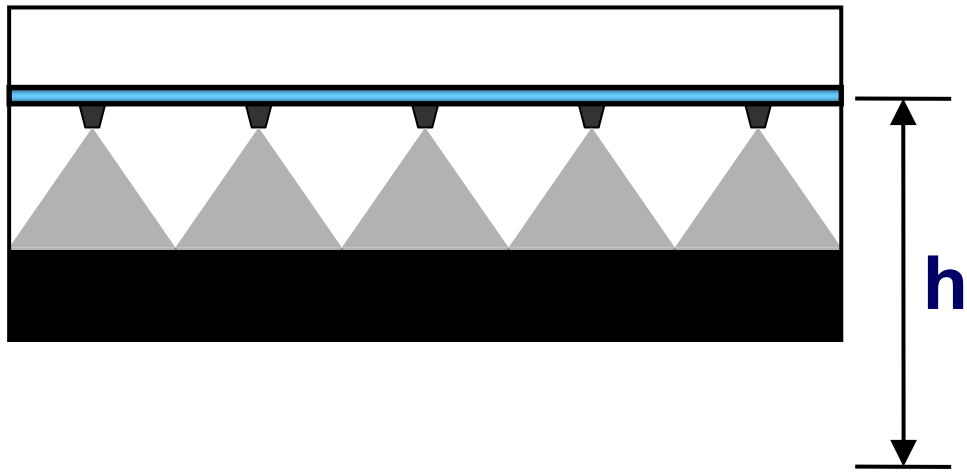
Spray Bar and Nozzles

Single Overlap

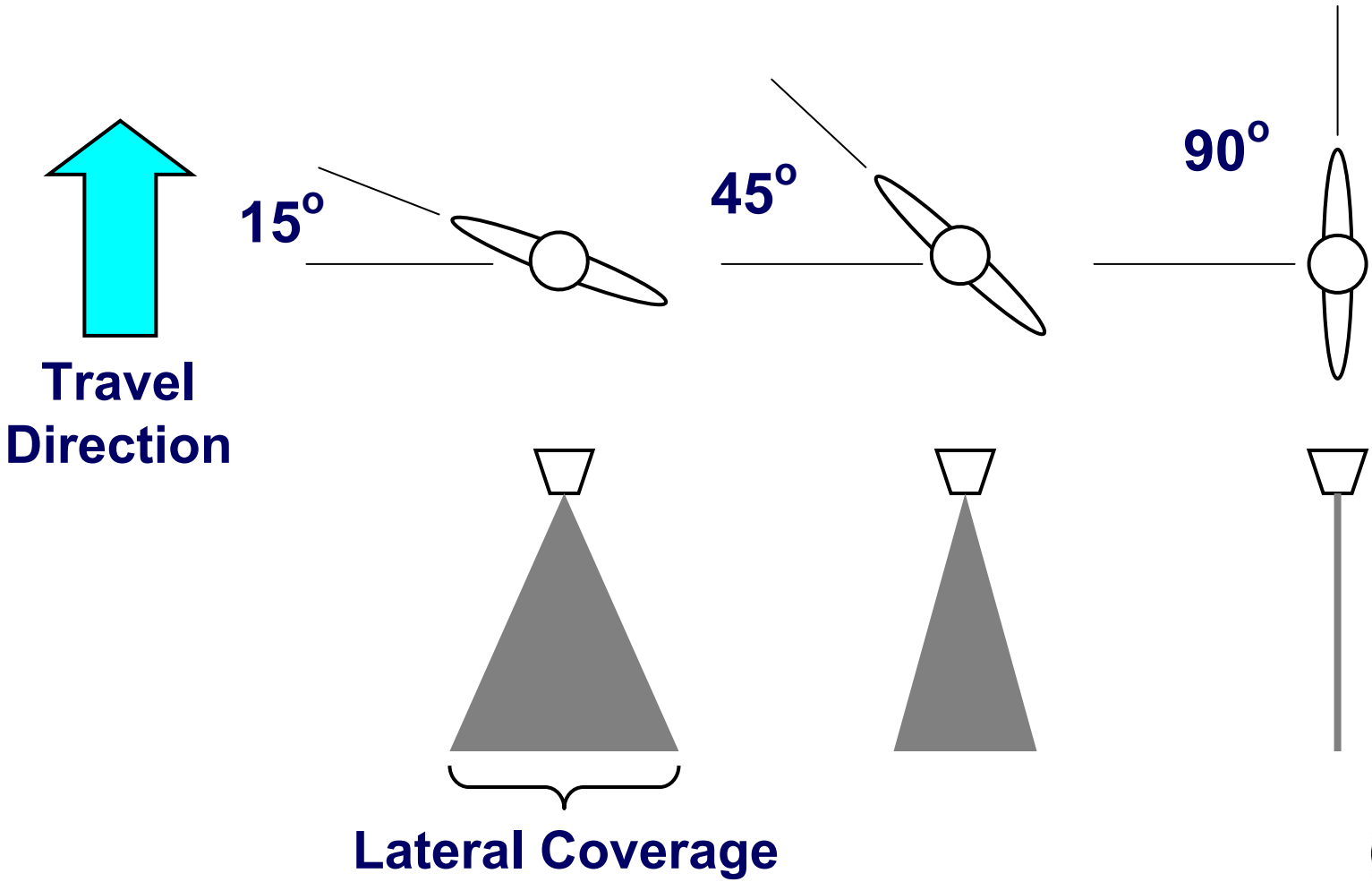
Double Overlap

Triple Overlap

Roadway Surface



Asphalt Distributor—Spray Nozzles

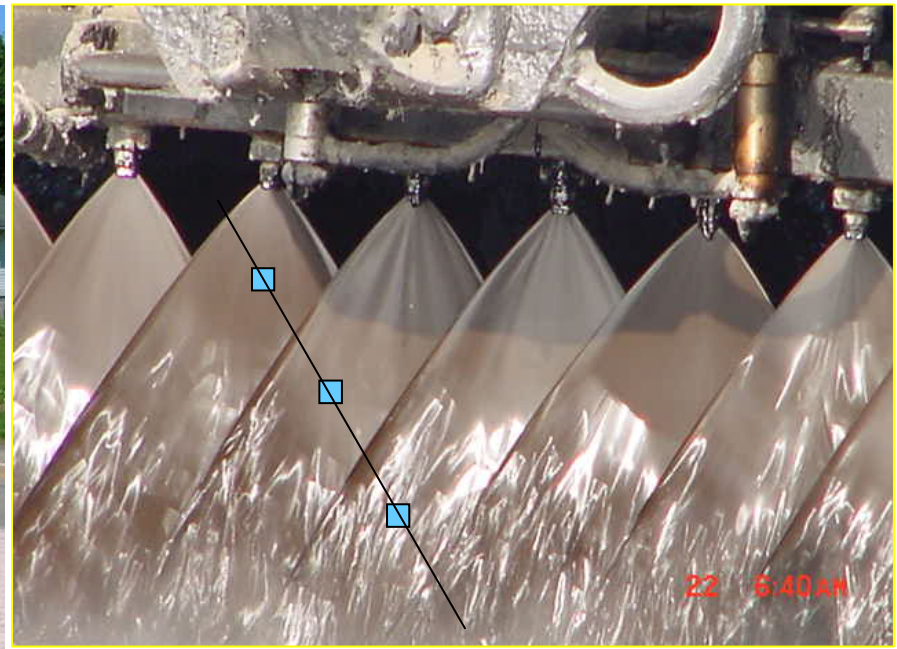


Distributor Truck Applying a Surface Seal

Rejuvenator



Asphalt Fog



Post Treatment Procedures

- Sand blotter and sweeping (if necessary)
- Pavement should NOT be opened to traffic until adequate friction is restored

Rejuvenating Seal Application



Rejuvenating Seal

Application of Sand



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Dos and Don'ts

- Do check water compatibility before dilution
- Do check dilution - has it been done, by whom, and when?
- Do ensure that there is no contamination of the base emulsion by water, oils, or other liquids.
- Do prevent contamination by other emulsions.
- Do protect emulsions from freezing or localized boiling due to the application of direct heat.
- If heat required Do ensure heating coils are under the liquid level (max 122°F (50°C)).

