

Seal Coats & Rejuvenators

Presented by Todd Mellema

This presentation is going to cover the following;

- Why Pavement Preservation is important.
- The difference between seal coats and rejuvenators.
- What applications to use each and why.
- Application methods, techniques and precautions.
- Economic advantages.



Pavement Preservation

Is Applied Asset Management.

Applied Asset Management combines Engineering,
Sound Business Practices and Economic Theory
together to manage our infrastructure in the most cost
effective manner.

Pavement Preservation

Is a managed plan using:

The Right Product

On the Right Pavement

At the Right Time

To maximize the investment for
maximum benefit.

Why is Pavement Preservation so important?

- Sources within the Congressional Budget Office claim the Highway Trust fund will have a budget shortfall of almost \$200 billion for 2011.



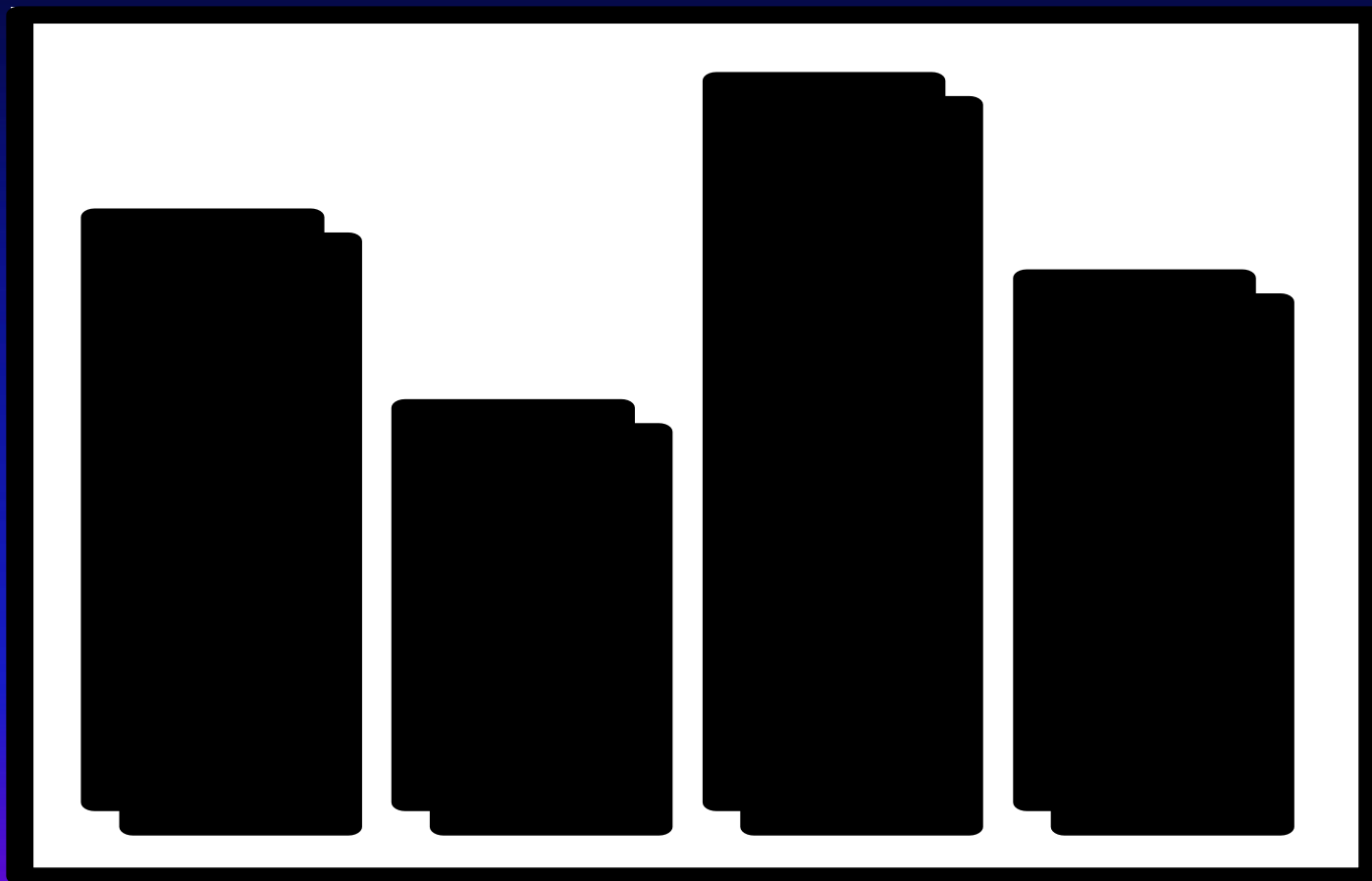
- The Colorado Department of Transportation alone estimates it will have a \$200 million shortfall in 2011.



