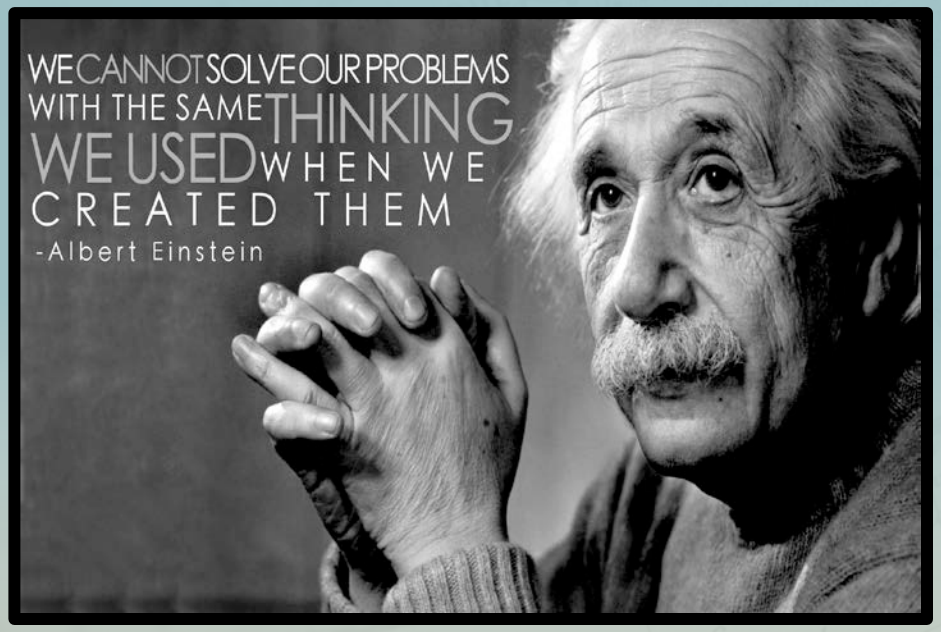
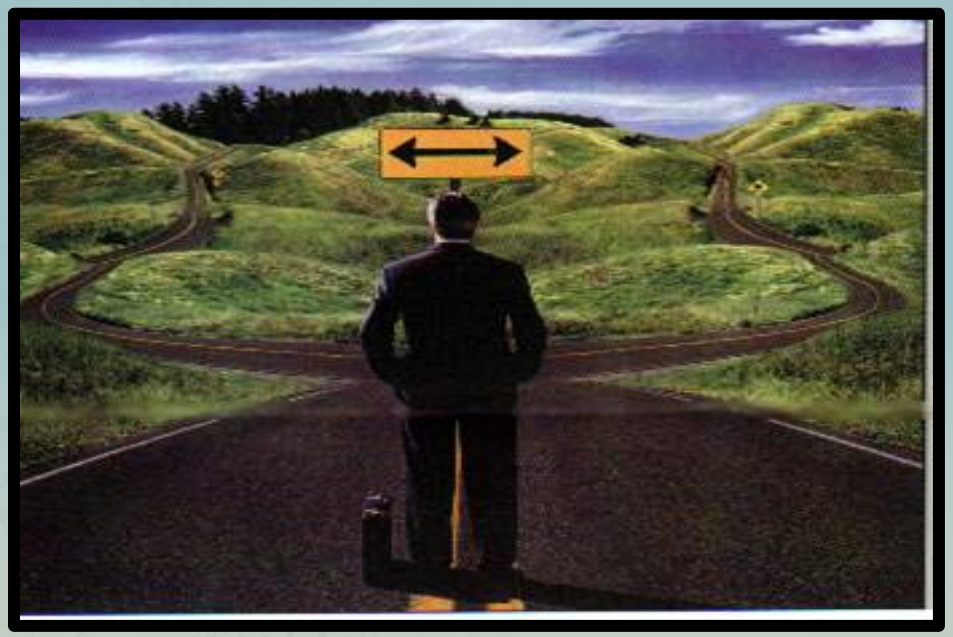
TRICOR REFINING, LLC

Producers of GOLDEN BEAR PRESERVATION PRODUCTS

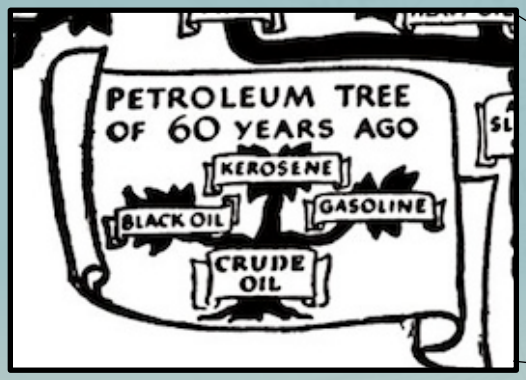
Fog Seal and Rejuvenator Seal Benefits and Differences

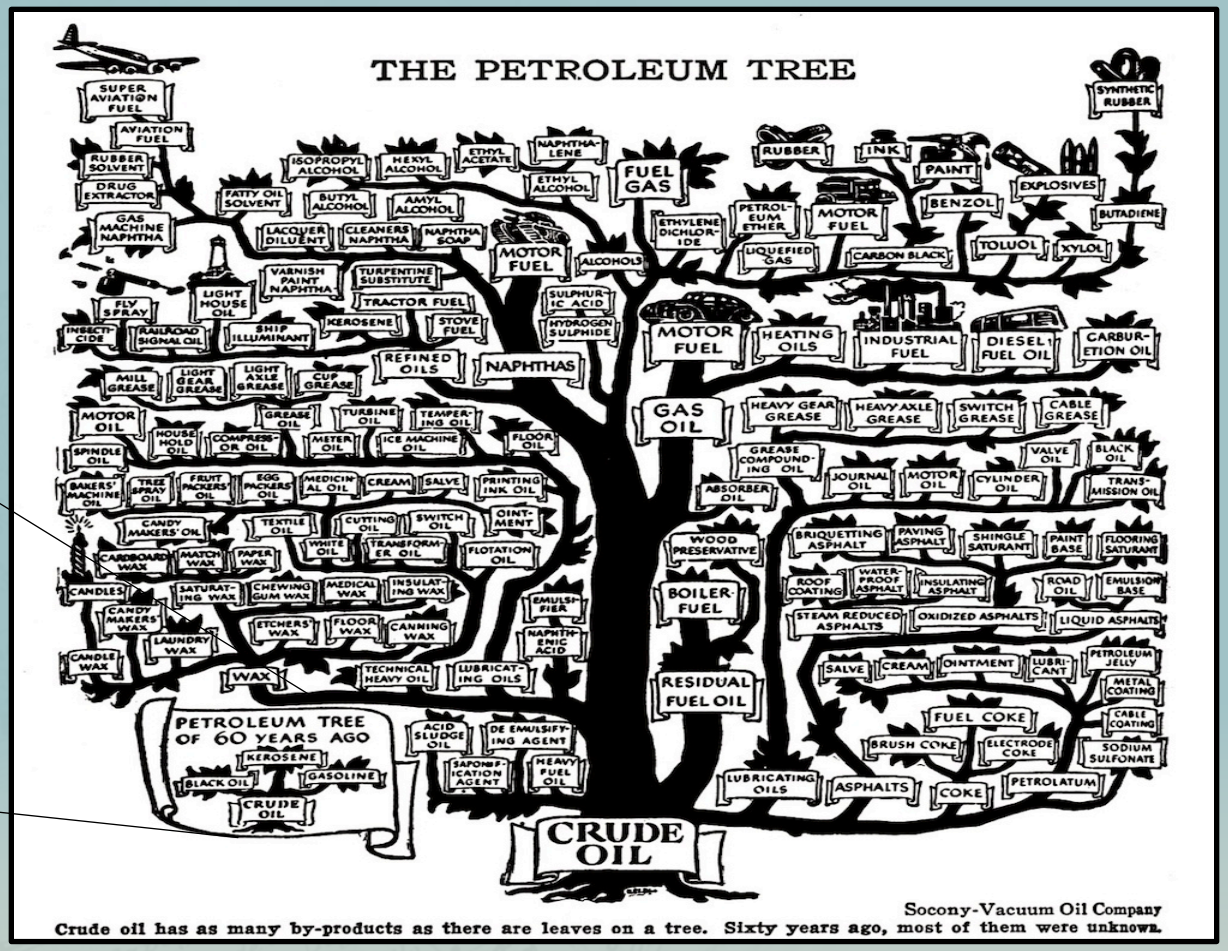
Jim Brownridge – Marketing Manager – Tricor Refining





