

PUERTO RICO
Department of Transportation
Pavement Preservation Conference
And
Technology Implementation

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San Juan Puerto Rico

Flexible Pavements Preservation
With
Rejuvenators

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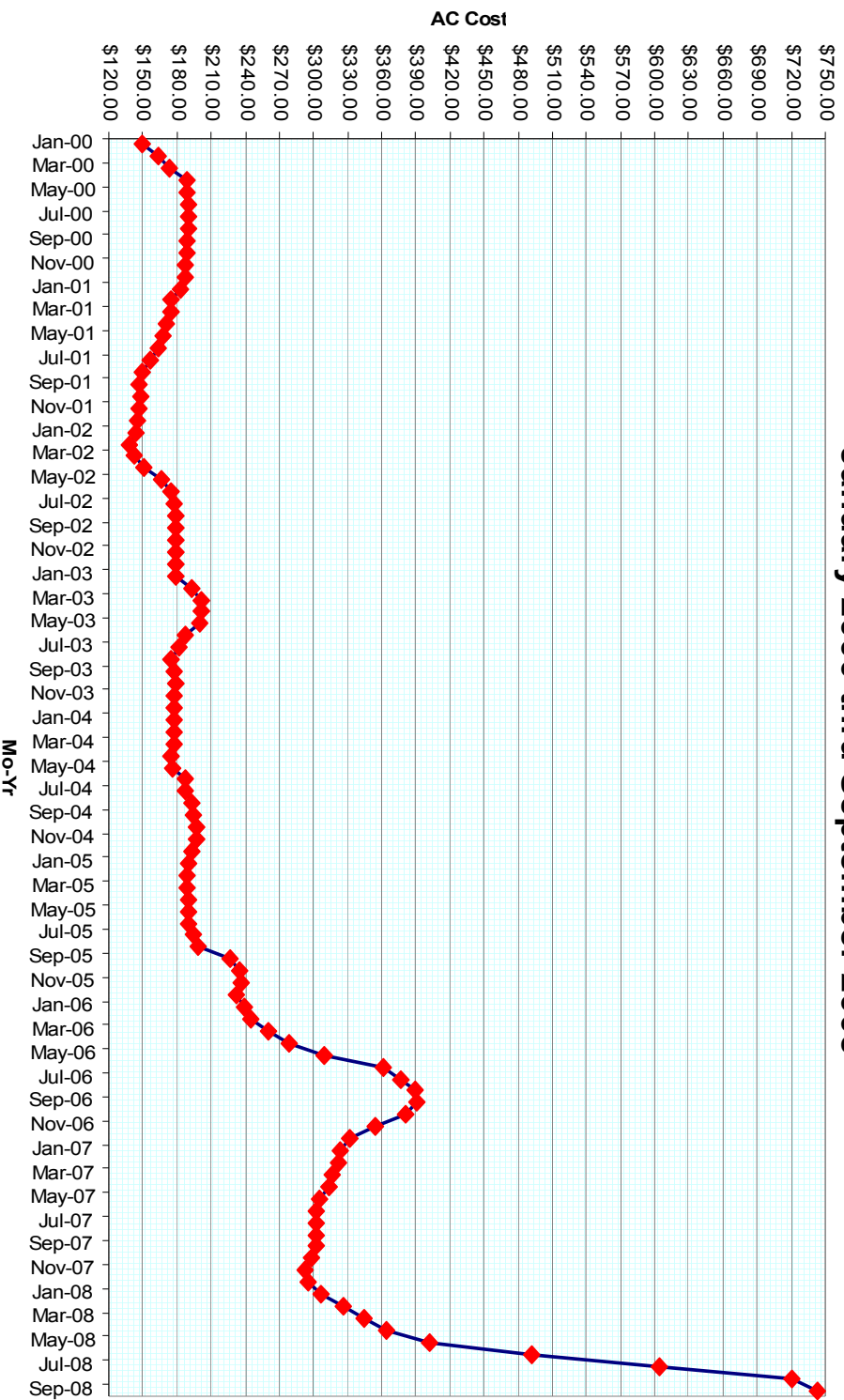




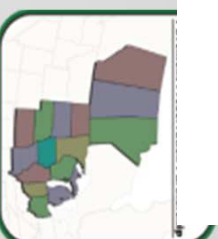
This Presentation is a condensed version
of
The NCPP Training Course
“Top of the Curve”
Fog Seals and Rejuvenators



ASPHALT PRICES January 2000 thru September 2008



The cost of AC has gone from below \$150 to over \$700 per liquid ton from January 2000 through September 2008.