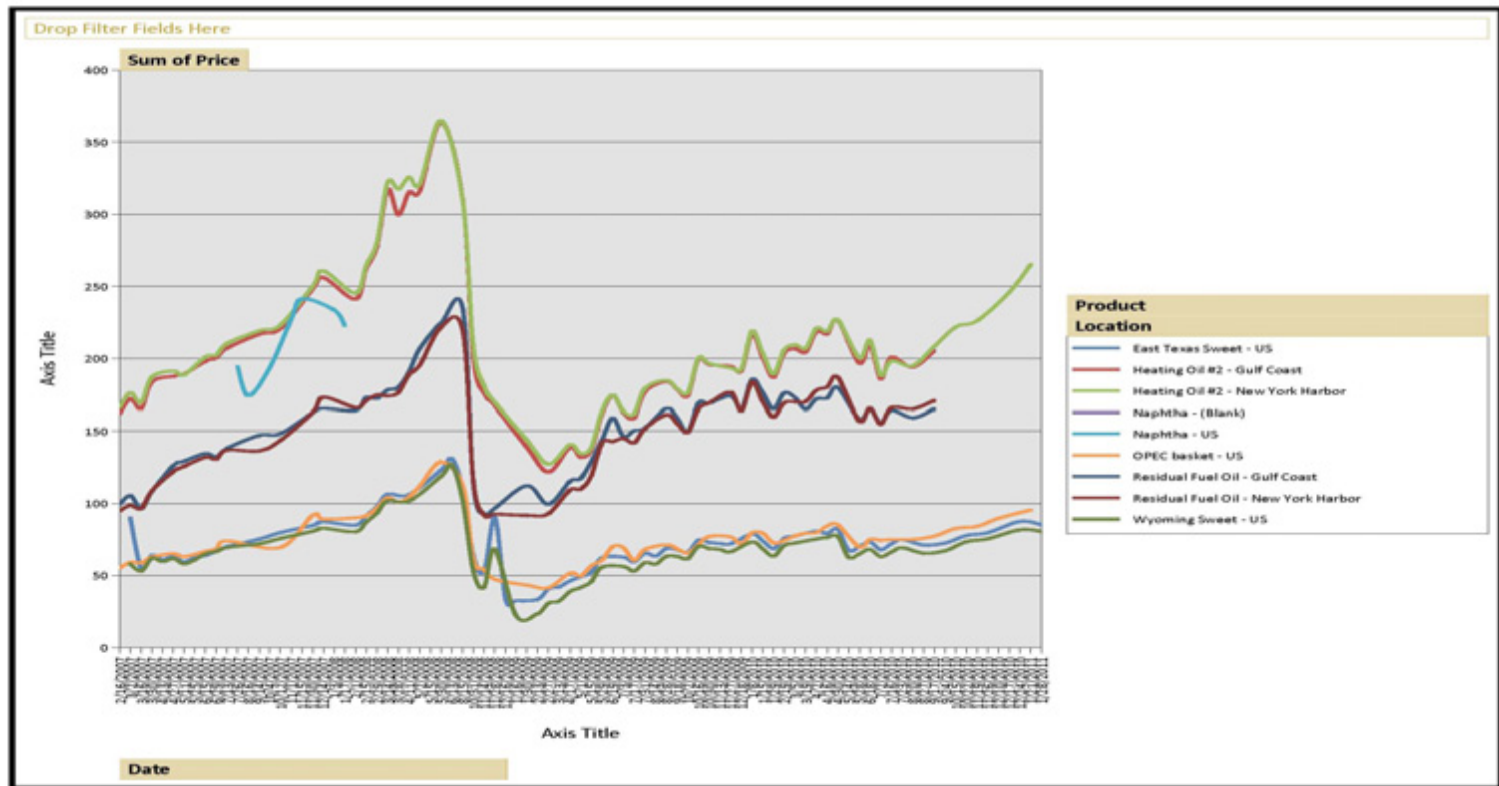


With the development of new highly efficient refining processes. Asphalt feed stocks now have gas value and must compete for market share.

This competition has resulted in driving the cost of asphalt binders up to the values we see today.



Oil & Gas Journal - Crude, Fuel Oil & Distillate Price Index,



The increased value of asphalt binders combined with other factors have driven the cost of hot mix asphalt up 300% from the mid \$20 to an excess of \$60 per ton or more depending on the region and quantity.



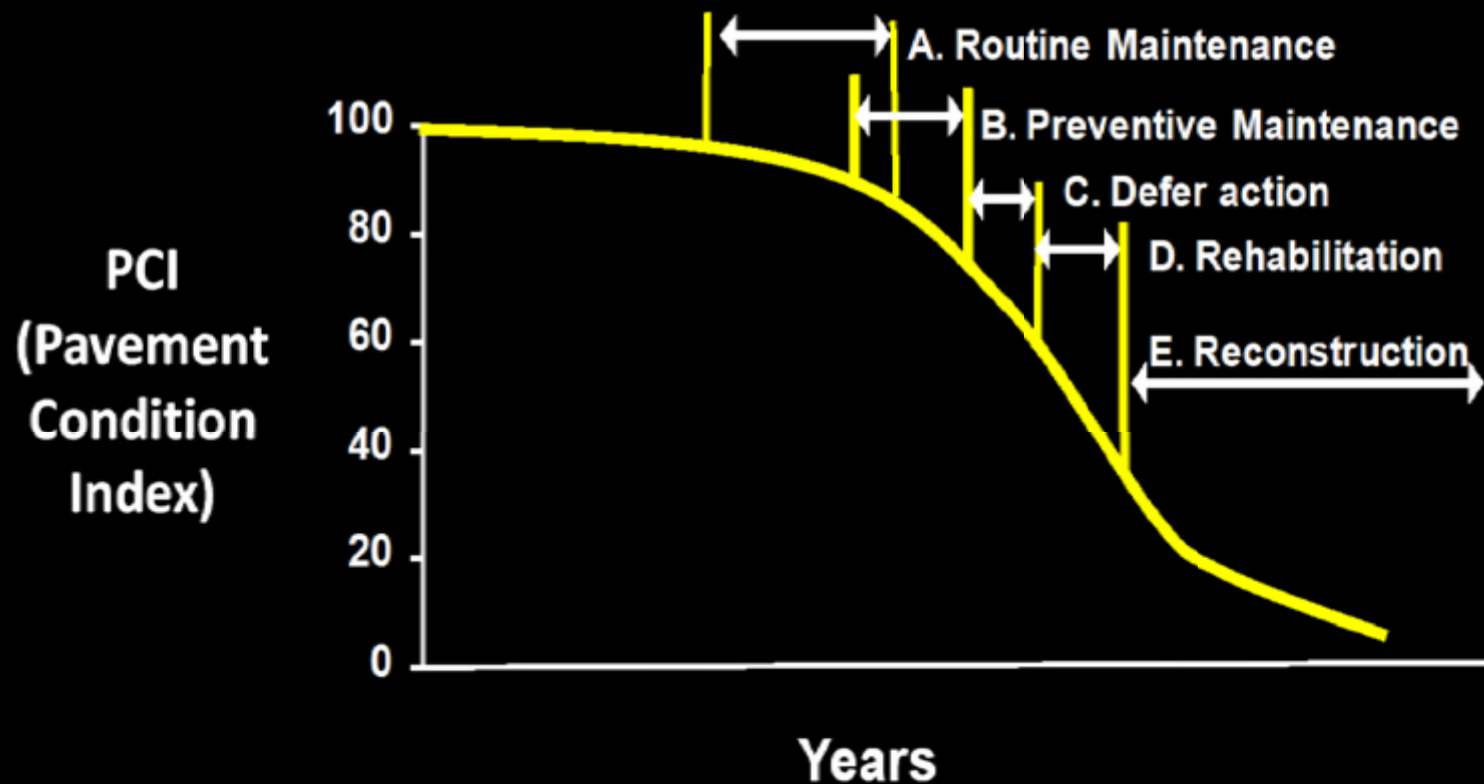
What is this telling us.