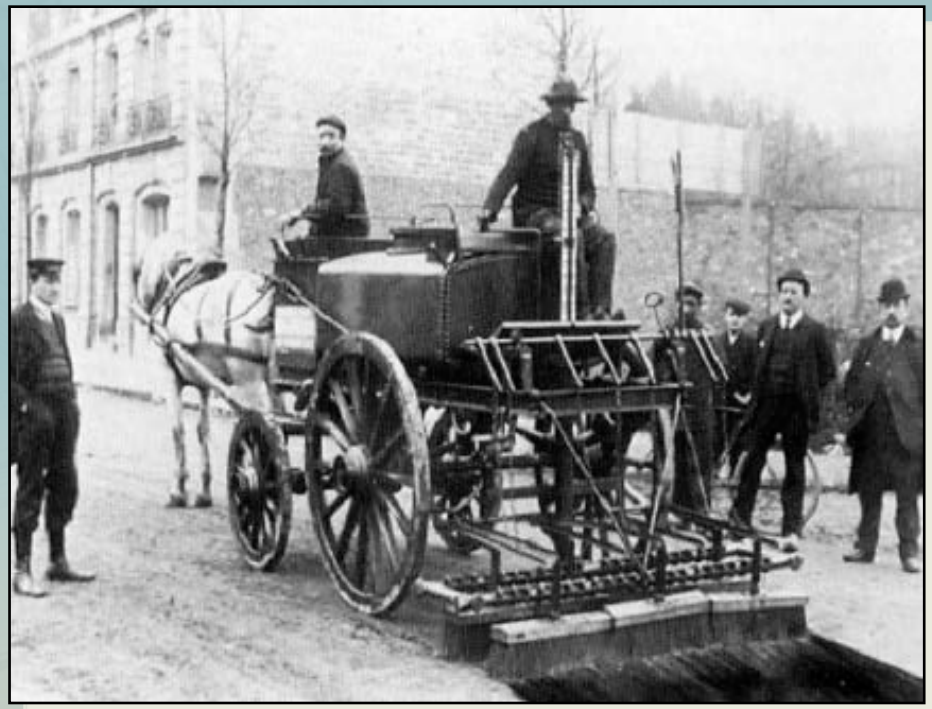
PETROLEUM TREE



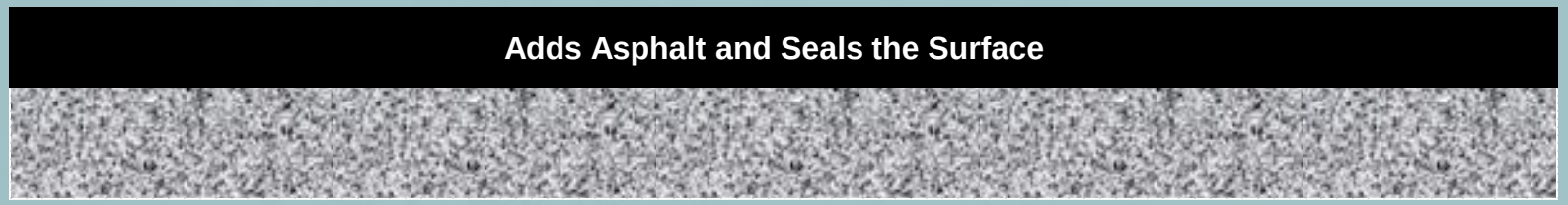


The New Way We Have Always Done It

Overview of Fog Seals and How Rejuvenators Can Further Extend Pavement Life



Fog Seal Description



By Definition, an application of diluted asphalt emulsion onto an asphalt pavement surface.

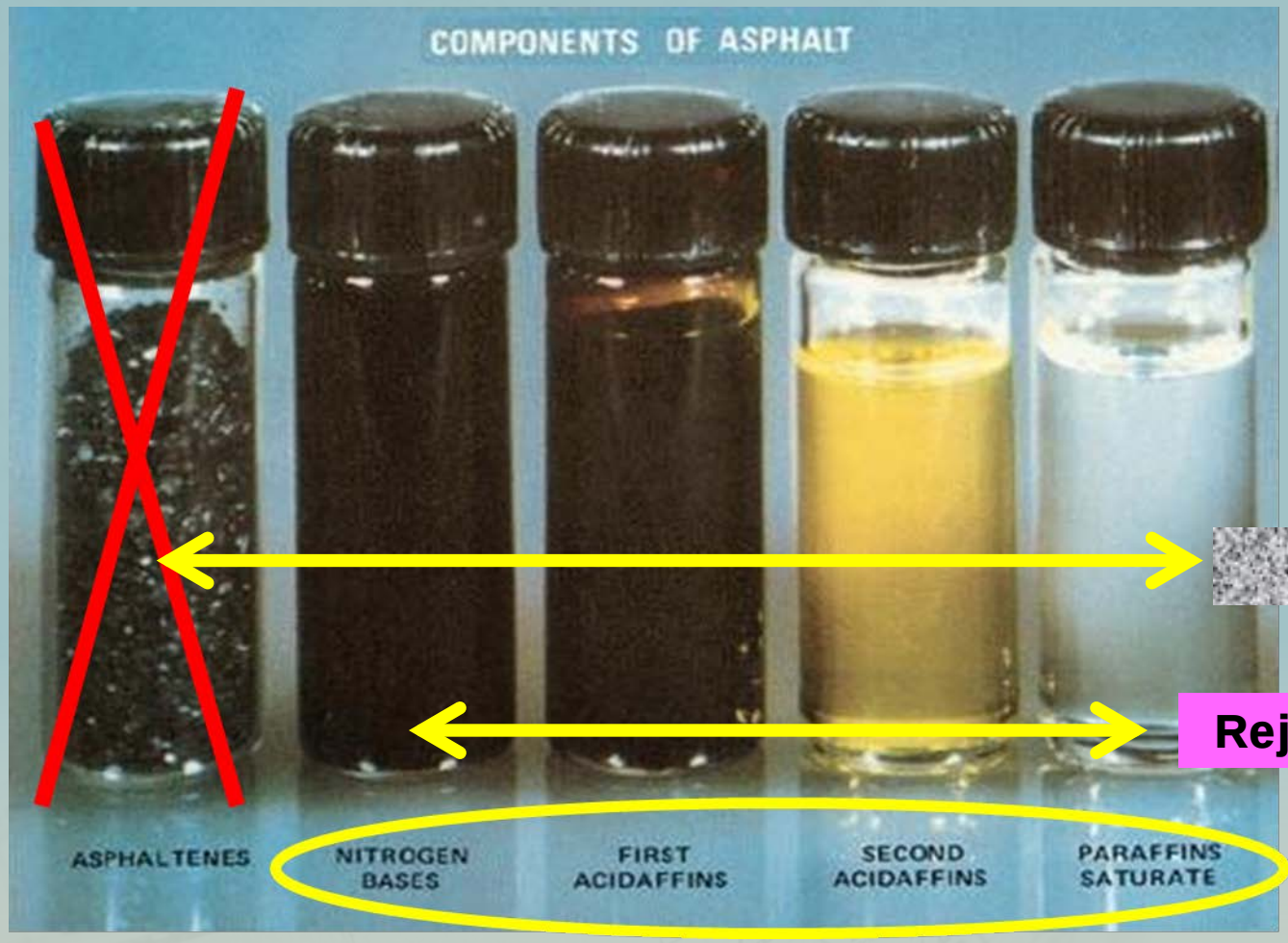
Simply filling the voids in a new asphalt surface with asphalt. It will darken (make black) the surface for a short period of time and retard oxidation. Performance Life is generally 1-3 years

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

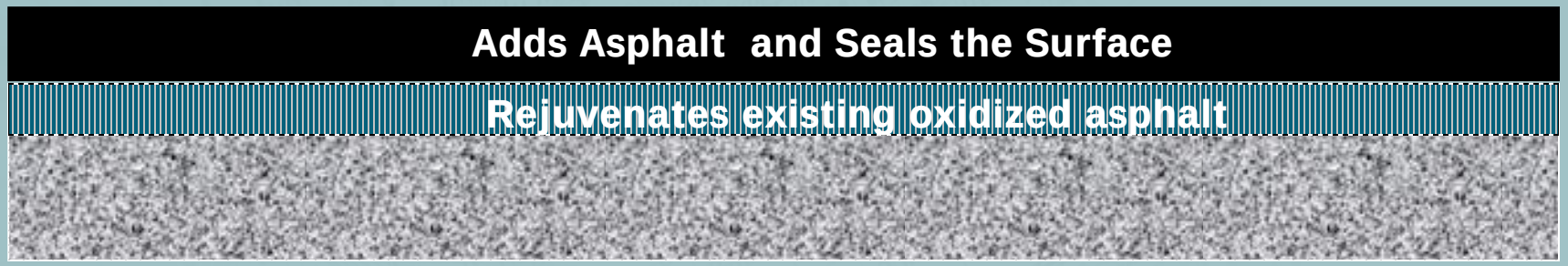
<u>Sealers</u> contain some maltenes + Asphalt & Do Not Penetrate the Binder

<u>Rejuvenators</u> contain Maltenes Fractions in Balance & Penetrate the Binder



Scrub Seals or "Scrub/Cape Seals"

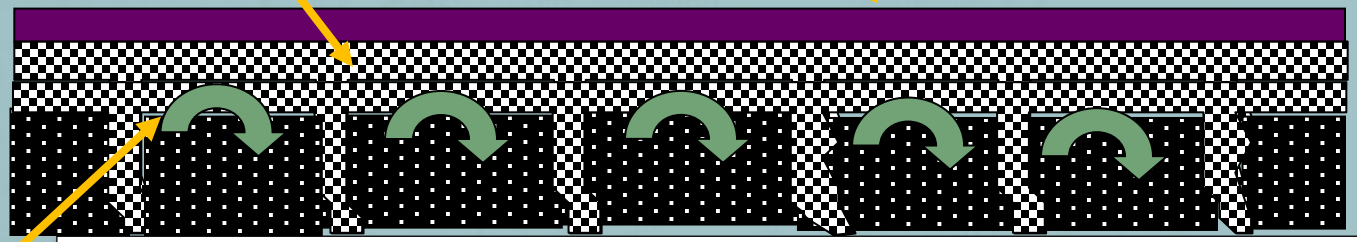
The Theory



Theory of Scrub Seal/Rejuvenator Benefit

Chip or texture aggregate and Asphalt

Polymer with asphalt (Film)



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 - Generally

Scrub Seals Using Modified Emulsions

Used in the western United States since the late 80's

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 recently developed generic specifications for the product.

Advantages

No Crack Filling is Required

Can be applied at both low and high temps

(40° F to 120° F)

High Flexibility

(3.5 % Polymer)

Although generic specs. Have reduced %

Will work with dirty chips

Typical Applications of Scrub Seals

Polymer Modified Emulsion Chip Seals

Typically CRS-2P cationic rapid set Polymer Modified emulsion.