Cost Impacts

- The average cost of HMA In-Place has gone from \$21 per ton to \$97 per ton.
- The cost for paving 1 lane mile has gone from \$11K to \$51K.



Cost-Effectiveness

- Studies by several DOTs have also shown that every \$1 spent on Pavement Preservation can save \$8-\$10 or more in future rehabilitation costs.



TERMINOLOGY

- **Fog Seal**
- **Rejuvenator**

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."

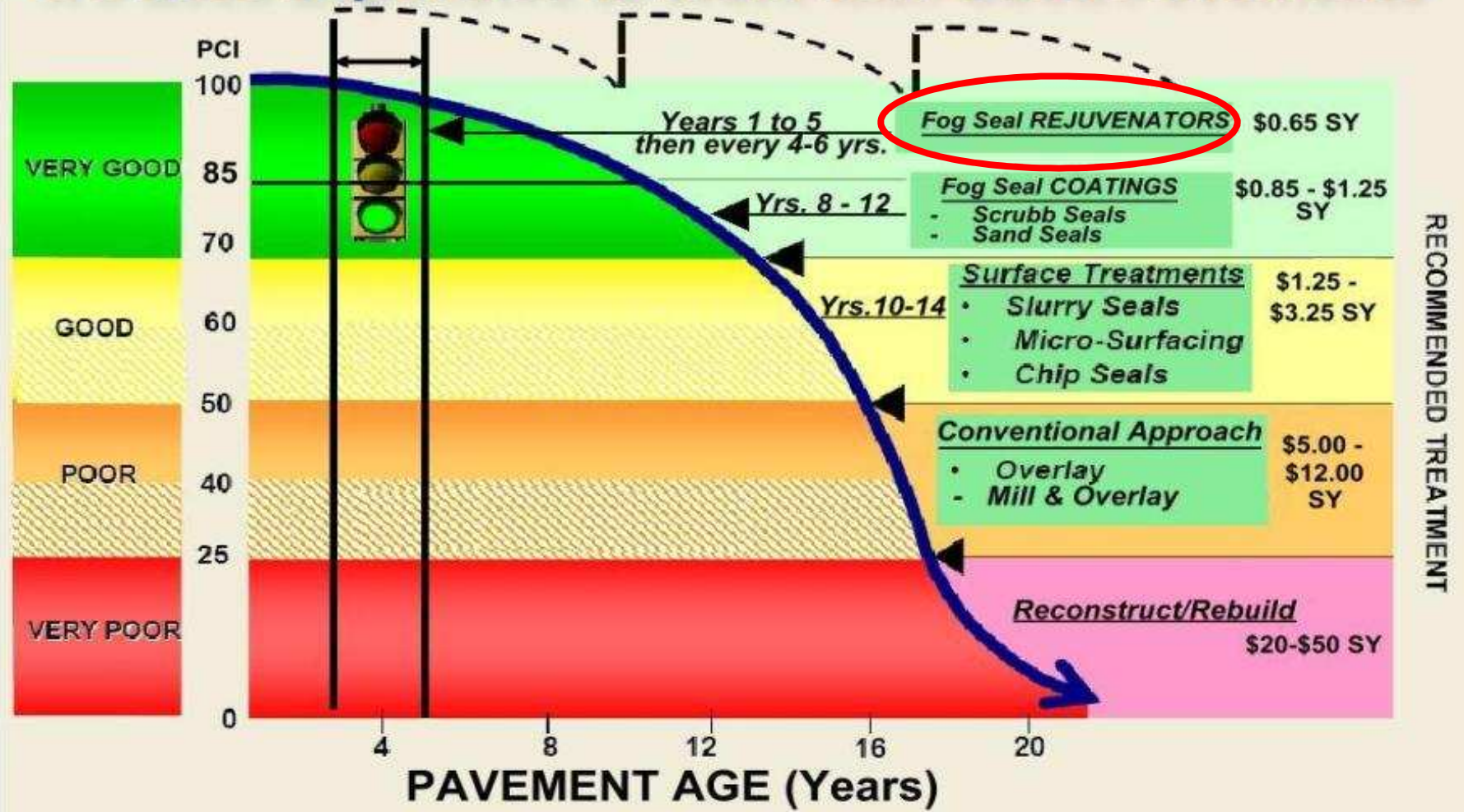


Rejuvenator

- An asphalt rejuvenator is a maltene base petroleum product which has the ability to absorb or penetrate into an asphaltic concrete pavement and restore those reactive components (*maltenes*) that have been removed from the asphalt binder due to the natural occurring oxidation process.
- A rejuvenator is also a light spray application of emulsion

PAVEMENT PRESERVATION

It's Less Expensive to Work with Good Pavements



Fog seal rejuvenators extend pavement life

- Numerous studies and reports conducted over the past 30+ years have confirmed the effectiveness of fog seal rejuvenators in extending pavement life.

**FHWA/FP2
Sealer/Rejuvenator Study**

Gayle N. King
Principal Investigator

Foundation for Pavement Preservation / FHWA



Spray
Surface

Report No. FHWA-RD-78-10B

TECHNIQUES FOR REHABILITATING PAVEMENTS WITH
A SYSTEMS ANALYSIS

Vol. 1. Analysis



September 1977
Final Report

Document is available to the public through
the National Technical Information Service,
Springfield, Virginia 22161

Prepared for
FEDERAL HIGHWAY ADMINISTRATION
Offices of Research & Development
Washington, D. C. 20590

**Asphalt Rejuvenators
"Fact, or Fable"**