We need to take better care of our
infrastructure with
Managed Pavement Preservation.

How do we do that?

Make the best use of funds available

- Manage assets
 - Employ Pavement Preservation techniques to protect your investment.
 - Perform scheduled preventive maintenance treatments to slow down binder deterioration therefore extending pavement life.



How do Seal Coatings and
Rejuvenators fit into all this.

- Seal Coatings and Rejuvenators help preserve the asphalt pavement by;
 - Waterproofing the surface
 - Protect the surface from damaging effects of the sun
 - Provide a wearing course
 - Rejuvenate the binder
 - Keep the pavement healthy and flexible
 - Lower the life cycle cost of the asphalt pavement

There are several different types of surface treatments that can be considered Seal Coats and they all perform different types of functions.

Chip Seals



Slurry Seal



Fog Seals



Sand or Scrub Seals



Mineral Filled Seal Coatings



There are also many types of
Rejuvenating Agents for many
applications.

Hot & Cold in Place Recycling



Infrared Patching



Cold Mix Asphalts



Penetrating Rejuvenators for Pavement Binder Rehabilitation



The remainder of this presentation is going to be limited to;

- Mineral filled seal coatings.
- Penetrating rejuvenators for pavement binder rehabilitation.

What's the difference between seal coats and rejuvenators?

- Mineral filled Seal Coats are primarily a thin surface coating that provides a protective, waterproof wearing course.
- Rejuvenators are a penetrating agent engineered to penetrate the surface and rehabilitate the binder.

Mineral Filled Seal Coat

- Seal coats are a good economical coating system that provides a durable, weatherproof surface to protect the pavement from traffic and the affects of weather and the sun.



Pros & Cons of Seal Coatings

Pros

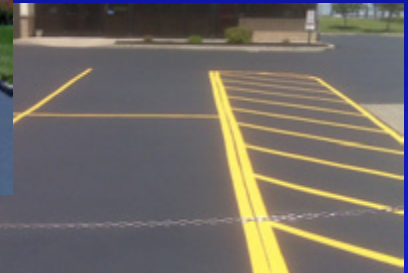
- Economical
- Reasonable durability
- Waterproof the surface
- Prevents oxidation
- Can be fuel resistant (coal tar only)
- Protects from the sun
- Provides a nice black surface

Cons

- Wear off quickly in high traffic areas
- Can only be used in warm weather
- Can be toxic (coal tar)
- Once it wears off, it provides no protection for the pavement
- Frequent reapplication can be detrimental to the pavement

Where to use Seal Coats

- Seal Coats can be used on almost any asphalt pavement surface where the traffic speed is 40 MPH or less.
 - Driveways
 - Parking lots
 - Residential communities



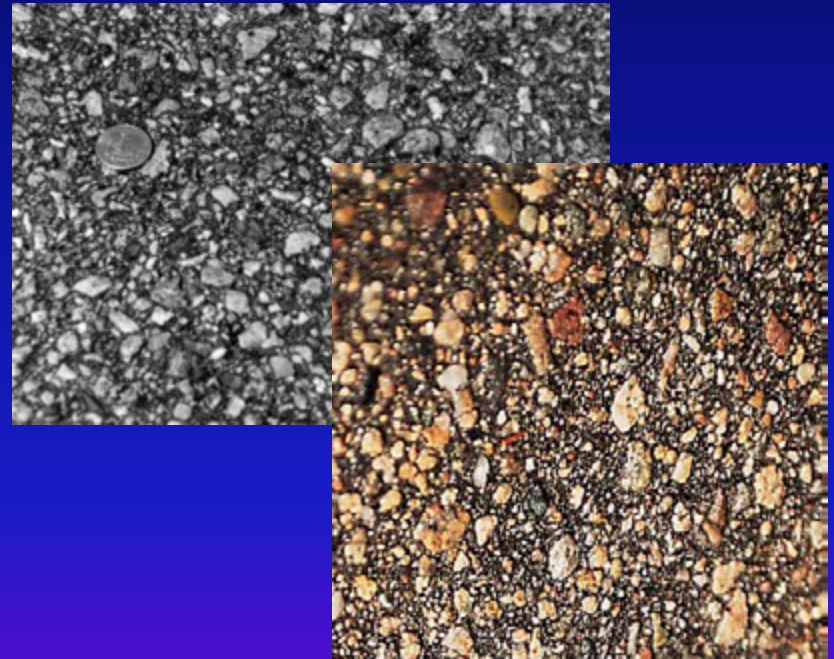
What type of pavements are good candidates for seal coats?

- Good tight pavements that are more than 90 days but less than a year old.



Can older pavements be Seal Coated?

- Yes – almost any type pavement surface can be seal coated with a mineral filled coal tar or asphalt emulsion seal coating.
- However, the older the pavement the less benefit there will be.



Application Best Practices

- The success or failure of any surface coating will be dictated by the care that is taken in the cleaning and prep work prior to application and the attention to detail during application.

- Mineral filled Seal Coats are manufactured using;
 - Clay and or mineral fillers
 - Fibers
 - Chemical stabilizers
 - Water
 - Refined coal tar and/or asphalt emulsions

Materials

- Sealer: Shall be a plant mix coal tar or asphalt emulsion sealer.
- Aggregate: If required, shall be a clean silica sand or boiler slag free of contaminants.
- Water: Water for dilution and mixing shall be potable and free of soluble salts. Water should be a minimum of 50°F.
- Oils spot primer: Must be compatible with sealer.

Application Precautions

- Pavement and ambient air temperatures should be at least 50° F and rising.
- Application should not proceed if rain or wet weather is occurring or is anticipated within eight hours of completion of the days work.
- Application should not occur if freezing temperatures are expected within 24 hours after application.
- DO NOT over dilute sealer beyond manufactures recommendations.

Equipment

- Application equipment should be in good working order and that is capable of maintaining the required application rates as specified by the seal coat manufacturer.
- Spray applicators should use a regulated positive displacement pump that can maintain consistent flow rates.