CHFRS-2P Cationic High Float Rapid set Polymer Modified emulsion
Improves chip retention

CRS-2P

CHFRS-2P

Santa Barbara County California

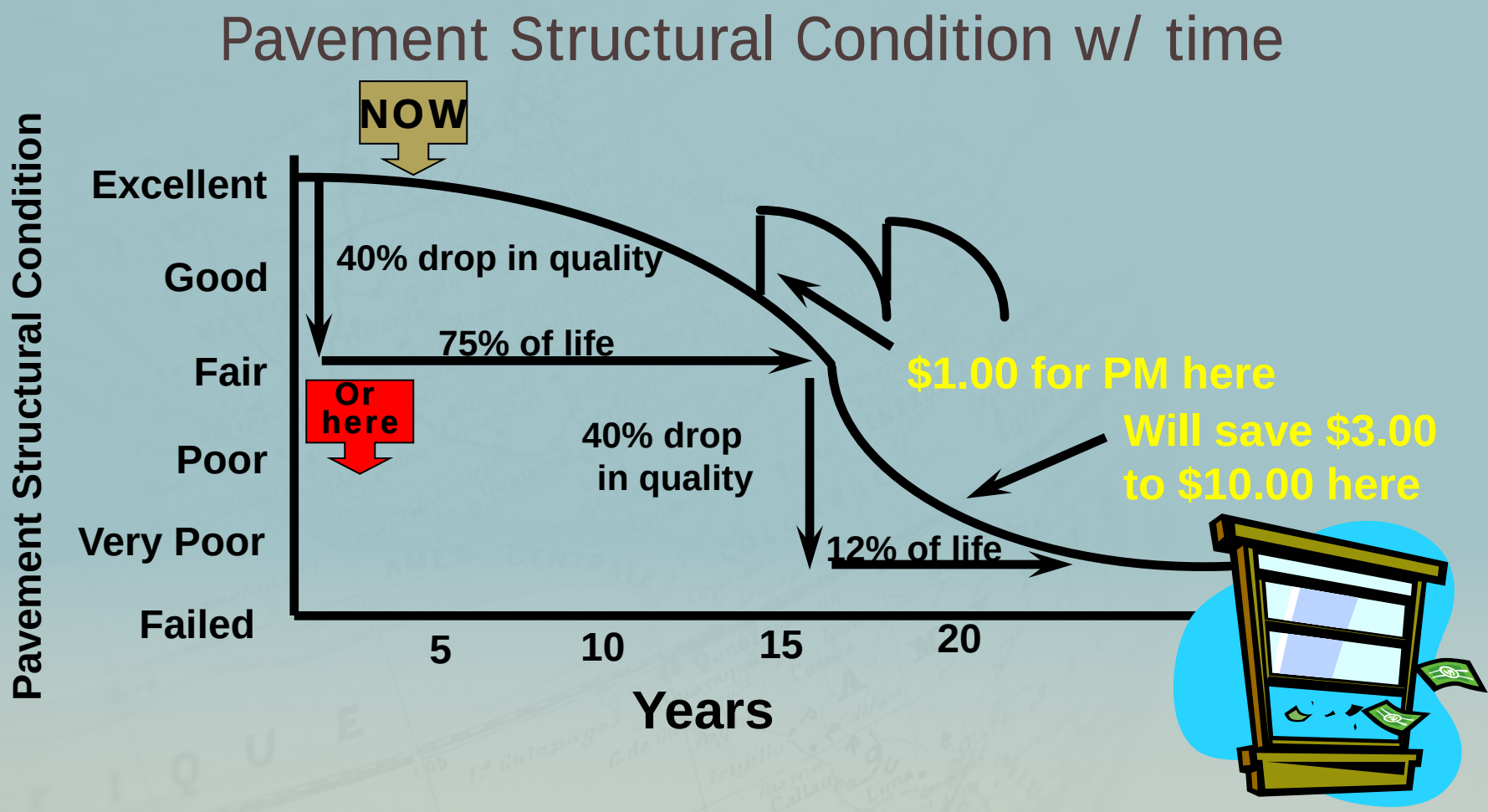
Santa Barbara County California

Drag and Scrub Methods from the Past

Drag and Scrub Methods from the Past

Scrub Appearance and Benefit - Utah

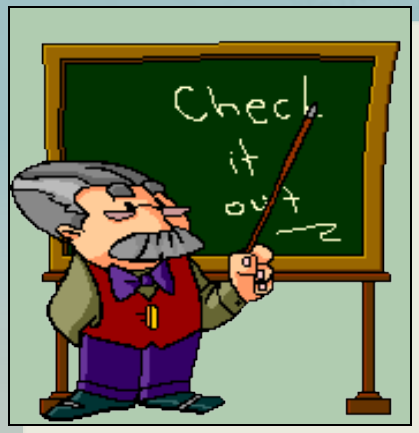
PAVEMENT PRESERVATION
TOP OF THE CURVE BENEFITS



The Role of an Asphalt Rejuvenator

“Maximizing the Performance of Your Road Inventory”

“Minimizing the cost of ownership of your Road Inventory”

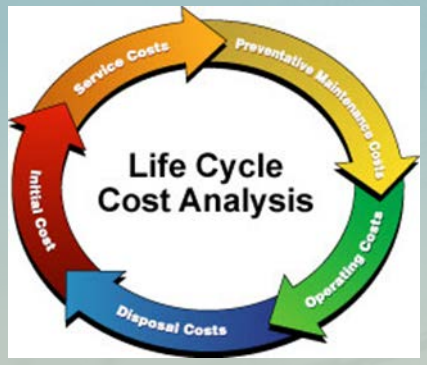


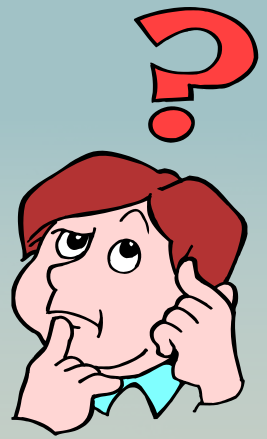
FP2 National Sealer Binder

Study – 1st Product Test Sections on US 95 – 40 miles north of I-40, Winslow, Arizona

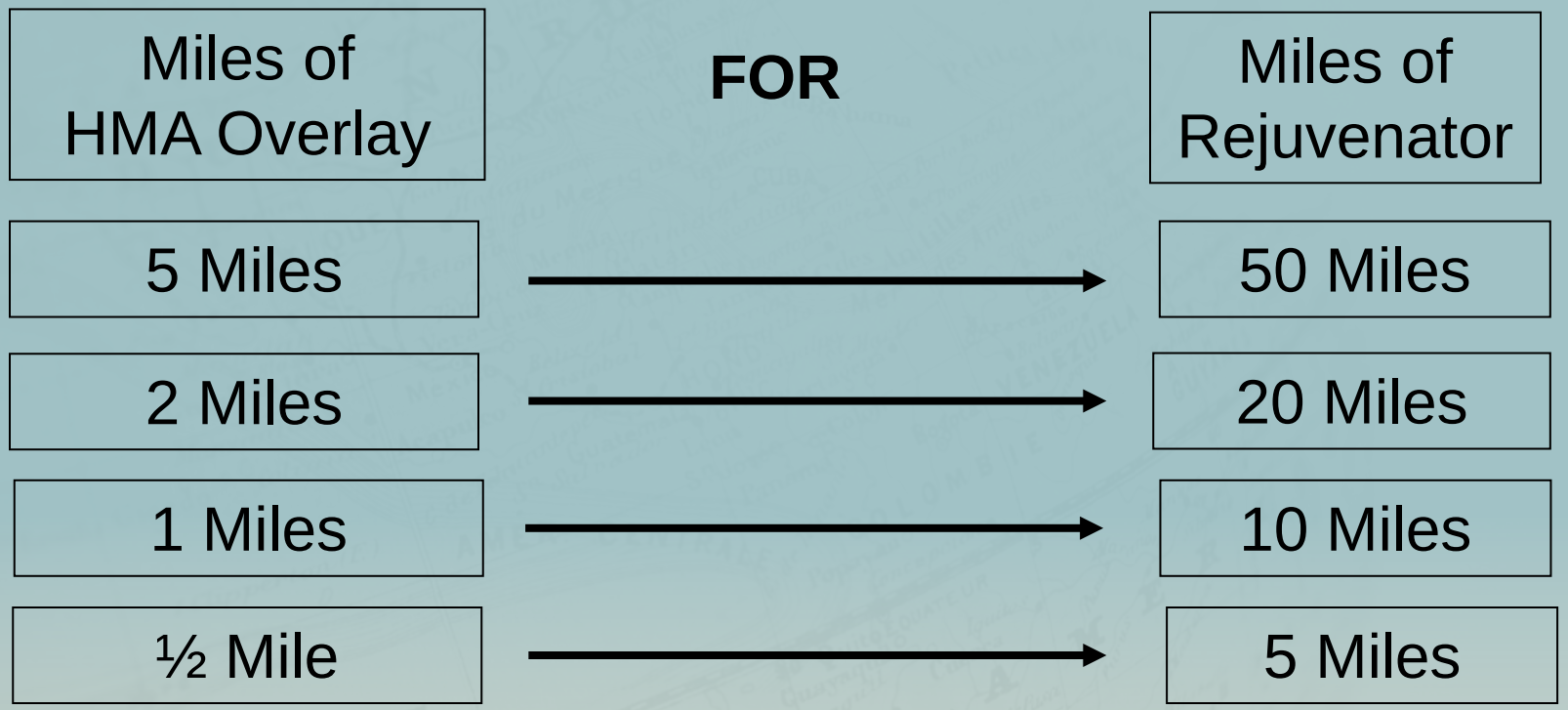
- **KNOW YOUR LIFE CYCLE COSTS**
  - **INPUTS FOR CITY STREETS**

- HMA Rejuvenator= $16,000 per mile (Lasts 3-5 years)
- HMA Chip Seal = $33,000 per mile (Lasts 5-7 years)
- HMA Milling and Overlay = $187,000 per mile (Lasts 10-12 years)
- HMA Full Depth Reconstruction = $550,000 per mile (Lasts 20 Years)
- A 500 mile Local Road Network has a current worth of $175,000,000! (And some say – that is a low number)