Dos and Don'ts

- **Do load from the bottom of tankers or sprayers to avoid foaming.**
- **Do check equipment and nozzles.**
- **Do check application rates.**
- **Do exercise proper traffic control.**
- **Do ensure the know-how is available on the job.**
- **Do add water to emulsion, not emulsion to water.**

Dos and Don'ts

- **Don't** store diluted emulsion longer than 24 hours.
- **Don't** continuously stir or circulate emulsion.
- **Don't** apply emulsion if air temperature is < 50°F (10°C) and pavement temperature < 60°F (15°C).
- **Don't** apply emulsion if rain or cool temperatures are imminent.
- **Don't** continue application if adequate breaking period is not available.
- **Don't** open treated surface to traffic until coefficient of friction is at least 0.30 as determined by CT 342.

Troubleshooting - Approach



Troubleshooting Summary

	Slick Surface	Not Breaking	Washes Off	Tacky Picks up	will not dilute	breaks too fast	dilution wrong
Road Wet	x	x	x				
Road Too Dry				x		x	
Road Dusty				x		x	
Hard Water					A		
Alkaline Water					C		
Acidic Water					A		
Application Too High	x	x	x	x			x
Application Too Low						x	x
Wrong Emulsion		x	x	x	x	x	
Rain	x	x	x				
Cold Weather	x	x					
Hot Weather				x		x	

A=Anionic; C=Cationic

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Common Problems and Related Solutions

PROBLEM	SOLUTION
Spattering of the Emulsion	▪Reduce the rate of dilution. ▪Ensure the spray bar height is set correctly. ▪Ensure the spray pressure is not set too high.
Streaking of the Emulsion	▪Ensure the emulsion is not too cold. ▪Ensure the emulsion viscosity is not too high. ▪Ensure the nozzles are at the same angle. ▪Ensure the spray bar is not too high or too low. ▪Ensure the spray bar pressure is not too high. ▪Ensure all nozzles are not plugged.
Bleeding or Flushing	▪Ensure the emulsion application rate is not too high. ▪Check application and dilution rate and recalibrate sprayer, if necessary.