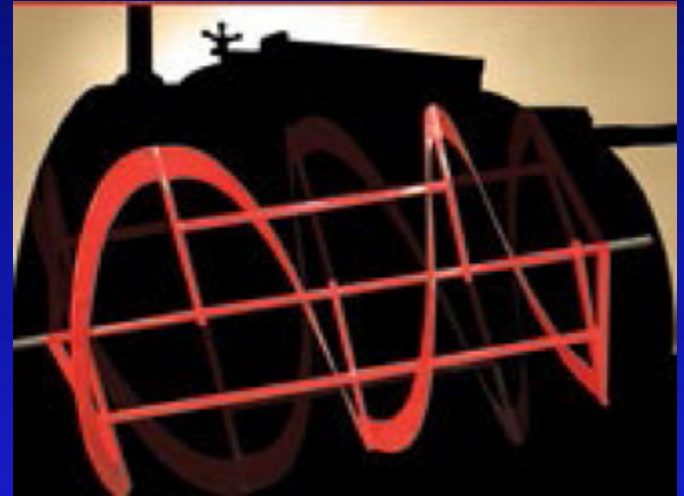
Equipment - Continued

- Self propelled squeegee applicators should ensure ground speed is known, pumps calibrated and ensure squeegees are clean, the correct durometer (hardness) and are set at the proper weight / tension setting.



Equipment - Continued

- Mixers should be:
 - Mechanically powered.
 - Agitators should be of a full sweep design.
 - Helical design agitators provide better mixing qualities resulting in maintaining consistent suspension of solids and require less torque and or horsepower.



Equipment - Continued

- Hand operated squeegee and or brush application should be restricted to trimming activities and areas not accessible to mechanized equipment.
- Hand applied material is to be applied at the same rate and standards as mechanized applicators.



Surface Preparation



- Pavement surfaces to be treated should be clean and dry and free of all dirt, sediments and other debris prior to application.

Surface Preparation - Continued

- Patching; Patch and repair all pavement defects, potholes, depressions, alligator areas.



Surface Preparation - Continued

- Crack seal:
 - Clean all cracks $\frac{1}{4}$ " and larger, remove vegetation and treat with a herbicide. If at all possible apply herbicide at least seven days in advance to cleaning to effectively kill weeds.
 - Install a hot applied crack sealant suitable for the application and climate.
 - Cracks larger than 1-1/2" should be treated with a mastic suitable for wide crack repair.

Cleaning - Continued

- Cleaning: Cleaning of the surface is the most important phase of installation. Clean the surface prior to installation using a mechanical blower and sweeping. Pay close attention to areas where water ponds to look for areas with heavy sediment. Treat these areas with aggressive brooming to remove the sediment.



Cleaning - Continued

- Oil Spots:
 - Remove oil and grease that has not penetrated the pavement surface with scraping or scrubbing with a detergent.
 - Treat cleaned oil spots with a oil spot primer as per manufacturers recommendations.



Mixing of the Seal Coat

- Dilute and blend the sealer mixture as recommended by the sealer manufacturer. Mixture must be of a continuous smooth homogeneous mixture of uniform consistency.
- Add small additional amounts of water as necessary to provide a workable consistency.
- In NO CASE is the water content to exceed the recommendations of the manufacturer.

Mixing - Continued

- If manufacturers or customers specification calls for sand do so as per the recommended specification.



Pros & Cons of Sand

Pros

- Sand adds skid resistance values.
- Increases viscosity
- Inexpensive filler to extend the seal coat.

Cons

- Sand adds surface area to the mixture decreasing the percentage of binder content requiring the addition of fortifiers to help strengthen the matrix.
- Once sand begins to wear out of the matrix it becomes an abrasive on the surface of the pavement which can result in shortening the life of the seal coating.

Application

- Apply the first coat at the application rate as specified by the manufacturer.
- Allow each coat to sufficiently dry so as application equipment may get back on to the previous applied seal coat without causing damaging.
- Apply a second coat as specified by the manufacturer.
- When applying by squeegee be sure to half lap each pass to ensure smooth consistent application rates.
- Add additional coats as deemed necessary and/or in heavy traffic areas.

Drying

- The final coat must be allowed to dry at least 8 hours in good dry conditions.
- If cool, humid or overcast weather conditions exist, longer drying times of up to 24 hours or more may be required.
- Thoroughly check the surface to ensure the seal coat has fully cured before opening to traffic.

Additives

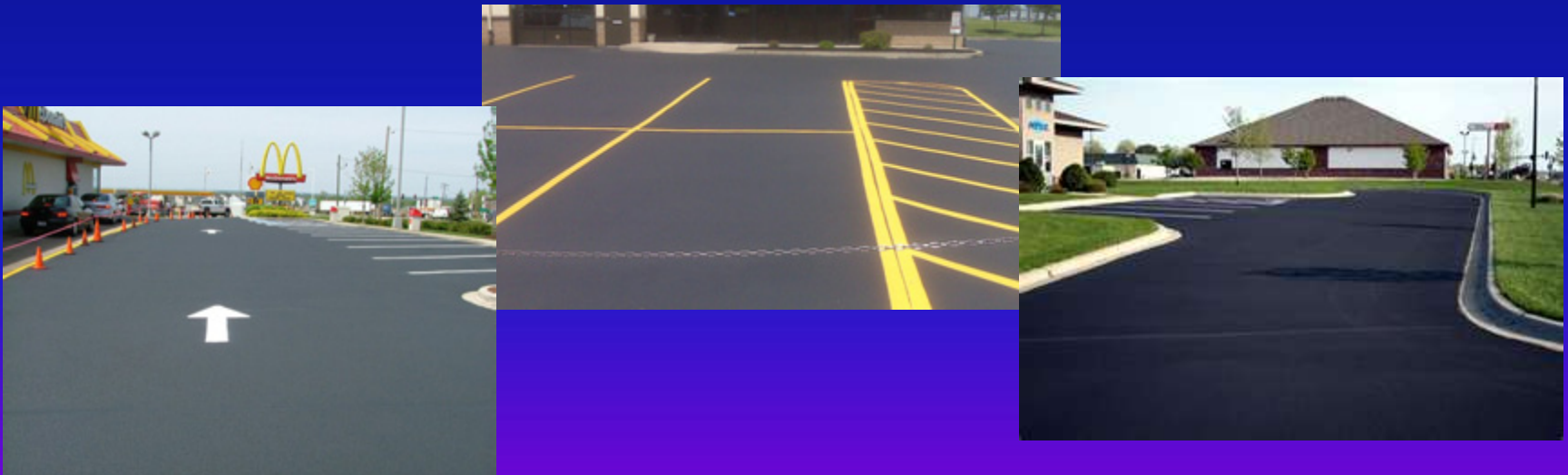
Additives have several advantages.