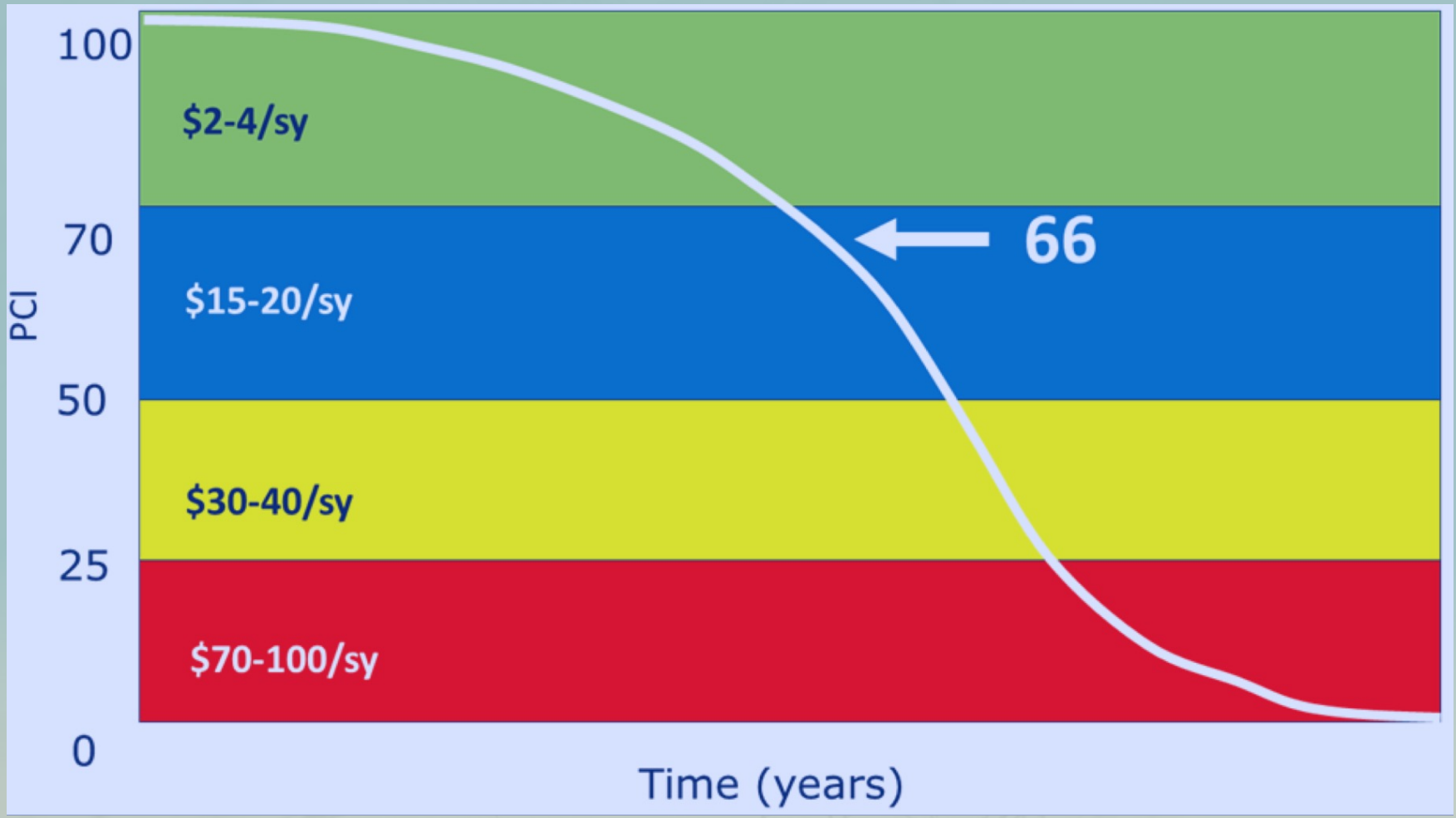


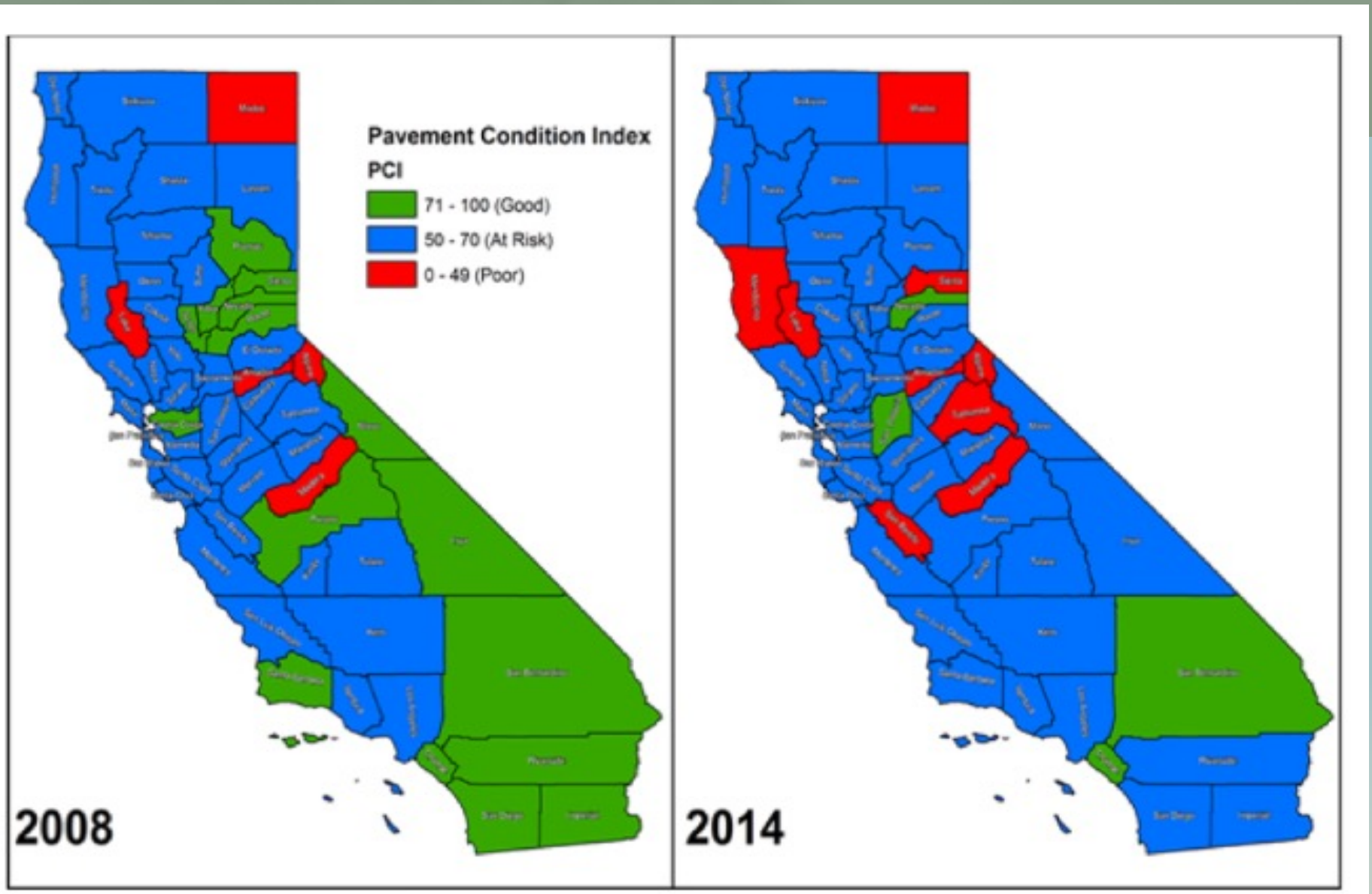


Any agency can implement the use of Rejuvenators by simply deferring a small amount of resurfacing.



Current Statewide PCI – State of California




Pavement Condition Index
PCI
71 - 100 (Good)
50 - 70 (At Risk)
0 - 49 (Poor)
2008
2014

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.

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.

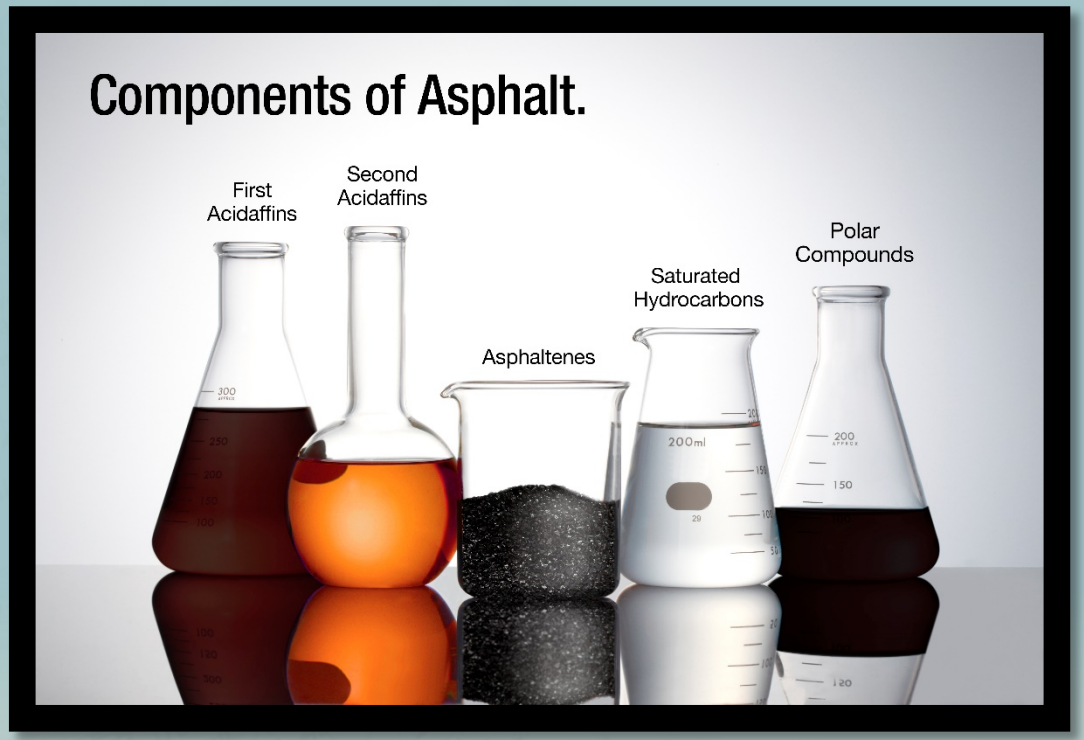
Maximum absorbance of the rejuvenator is <u>expected</u> and desired.

WHAT IS AN ENGINEERED REJUVENATOR EMULSION?