Robert E. Boyer, Ph.D., P.E.
Senior District Engineer
Asphalt Institute



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San Antonio, Texas
February 28 - March 3, 2000

**PREVENTATIVE MAINTENANCE OF
ASPHALT CONCRETE PAVEMENTS**

NCAT Report 88-01

ENGINEERING

Reclaimite Usage,
Apoma Center
Ike, Calif.

1988 Annual Meeting of Our Transportation Research



277 Technology Parkway • Auburn, AL 36830

**LOWEST COST
VERSUS
FUNCTION**



DEPARTMENT OF THE NAVY
WESTERN DIVISION
NAVAL FACILITIES ENGINEERING COMMAND
SAN BRUNO, CALIFORNIA 94354



Sealer/Binder Study

Rejuvenators tested and reported on in the Sealer/Rejuvenator Study include:

Reclamite® - Maltene base. First produced, tested and marketed in the late 1960's.

PASS®-QB - Polymerized asphalt emulsion with some maltene base oil content.

CRF® - Maltene based restorative seal with some asphaltene content.

ERA-1 & ERA-25 - Blends of asphalt with the same rejuvenator base oil used for Reclamite.

Other maltene based rejuvenators available include: **JOINTBOND®**, **Cyclogen® ME**, and **ERA-50**.



Asphalt Cement Properties



Concerns

- Typically AC makes up approximately 6% of hot-mix asphalt.
- One SY of 1-1/2" compacted hot-mix, weighs approximately 168 lbs.
- 6% of 168 lbs = 10 lbs.

Thus, 10 lbs. of AC per SY of hot-mix

10 lbs.
AC per SY
of 1.5" Mix



Which component changed?



Slide 14

CD1

Colin Durante, 6/3/2008

Chemical Properties

- Review the general chemical makeup of asphalt cement (AC) and the causes for aging and deterioration
- Asphalt is comprised of two fractional components
Asphaltenes & Maltenes

Components of asphalt.