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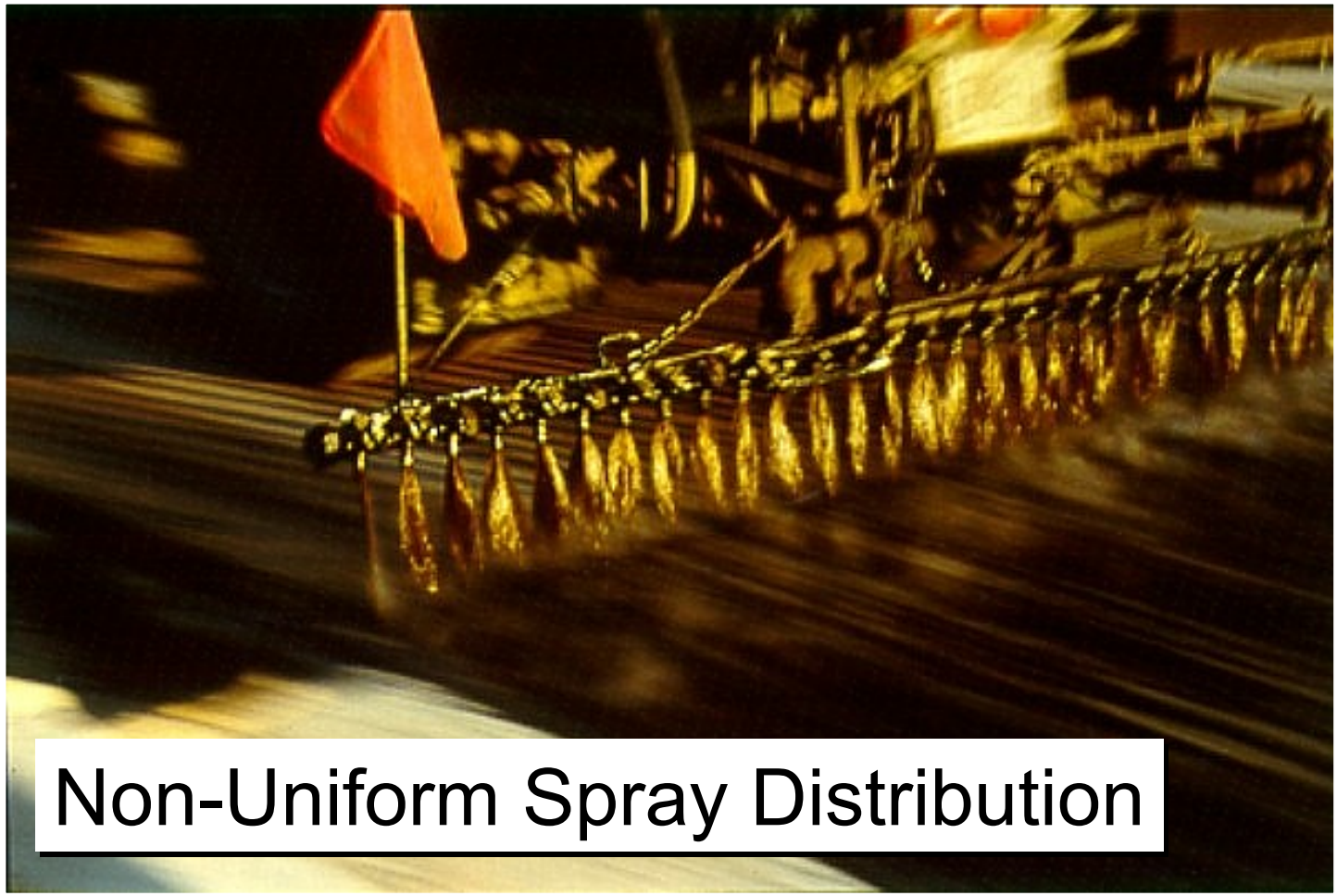
Troubleshooting

What is wrong here?