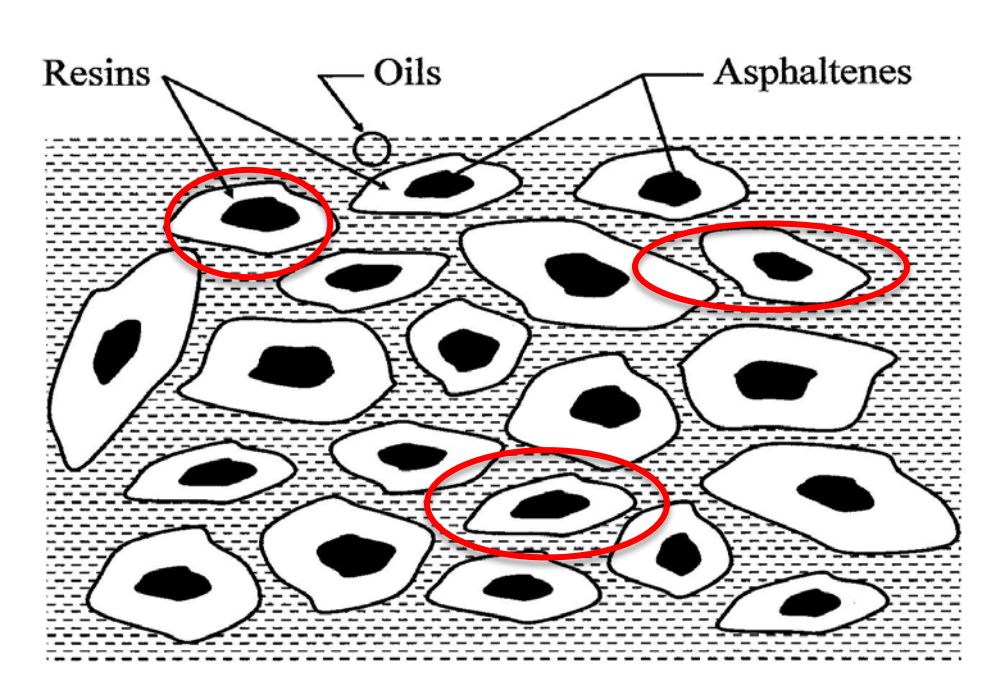
Asphalt consists of two main fractions:

“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

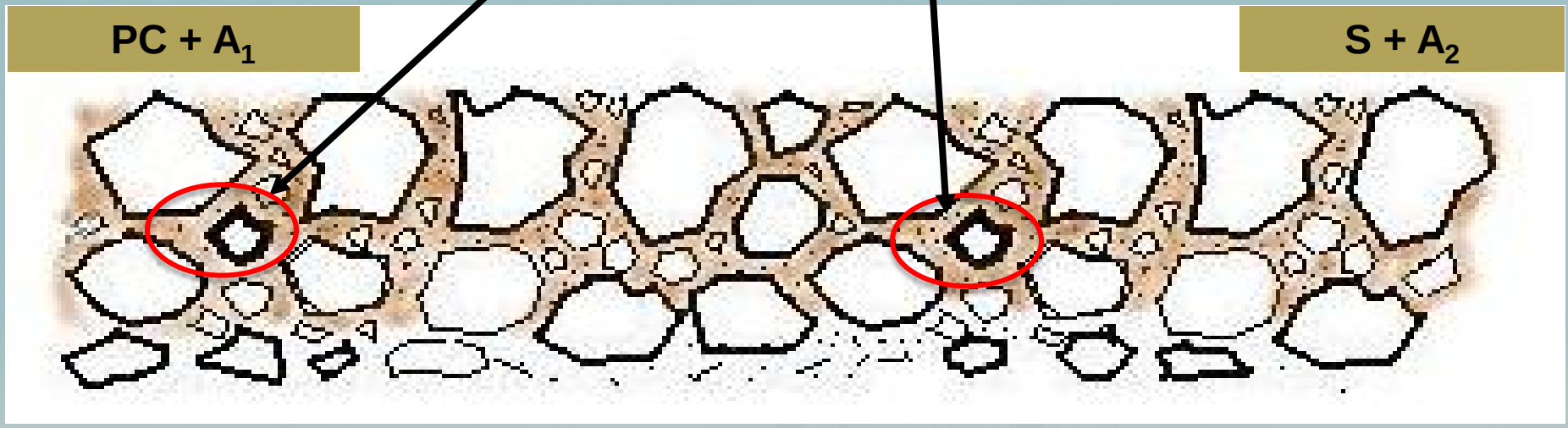


What is an Engineered Maltene Based Rejuvenator Emulsion



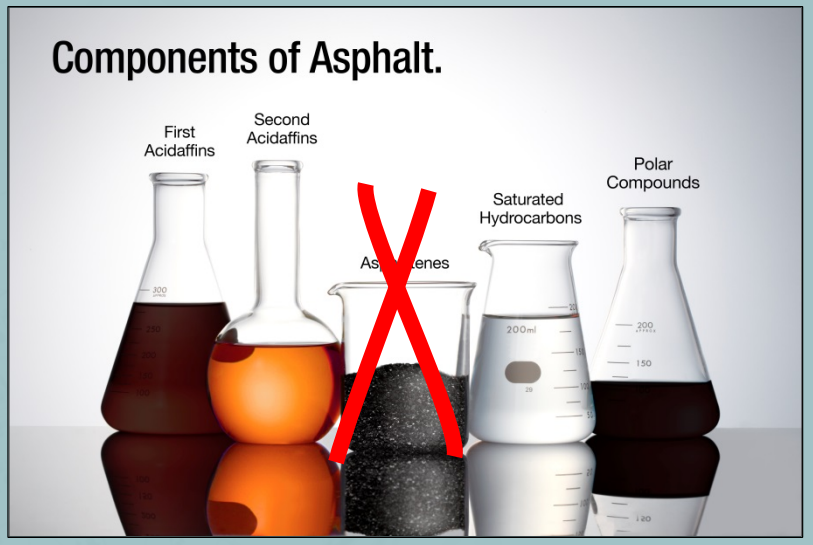
FUNCTION OF THE MALTENE FRACTIONS

Maltenes must penetrate into the pavement co-mingle and flux with 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



ASPHALT INSTITUTE
Research Park Drive
Lexington
Kentucky 40512

ES-8
Educational Series No. 8 (ES-8)

PAVING ASPHALT

City of Visalia California

City of Visalia California

City of Visalia California

City of Delano, California

City of Delano California

Curing Rejuvenator

Sanding Operation – 1 to 2 lbs. sq yd.

Sanded and Swept

Arizona

Frank Lloyd Wright, Scottsdale

Arizona


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

Asphalt Pavement And Recycling Technologies, Inc.
5207 Minter Field Avenue
Shafter, CA 93263
Telephone: (661) 393-2748
Fax: (661) 393-2804
stevee@apartshafter.com
bobs@apartshafter.com

Report: 14-1030 **November 15, 2014**

Customer: **Tricor Refining – Jim Brownridge**

Project: **RECLAMITE® Preservative Seal – City of Visalia, California**

Samples submitted:

Eight pavement core samples (4 untreated and 4 treated) identified as:

4100 East Oak Avenue @ 500 North Sol Street
2000 North Tommy Street @ 5800 West Vine Avenue
2700 North Chinowth @ 4000 West Oriole Court
3300 West Riggin Avenue @ 3000 North Leila Street

The samples were taken on 10-30-14.

Requested Testing:

Remove the top 3/8-inch layer of each core and recover the asphalt binder. Determine Dynamic Shear Rheology properties at 64°C of each sample. In addition, determine the equivalent penetration at 25°C of each sample.

Summary of Testing:

The top 3/8-inch of each core was removed for testing. The asphalt was extracted and recovered as prescribed by California Test Method 365. Viscosities were determined on the recovered asphalt binder using a sliding plate microviscometer (CTM 348). Penetrations were calculated from a nomograph. These data are reported by Table I. Dynamic Shear Rheology tests were performed at 64°C as per AASHTO T315. Test data are reported by Table II.

Tricor Refining

City of Visalia, California
Top 3/8"of Core Samples

Sample Identification	Microviscosity, 25°C, MP		Equivalent Penetration
	0.05 sec^{-1}	0.001 sec^{-1}	
4100 E. Oak Ave. @ 500 N. Sol St.			
Untreated	1843	1363	3
Treated	138.1	73.63	9
Increase in Penetration, %		200	
Decrease in Viscosity, %		1235	
2000 N. Tommy St. @ 5800 W. Vine Ave.			
Untreated	1608	1471	3
Treated	90.38	77.34	11
Increase in Penetration, %		267	
Decrease in Viscosity, %		1679	
2700 N. Chinowth @4000 W. Oriole Ct.			
Untreated	1760	736.0	3
Treated	116.1	51.59	10
Increase in Penetration, %		233	
Decrease in Viscosity, %		1416	
3300 W. Riggin Ave. @ 3000 N. Leila St.			
Untreated	393.8	313.3	6
Treated	38.64	22.48	16
Increase in Penetration, %		167	
Decrease in Viscosity, %		919	

Dynamic Shear Rheology

Tricor Refining

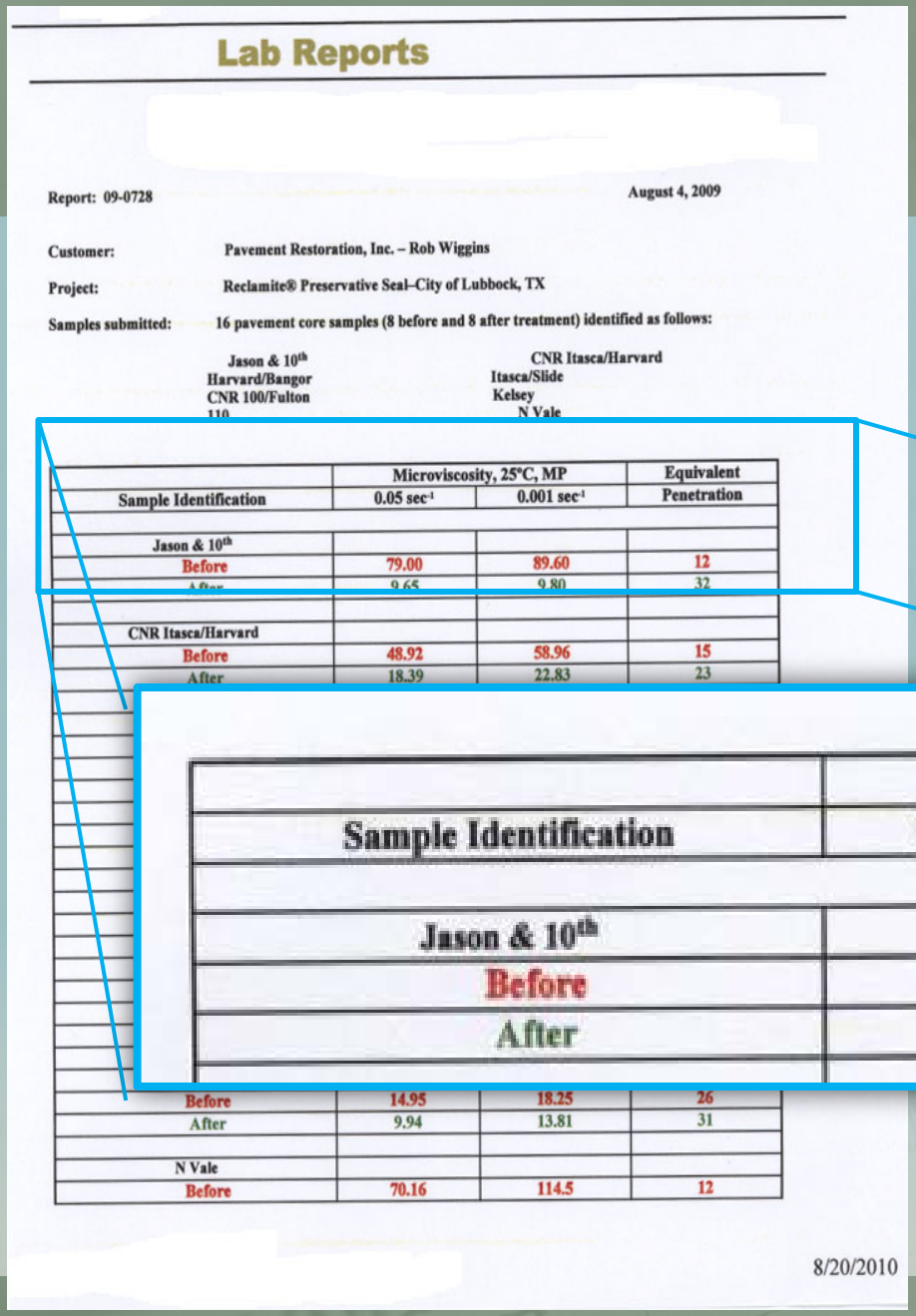
City of Visalia, California
Top 3/8"of Core Samples