- Improve durability
- Improve filler and or sand suspension
- Decrease tire scuffing
- Increase or decrease viscosity
- Accelerate or lengthen drying time

If using additives be sure to mix a test sample to test compatibility and determine the required percent of addition.

Benefits & Results

Seal coats provide a cosmetically appealing durable, weather proof, like new black appearance that will protect the pavement from the elements for up to 1 to 3 years or longer.



Cost of Application

- Depending on the type of mineral filled seal coat used, the geographic area and the size of the project, the average cost for labor, equipment and materials is approximately:

\$0.75 to \$2.25 per sq yard

Or

\$4,800.00 to \$14,520.00 per lane mile

Rejuvenators

What are Rejuvenators?

Rejuvenators are a penetrating agent engineered to penetrate the surface and rehabilitate the asphalt binder.

What do Rejuvenators do?

- Rejuvenators by design penetrate deep into the surface of the asphalt pavement and rehabilitate the binder by reintroducing the *maltenes* necessary that have been lost due to the natural occurring oxidation process. These *maltenes* are necessary to keep the asphalt binder healthy.
- A healthy binder results in a flexible mat that resists raveling thereby keeping the top layer of fines in place protecting the course aggregate resulting in keeping the asphalt matrix healthy.

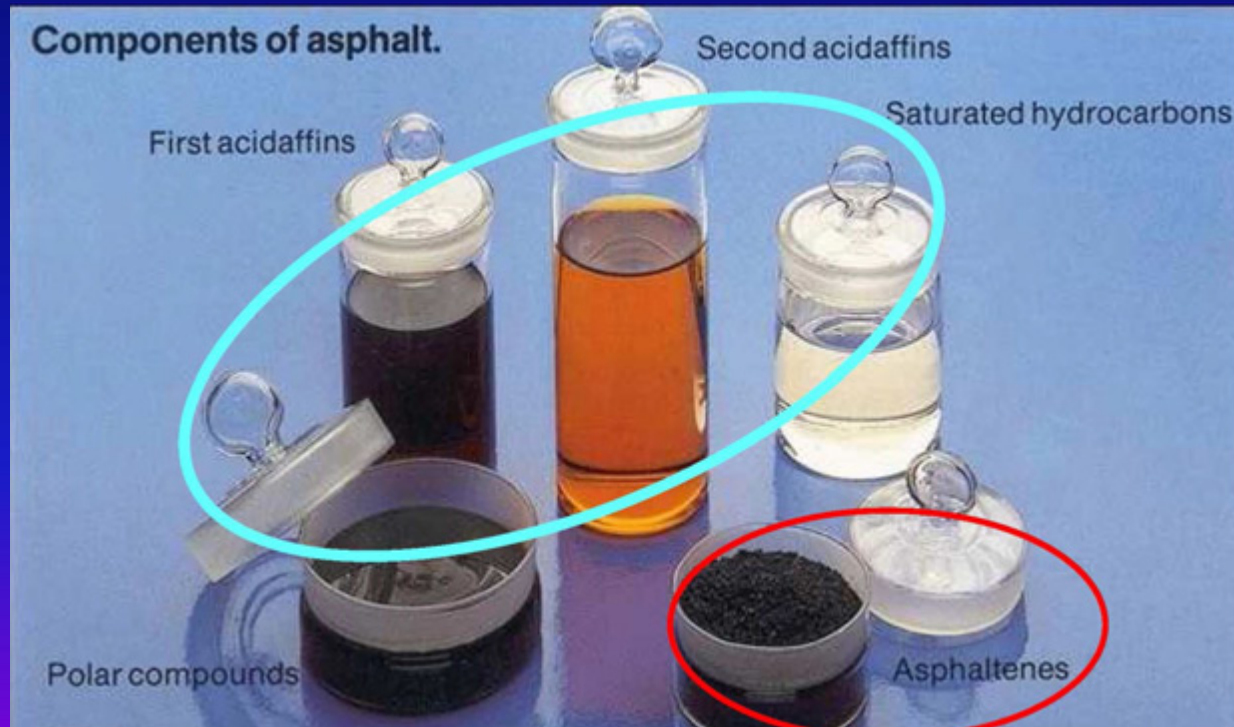
What are Maltenes?

- Maltenes are a fractional component of the asphalt cement.



Petroleum Asphalt is comprised of two fractional components:

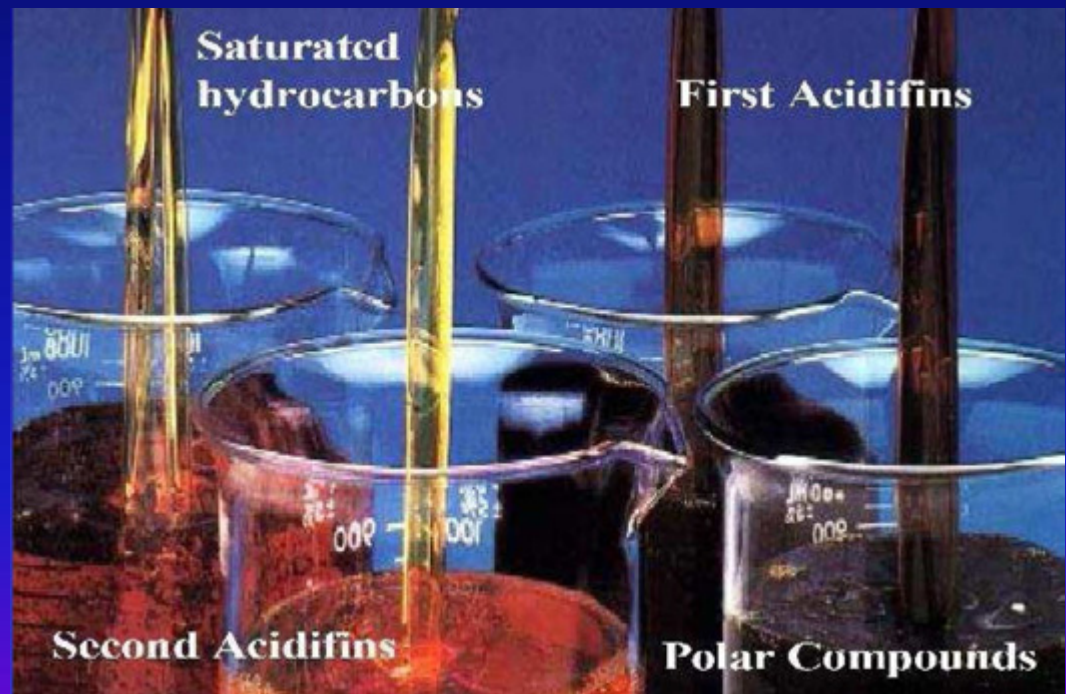
Maltenes and **Asphaltenes**



- Asphaltenes are defined as that fraction of the asphalt insoluble in n-pentane.
 - The function of the asphaltenes is to serve as a bodying agent.
- Maltenes is the collective name for the remainder of the asphalt material left after extraction of the asphaltenes.