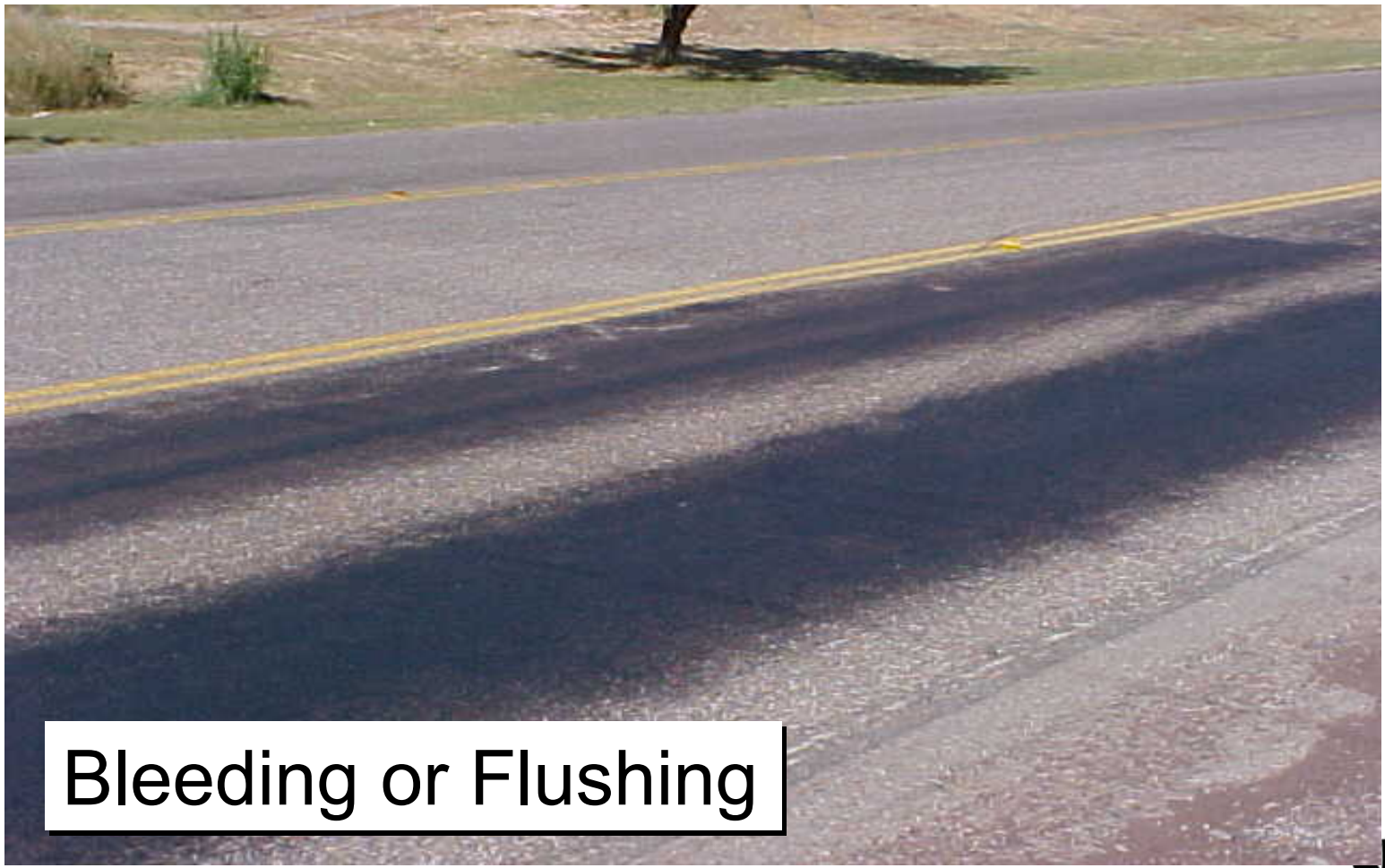
Troubleshooting

What is wrong here?



Troubleshooting

What is wrong here?



Troubleshooting - Possible Construction Problems

- Problem:
  Sand not sticking

- Potential causes?

Troubleshooting - Possible Construction Problems

- Problem:
  Excessive splattering of emulsion

- Potential causes?

Troubleshooting - Possible Construction Problems

- Problem:
  Emulsion not breaking or breaking later than expected
- Potential causes?

Troubleshooting - Possible Construction Problems

- Problem:
  Treatment washes off pavement

- Potential causes?

Troubleshooting - Possible Construction Problems

- Problem:
  Treatment remains tacky, causing "pickup" by tires

- Potential causes?

Troubleshooting - Possible Construction Problems

- Problem:
  Emulsion will not dilute

- Potential causes?

Troubleshooting - Possible Construction Problems

- Problem:
  Emulsion breaking too fast

- Potential causes?

Summary

- Provided an overview of fog and rejuvenating seals
- Discussed design, materials, and specifications
- Discussed construction and inspection
- Discussed Dos and Don’ts
- Discussed problems and potential causes for troubleshooting

Thank You

Questions?