Sample Identification	Dynamic Shear Rheology, 64°C		
	G*, kPa	Phase Angle, δ, °	G*/Sinδ, kPa
4100 E. Oak Ave. @ 500 N. Sol St.			
Untreated	155.9	74.0	162.2
Treated	23.59	82.5	23.79
2000 N. Tommy St. @ 5800 W. Vine Ave.			
Untreated	179.0	73.2	187.0
Treated	17.75	83.7	17.86
2700 N. Chinowth @4000 W. Oriole Ct.			
Untreated	101.6	77.6	104.0
Treated	22.51	83.5	22.65
3300 W. Riggin Ave. @ 3000 N. Leila St.			
Untreated	73.09	78.7	74.53
Treated	13.10	83.9	13.18

Lab report results of core test data in Texas.

Army Corp of Engineers success levels:

- 45% reduction in viscosity
- 25% increase in penetration



Lab Reports

Report: 09-0728 August 4, 2009

Customer: Pavement Restoration, Inc. – Rob Wiggins

Project: Reclamite® Preservative Seal–City of Lubbock, TX

Samples submitted: 16 pavement core samples (8 before and 8 after treatment) identified as follows:

Jason & 10th
Harvard/Bangor
CNR 100/Fulton
110

CNR Itasca/Harvard
Itasca/Slide
Kelsey
N Vale

Sample Identification	Microviscosity, 25°C, MP 0.05 sec-1	0.001 sec-1	Equivalent Penetration
Jason & 10th			
Before	79.00	89.60	12
After	9.65	9.80	32
CNR Itasca/Harvard			
Before	48.92	58.96	15
After	18.39	22.83	23
Before	14.95	18.25	26
After	9.94	13.81	31
N Vale			
Before	70.16	114.5	12

8/20/2010

167% increase in penetration

89% reduction in viscosity

88% reduction in viscosity

Look at Avon's Data

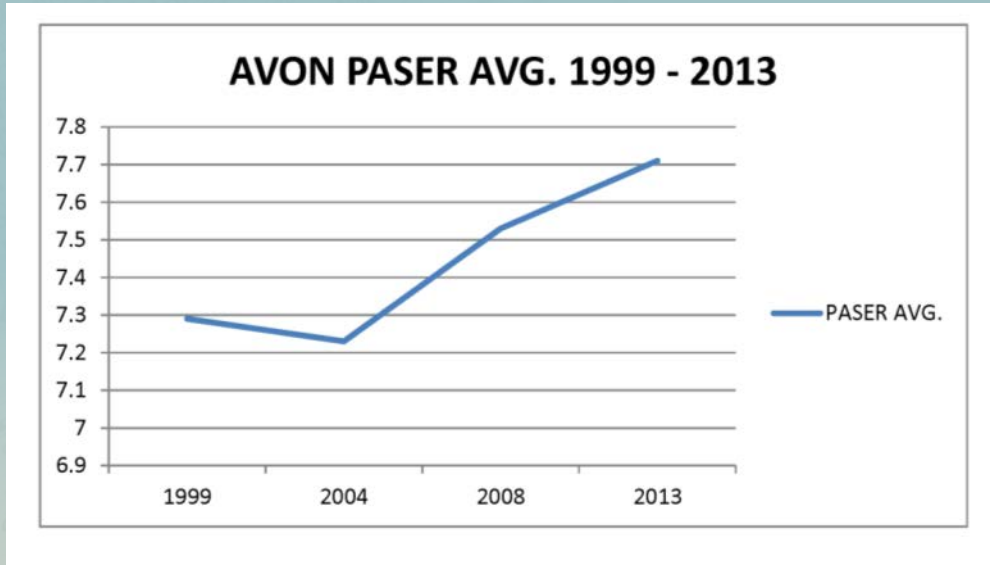
City of Avon, Indiana - Indianapolis

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



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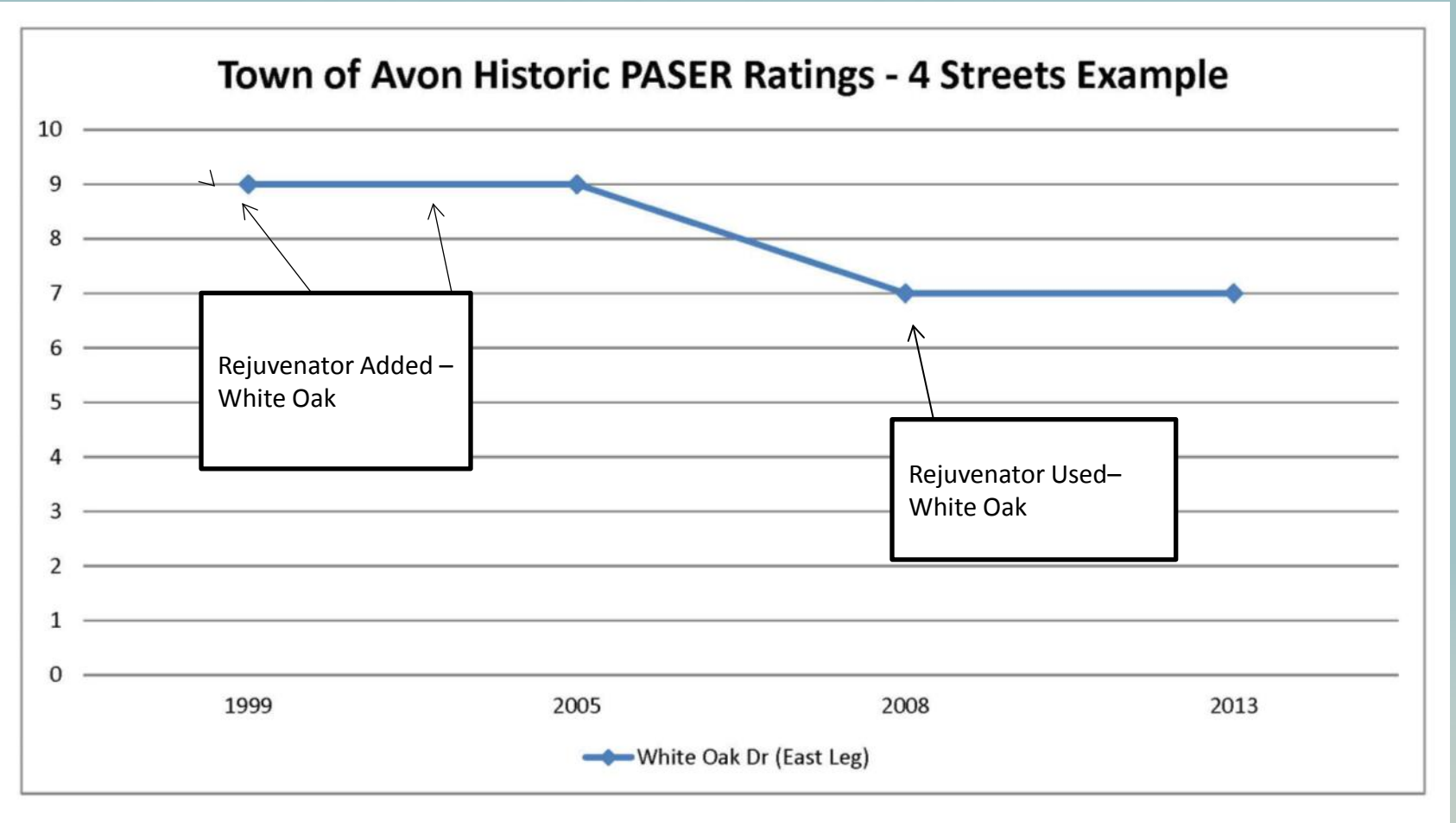