Maltenes are the so called goodies that keep asphalt binders healthy.

- There are four principle bodies of maltenes that have been identified and each has a specific function.



The four bodies are:

- Polar compounds are nitrogen base components of highly reactive resins, which act as a dispersant for the asphaltenes.
- First acidifins – are components of resinous hydrocarbons which function as a solvent for the dispersed asphaltenes.
- Second acidifins – are components of slightly unsaturated hydrocarbons that also serve as a solvent for the dispersed asphaltenes.
- Saturated hydrocarbons or paraffins – are components of hydrocarbons, which function as a jelling agent for the asphalt components.

Why are these four compounds important?

- Because Asphaltenes are soluble only in the presence of Polar Compounds. The First and Second Acidifins act as a medium to disperse the dissolved Asphaltenes, and the Saturated Hydrocarbons develop the setting characteristics of the entire solution.

What are the primary causes of asphalt binder deterioration?

There are basically three primary causes of asphalt binder deterioration.

1. Highly efficient refining processes
2. Hot mix production
3. Mother Nature



The American paving industry is behind the eight ball before the liquid asphalt even leaves the refinery.



Refining Technology

- Advances in refining technology have produced such highly efficient refining processes that asphalts now have Gas Value. With these efficient techniques refiners can strip more and more of the Maltenes out of today's asphalts leaving us with a barely usable bitumen that we are forced to fortify with polymers to substitute the lost of the maltenes.

This doesn't mean the refiners are cheating us.

The refiners are making as good of asphalt as the specifications will allow and economic and or market demands will permit.

Europe has solved this problem

- The BP refinery at Rotterdam Germany is one of the largest refineries in Europe. This facility, one of several in Europe, produces bitumen specifically engineered with a proper balance of the Asphaltenes and Maltenes necessary for quality roadway construction.





Hot Mix Production

- The process of hot mix production is the second phase of the breakdown of asphalt binders. The extreme heating required for the mixing process aids in the aging process by literally cooking out (blue smoke) a fraction of the Maltenes.
- This combined with transportation to the job site, the hot mix in mass retains heat longer thereby allowing more of the light ends or Maltenes to cook out of the mix.

Mother Nature

Asphalt deterioration continues once the asphalt mixture is placed on a roadway due to :

- Constant exposure to the sun's UV
- Climatic conditions
- High and low ambient temperatures
- Oxidation
- Stripping action of storm water and snow runoff
- Traffic wear

The constant UV exposure and heating effects of the sun cause the maltene fractions to be baked out or oxidized from the pavement's binder.



This is why a new pavement looks like this.....



One year old pavement looks like this



And a 15 year old pavement look like this.



And a 20 year old pavement look like this.



A true REJUVENATOR is a maltene based emulsion comprised of the same maltene fractions found in quality asphalt cement.

Rejuvenators are manufactured using;

- Asphalt or Asphalt saturates (Asphaltenes)
- Refined hydrocarbons (Maltenes)
- Organic resins
- Chemical stabilizers
- Water

Rejuvenators

After a rejuvenator is applied to the pavement surface, the water evaporates and the rejuvenator penetrates down into the pavement where it fluxes and blends with the asphalt binder restoring the lost maltenes. As a result the Asphaltene to Maltene ratio is brought back to near its original level.

A maltene base rejuvenator acts like a conditioner and restores the pavement's flexibility and resistance to cracking and the asphalt binder's cohesive ability to retain aggregate. This type of fog seal rejuvenator essentially makes the pavement "like new".

Thus, the function of a REJUVENATOR is to “rejuvenate” or “rehabilitate” the aged asphalt binder thereby restoring the pavements flexibility and the asphalt’s cohesive ability to retain aggregate and to waterproof the surface.

Selecting suitable pavements for Rejuvenators

Suitable pavements for rejuvenator application

- Best locations;

- New pavements greater than 60 days old
- Urban streets and rural roads
- Highway paved shoulders
- Airports
- Parking lots
- Open Graded Mix surfaces
 - *NOTE: Multiple studies have indicated that pavements treated with rejuvenators should have a minimum 7%-8% voids in the total mixture to allow proper penetration.*

Additional locations where rejuvenators are recommended however caution should be exercised;

- Interstate and State highways.
 - Caution should be exercised when applying rejuvenators on roadways where speeds exceed 50 MPH. Only treat pavements with high skid values where skid values will remain acceptable after application.
 - Where skid values may be questionable or lower than acceptable. It is recommended to broadcast a light layer of sand on to the rejuvenator before the emulsion breaks to enhance skid values.

When selecting pavements for rejuvenation.

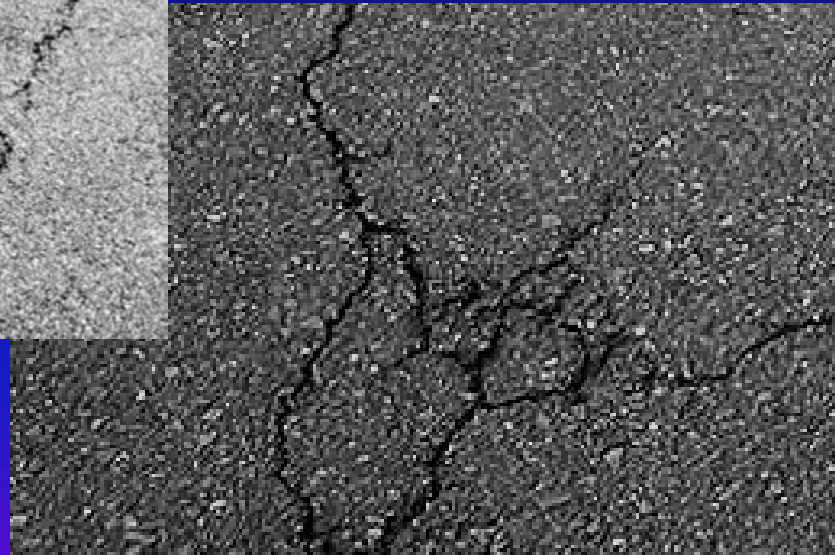
- The best candidates are always new pavements. After paving wait about 60 to 90 day to allow the pavement to cure then make your first application.
- To maintain a healthy pavement get into a program to reapply the rejuvenator every 3 to 5 years.
- Religious attention to reapplication can extend the life of asphalt pavements 25% to 50% or longer depending on the application.

Pavements NOT suitable for
rejuvenation.

- Asphalt pavements exhibiting excessive stress



- Pavements with numerous areas of base failure.



- Pavements with excessive amount of alligator cracking.



- Pavement exhibiting excessive stripping where the course aggregate is severely exposed.





DISSCO
Pavement Preservation Solutions

38th Annual
Rocky Mountain Asphalt Conference
& Equipment Show

2011

Application of Rejuvenators

- Pavements selected for treatment with a rejuvenator should be in good to excellent condition to provide maximum life extension.
- Pavements from 1 to 5 years of age are excellent candidates as they typically are relatively free of cracking and raveling.
- Older pavements can be considered as long as the base is solid and they have minimal amounts of cracking and or raveling.

Weather Limitations

- Rejuvenators are best applied when the surface and ambient temperatures are 50°F and rising.
- Higher temperatures allow rejuvenators to penetrate quicker into the pavement.
- Lower temperatures slow penetration and cure times, however as necessary rejuvenators can be heated as a means of getting faster penetration in lower temperatures.

Weather Limitations - Continued

- Rejuvenators should never be applied if the surface or ambient temperature is 32°F or lower.
- Application should not occur if freezing temperatures are expected within 24 hours after application.
- Application should not occur if precipitation is eminent or is forecast to occur within 24 hours of the anticipated completion of the application.

Pavement Surface Conditions



- Pavement surfaces to be treated with rejuvenators should be clean and dry and free of all dirt, sediments and other debris prior to application of the product.

Caution

- NEVER, EVER, EVER apply a rejuvenator over top of a previously applied mineral filled coal tar or asphalt emulsion seal coating.
- Rejuvenators are designed to PENETRATE the asphalt surface. A previously applied mineral filled seal coat will prevent this function from occurring and the rejuvenator will soften the seal coat and it will set there and not cure properly. It will eventually cure. But it could take days.

Caution - Continued

- If it is desired to rejuvenate a pavement that has been coated with a previously applied seal coating it is necessary that almost all of the previously applied seal coating be worn off or removed before application.



Application Equipment

- Application equipment should be in good working order and capable and calibrated to maintain consistent application rates as prescribed by the manufacture.
- All spray nozzles should be checked to ensure they are free of contaminates or plugs.



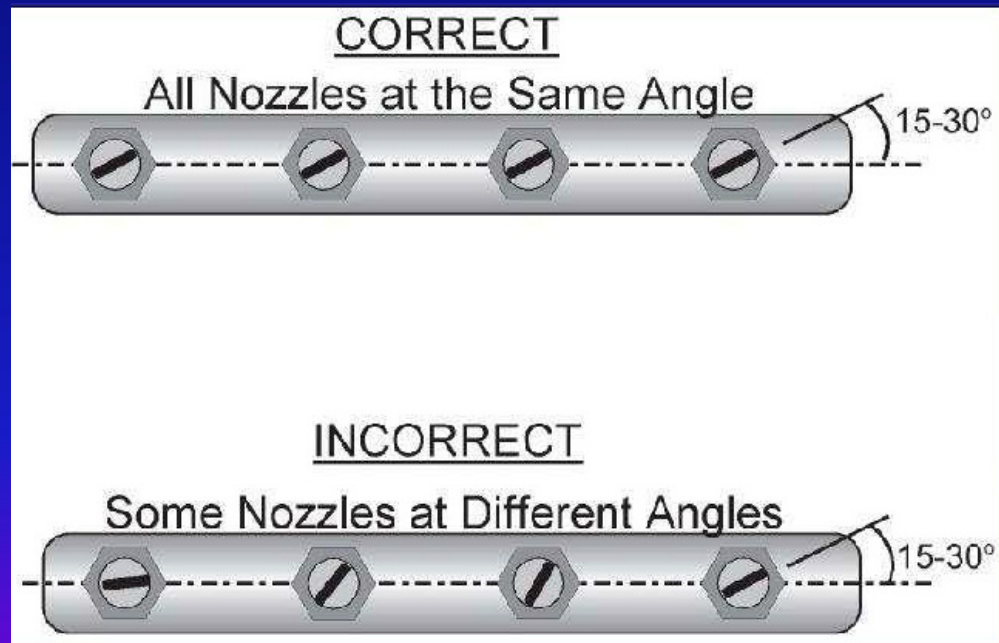
Spray Truck Operation

Spray pattern should be verified that the tips are set to provide a consistent even application.