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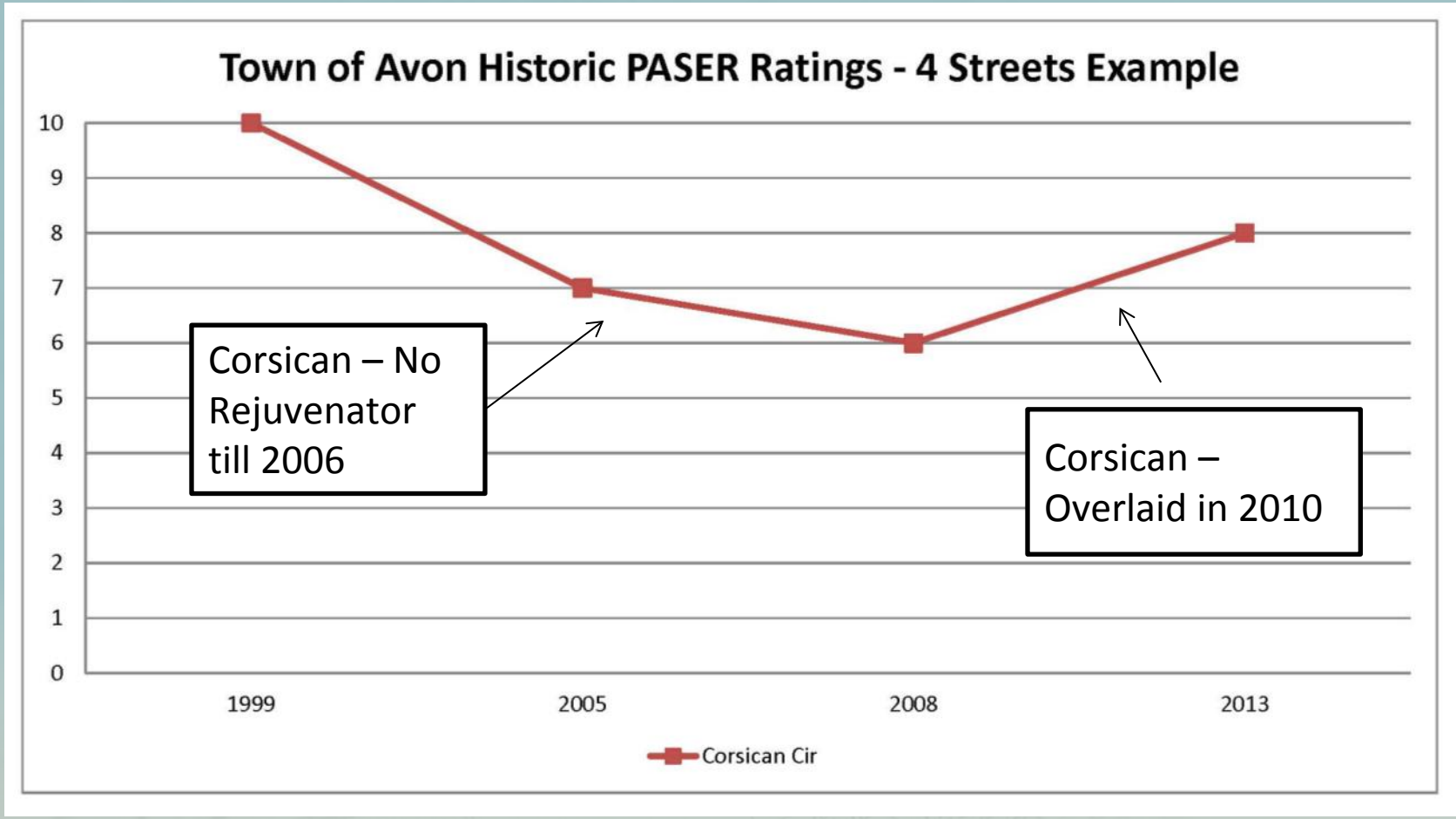

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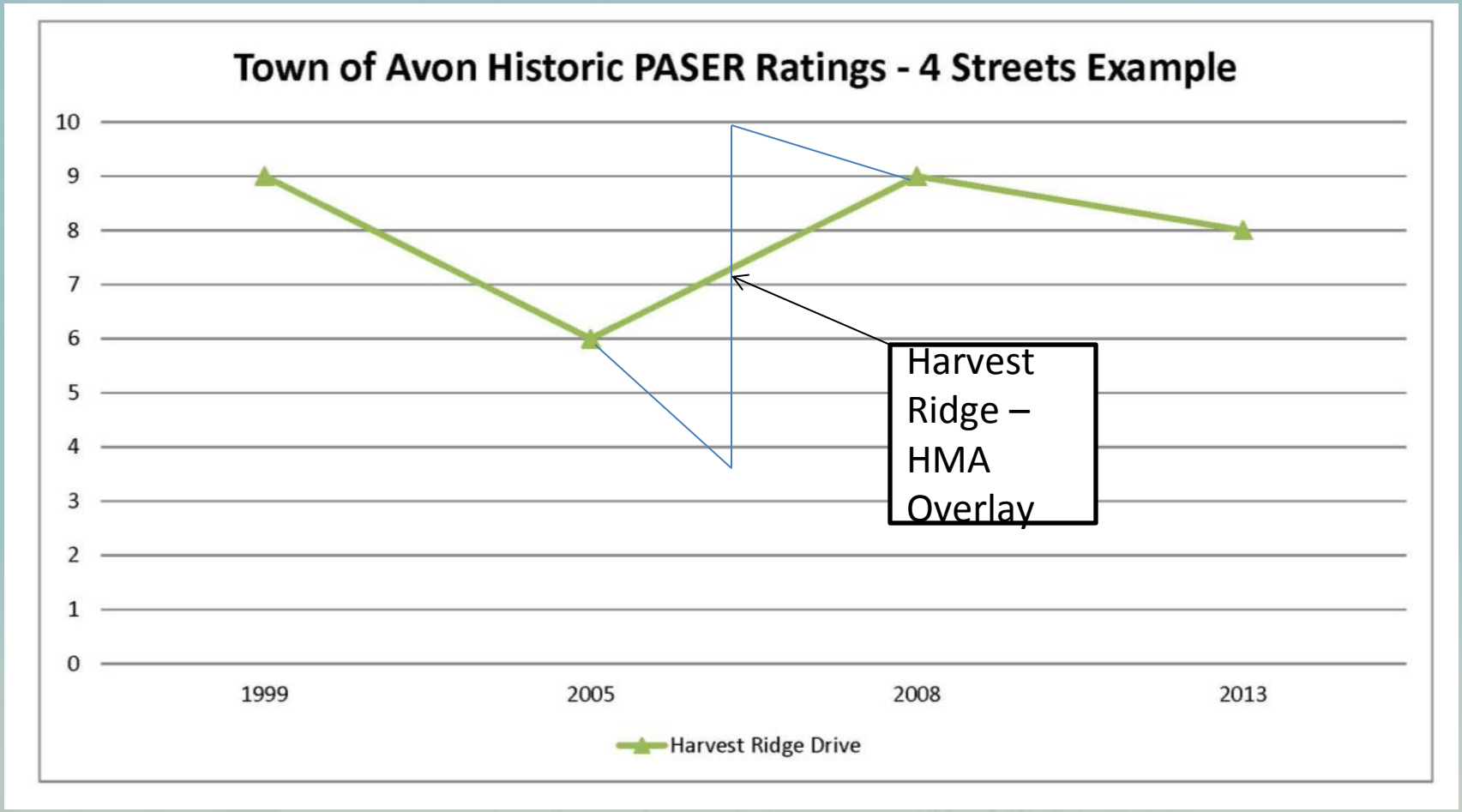

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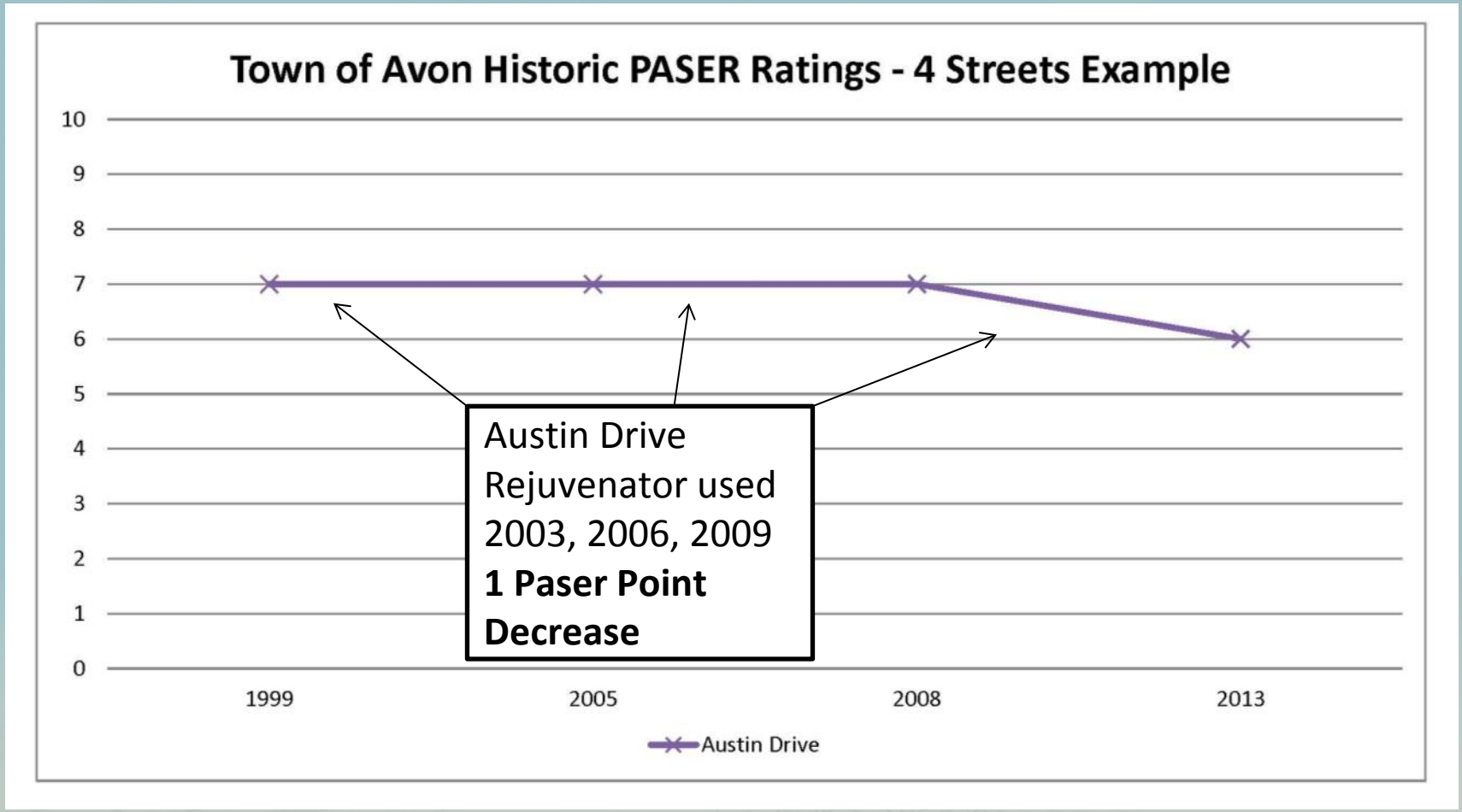