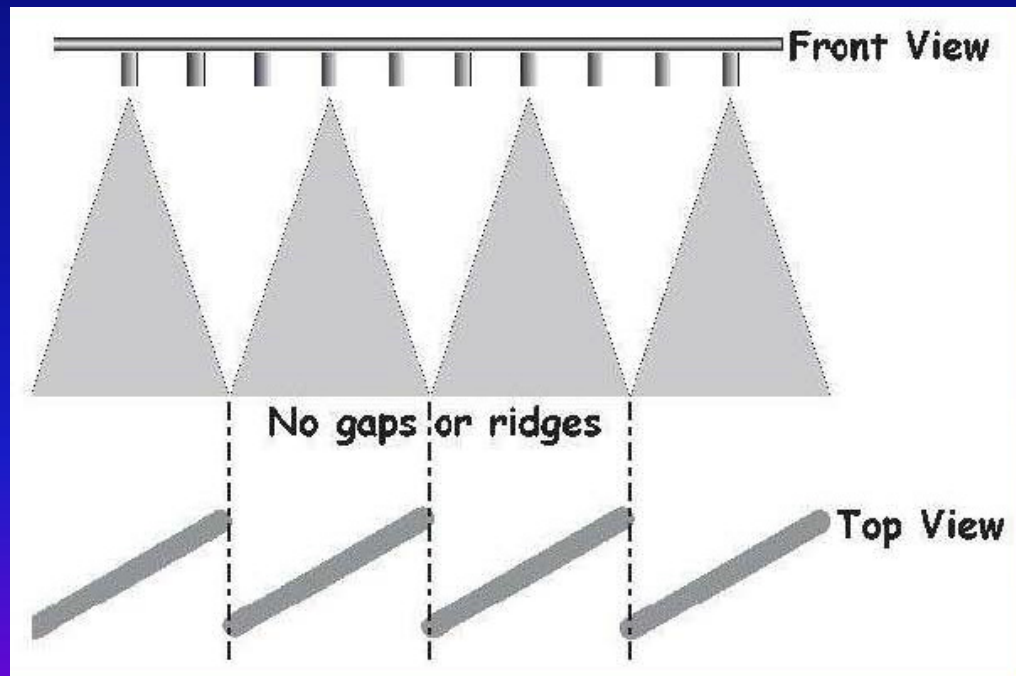
Spray Truck Operation

All nozzles are to be set at the same angle, typically at 15° - 30° from the bar.



Spray Truck Operation

Spray bar height and pattern should also be checked to verify uniformity and proper overlap.



Application Rates

- Typically rejuvenators are diluted at a 1:1 or a 2:1 product to water ratio, but may be diluted 60/40 depending on temperature and humidity conditions or the type of penetration or rejuvenation characteristics desired.
- Normally rejuvenators are applied at a rate of:
.08 to .12 gal/SY depending on the level of absorption.

Benefits and Results

- Rejuvenators work by changing the chemistry of the asphalt cement by replenishing the lost maltenes back into the binder effectively restoring its asphaltene to maltene ratio back to nearly new levels.
- This in turn softens the pavement surface and restores its flexibility and resistance to cracking.
- It also restores the cohesive ability of the asphalt binder to retain aggregate, thereby preventing further raveling.

Benefits and Results

- Rejuvenators also work to provide a long lasting seal of the pavement surface preventing the intrusion of air and water into the surface.



Benefits and Results

- The biggest benefits to Rejuvenators is;
 - Rejuvenators extend the life of the pavement
 - Provide an overall lower life cycle cost
 - The beauty of rejuvenators is:
 - Once the product has visibly worn off the surface, the product that has penetrated into the pavement is still protecting the pavement.

Cost of Application

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

\$0.75 to \$0.90 per sq yard

Or

\$4,800.00 to 5,800.00 per lane mile

Return On Investment Analysis

- Values Per Lane Mile

- New Road Investment 2010* \$ 645,461.00
- Overlay Investment 2010* \$ 262,494.00
- Today's Annual Road Maint. Cost* \$ 8,916.00
- Annual Inflation Rate 2.98%

- ** Investment values derived from the 2010 CDOT Fact Book*

Return On Investment Analysis

Return On Investment Analysis per Lane Mile

New Road Investment 2010*	\$ 645,461.00
Overlay Investment 2010*	\$ 262,494.00
Todays Annual Road Maintenance Cost*	\$ 8,916.00
Inflation Rate	2.98%

Year	Currant Scenario Investment	Rejuvenator Scenario Investment	Standard 1 Overlay - Year 9 Reconstruct - Year 18	Standard 2 Overlay Year 9 Overlay Year - 18
1	\$ 9,182.00	\$ 14,500.00		
9	\$ 353,510.00		\$ 520,998.00	\$ 520,988.00
18	\$ 1,110,146.00	\$ 678,597.00	\$ 2,035,791.00	\$ 678,597.00
Total cost for inflation	\$ 1,651,764.00	\$ 788,259.00	\$ 2,556,789.00	\$ 1,199,595.00
Total cost in Todays Dollars	\$ 877,764.00	\$ 387,992.00	\$ 1,291,446.00	\$ 666,226.00

Rejuvenator compared to your Currant Scenario

Cost Savings in Todays Dollars	\$ 489,772.00
Total Cost Savings Over Next 18 Years	\$ 863,254.00

Rejuvenator Compaired to Indusry Standard 1

Cost Savings in Todays Dollars	\$ 903,454.00
Total Cost Savings Over Next 18 Years	\$ 1,768,530.00

Rejuvenator Compaired to Indusry Standard 2

Cost Savings in Todays Dollars	\$ 278,234.00
Total Cost Savings Over Next 18 Years	\$ 411,336.00

* Investment values derived from the 2011 CDOT Fact Book

Summary

- Rejuvenators and Seal Coats are inexpensive and remain a very cost effective means for extending the life of asphalt pavements.
- Maltene based rejuvenators have been used for over 35 years and have a documented, time tested and proven history of effectiveness.
- Rejuvenators and seal coats are probably the most underutilized of all pavement preservation and maintenance tools.

Summary

- Maltene based Rejuvenators work by changing the chemistry of the asphalt binder 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.

Summary

- Mineral Filled Seal Coats are made utilizing either coal tar and/or asphalt emulsions.
- Seal Coats work by enriching a pavement's surface with a new coating that waterproofs, fills voids and locks remaining aggregate in place .
- Seal Coats seal a pavement's surface and help prevent further oxidation and loss of maltenes.

Summary

- Both Rejuvenators and Seal Coats can be a cost effective and safe means of extending pavement life when properly applied by qualified contractors and/or personnel.



References

- “FHWA/FP2 Sealer/Binder Study”, 2007, Gayle King, Project Manager, GHK, Inc.
- “Asphalt Rejuvenators - Fact or Fable”, August 2000, Robert Boyer, Asphalt Institute.
- “Preventive Maintenance of Asphalt Concrete Pavements”, January 1998, E. Ray Brown, National Center for Asphalt Technology.
- “Pavement Preservation With ... Rejuvenators & Seal Coats” September 2008, John Calvert, Pavement Technology Inc.
- “Fog Seals” February 2009, Chris Lee, Vance Bros.
- “Advanced Seal Coating” NPE 2009, Girish Dubey, Star materials.
- “Seal Coating Best Practices”, CAPA 2010, Dan Stevens
- “Applied Asset Management”, 2010, Larry Galehouse, National Center For Pavement Preservation.

Thank you

Questions??

Presented by;

Todd Mellema - President
DISSCO

Denver Industrial Sales & Service Co.
850 S Lipan St., Denver, CO 80223
Ph; 303-935-2485, Fax; 303-935-6787
E-mail; toddmellema@dissco.net
www.dissco.net