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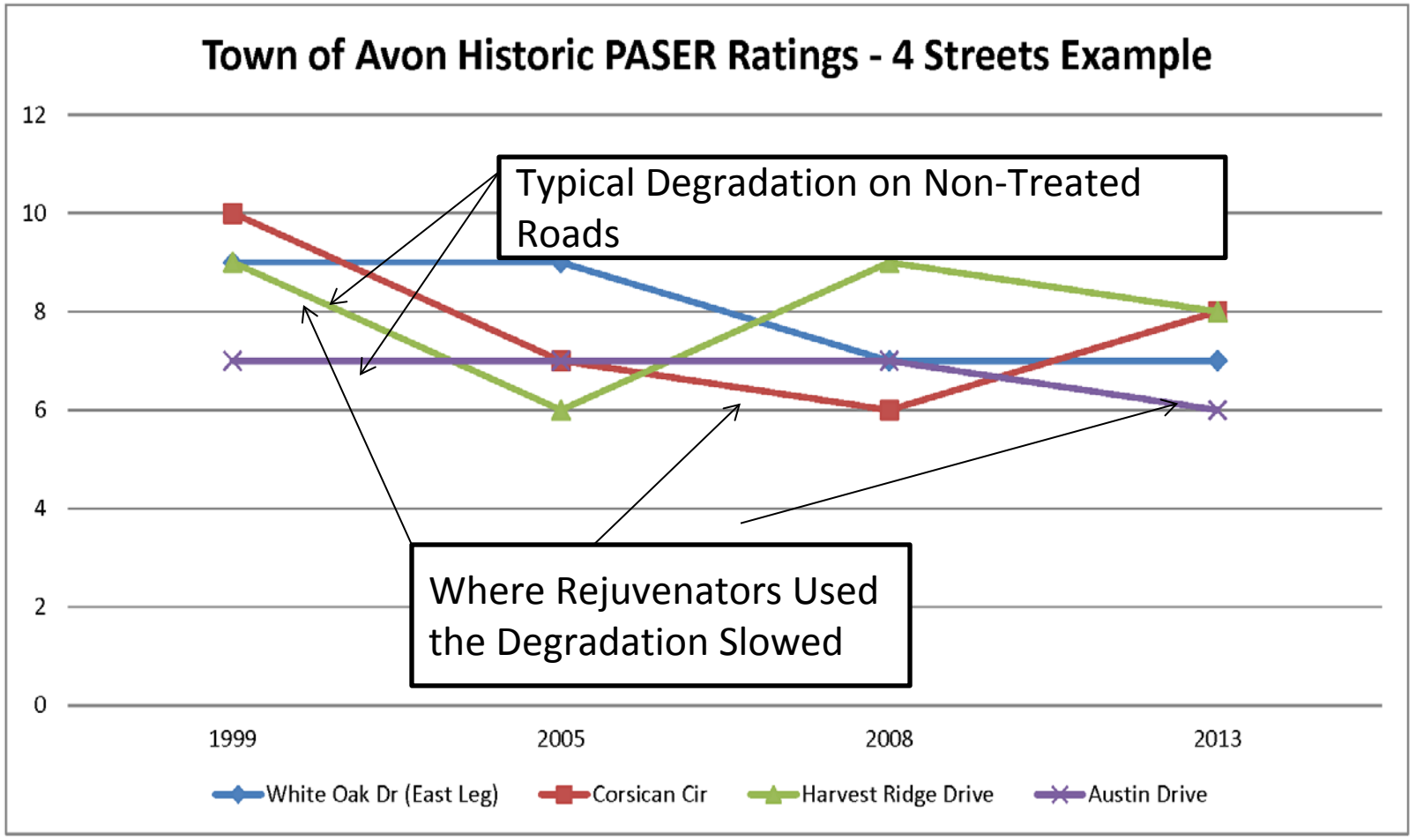

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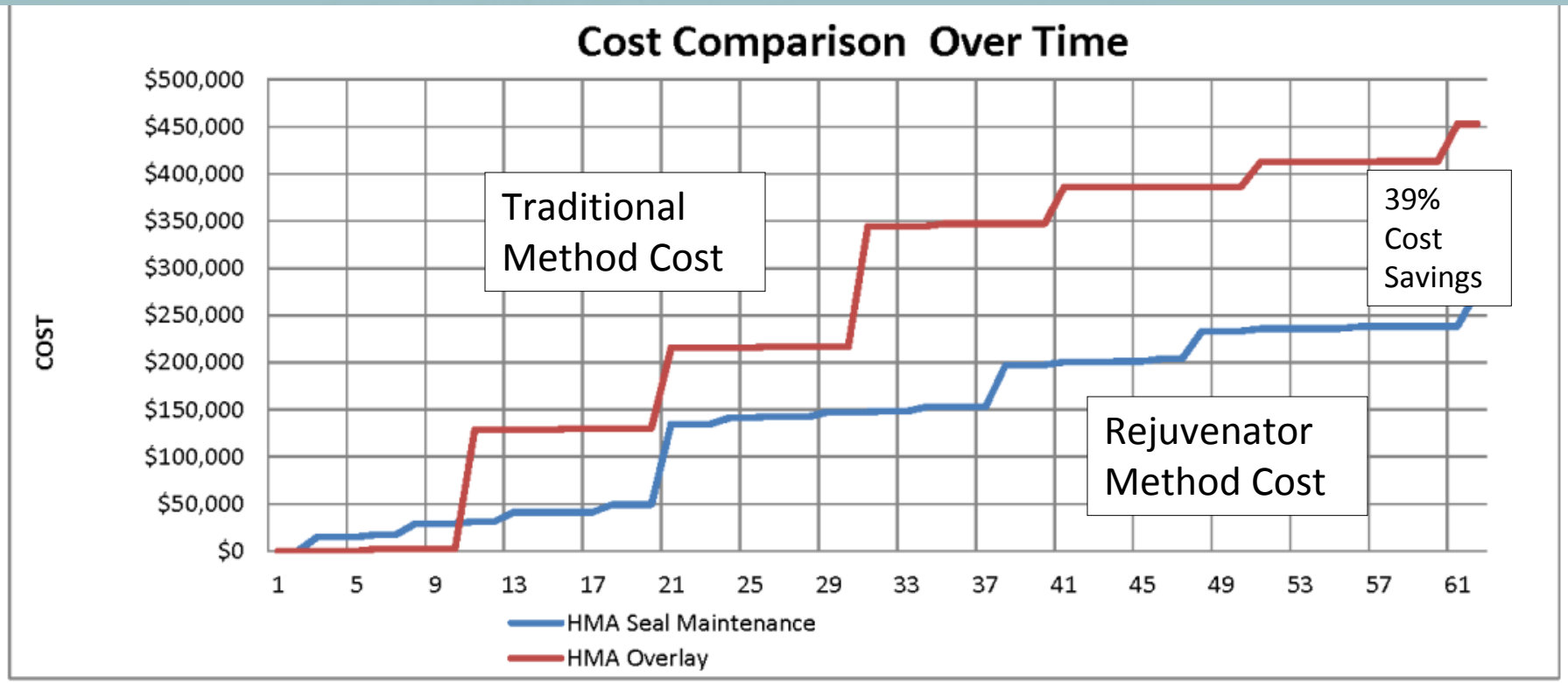
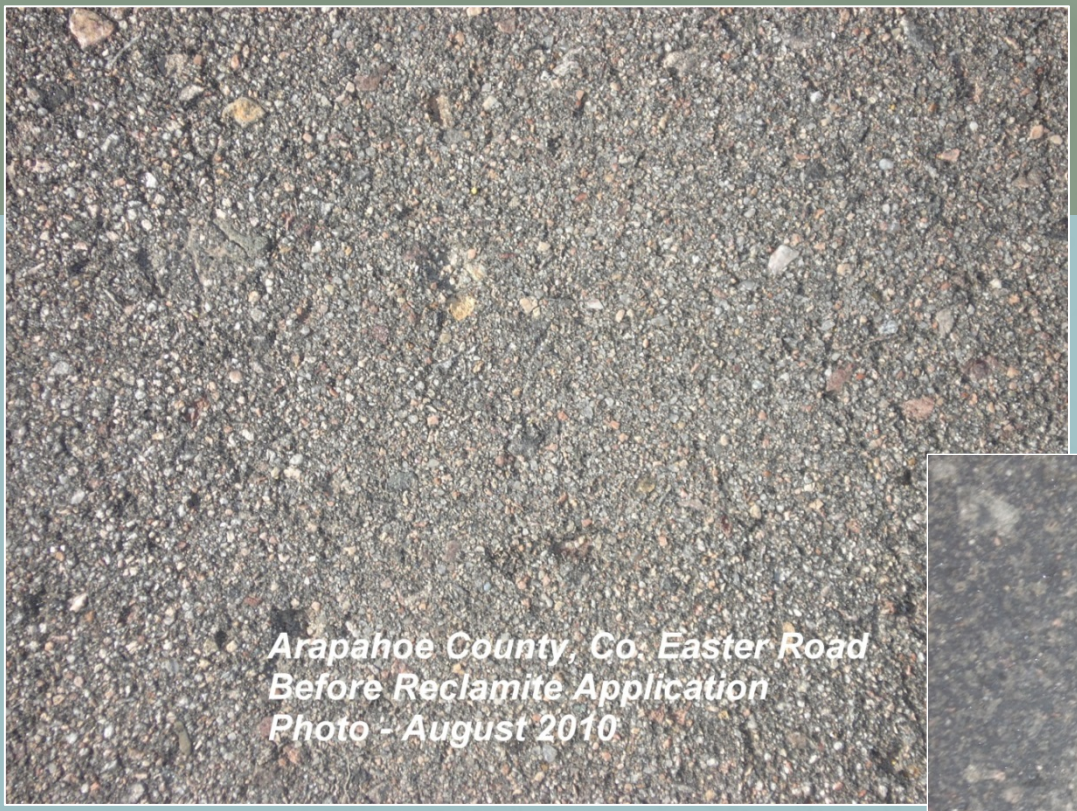


Where and When to Use a Rejuvenating Seal?

- Construction seal to new asphalt pavements.
- **Rejuvenating seal to pavements to extend pavement life before the use of a wear course seal is required.**
- To correct pavements exhibiting minor segregation, raveling, poor compaction.
- **Note: A rejuvenating scrub seal** should be considered on pavements exhibiting more distress than a straight maltene rejuvenator seal could address.

Colorado



Arapahoe County, Co. Easter Road
Before Reclamite Application
Photo - August 2010

Arapahoe County, Co. Easter Road
Photo After Treatment- October 2010

Pikes Peak Highway Colorado Before Reclamite® Application

Pikes Peak Highway Colorado After Reclamite® Application

Missouri

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.

Alabama

Tennessee

Arizona

Reclamite, no need for immediate restriping of thermo paint

Ring Test Appearance

Which roads make GOOD rejuvenator candidates?

Open Grade HMA

Aged dense graded HMA showing aggregate loss

Chip seals (lose of rock)

Which roads make BAD rejuvenator candidates?

Tight Surface

Not suitable

Rich Surface

Not Suitable

Thank You – Questions Welcome

Jim Brownridge

Marketing Manager

Direct Phone: 661.337.9979

www.tricorrefining.com