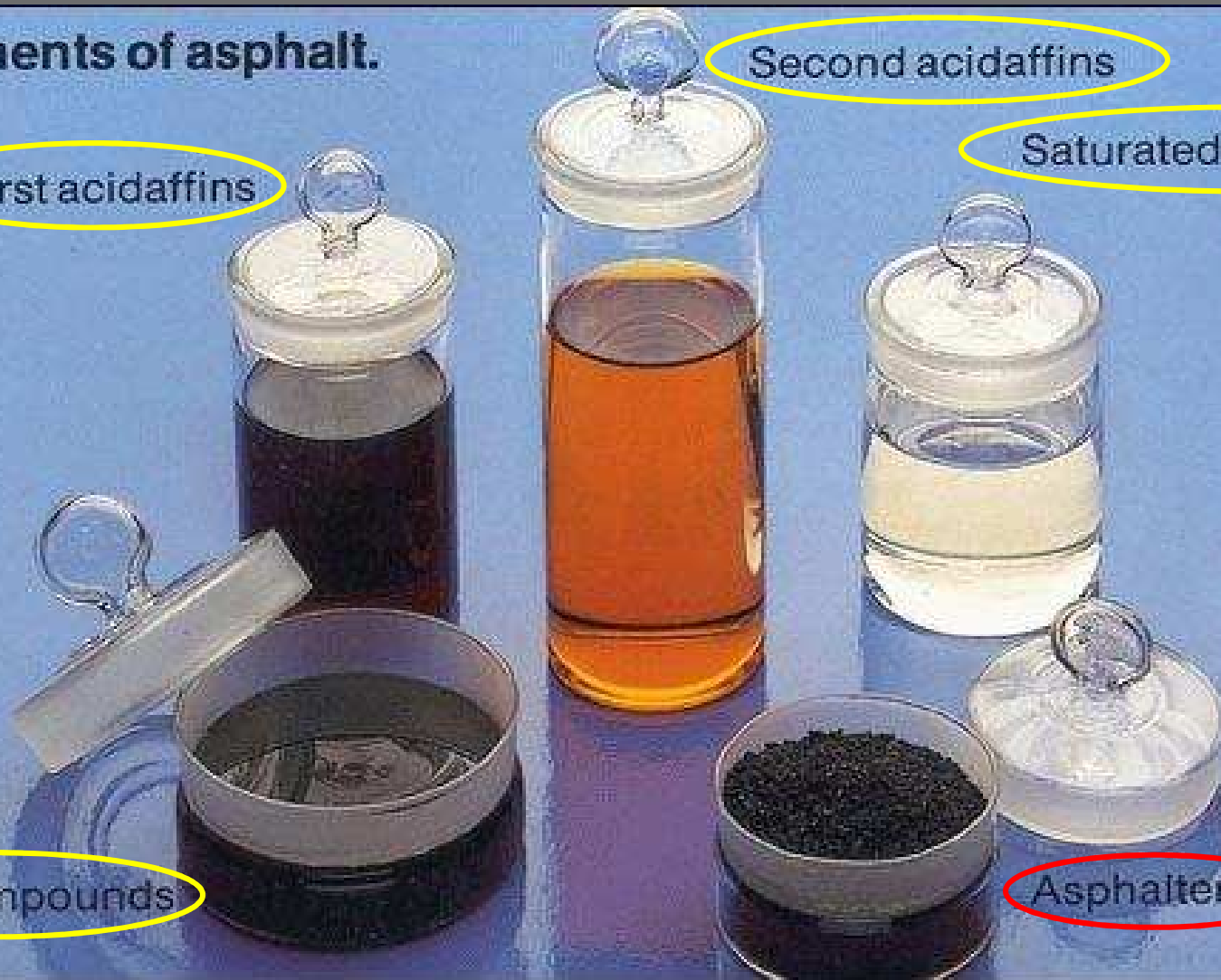
First acidaffins

Second acidaffins

Saturated hydrocarbons

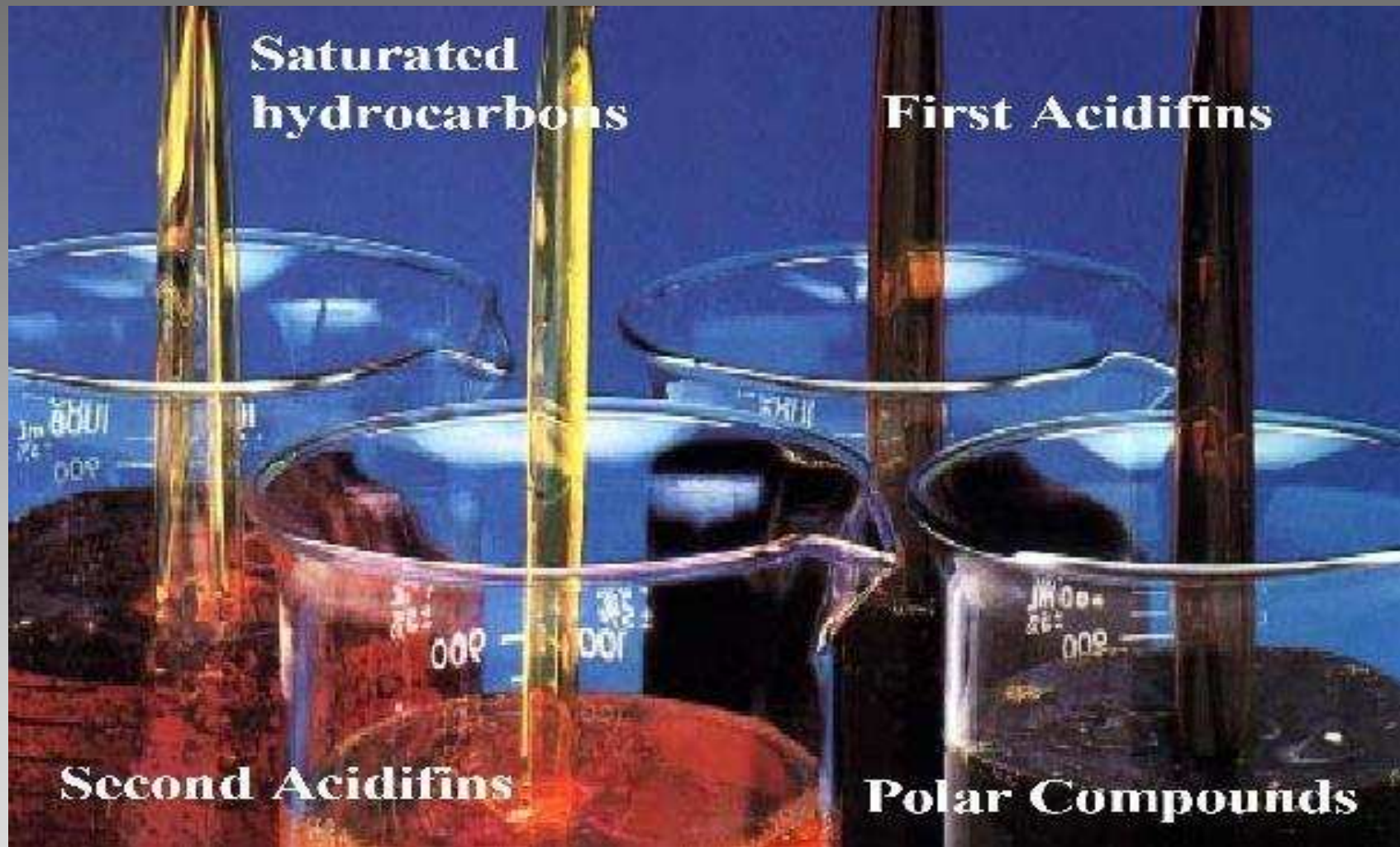
Polar compounds

Asphaltenes



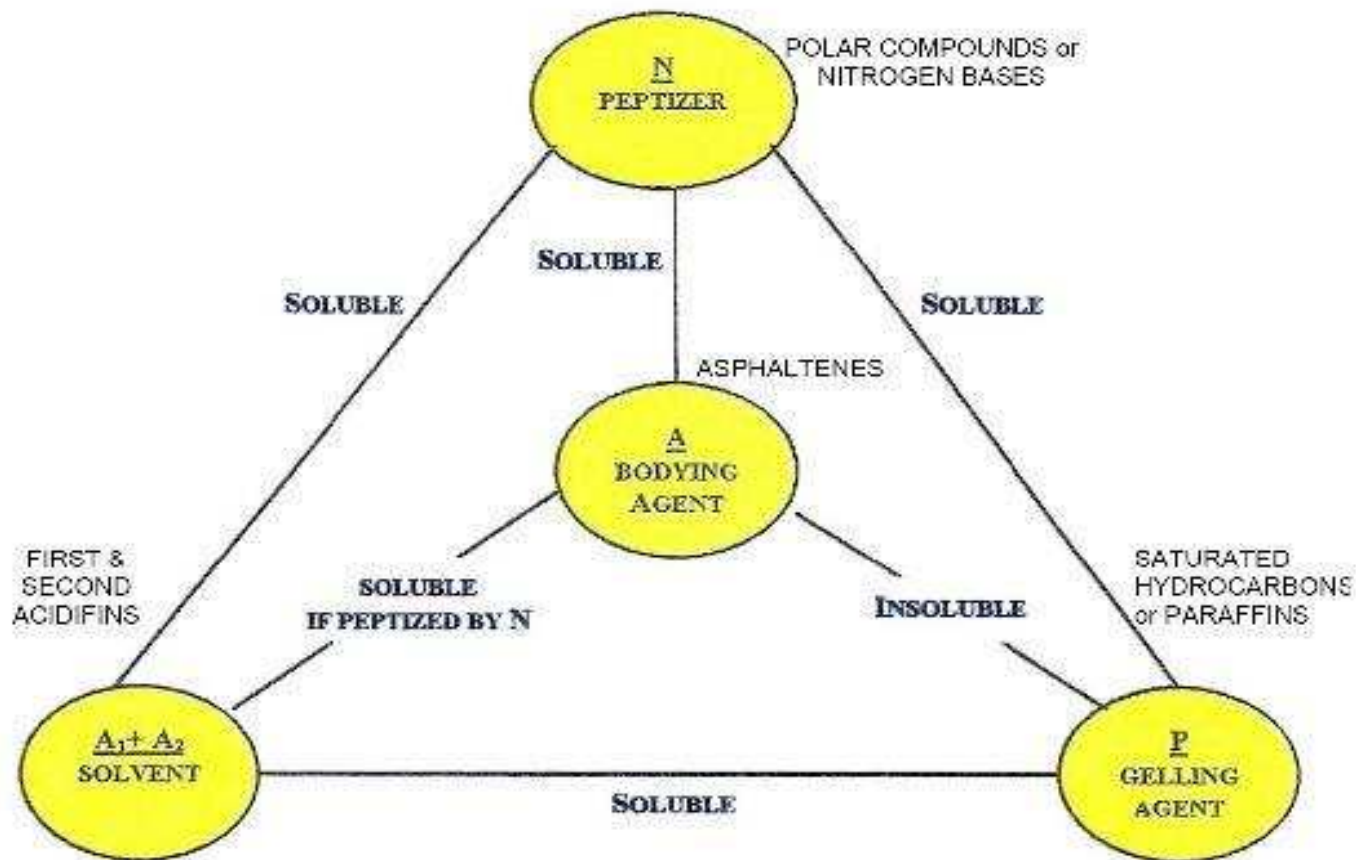
- **Asphaltenes (A)** are that fraction of the asphalt insoluble in n-pentane.
 - The function of the asphaltenes is to serve as a bodying agent.
- **Maltenes** is the collective name for the remainder of the asphalt material left after precipitation of the asphaltenes.
 - Four principle bodies of maltenes have been identified and each has a specific function.

Four Maltene Fractions of Asphalt



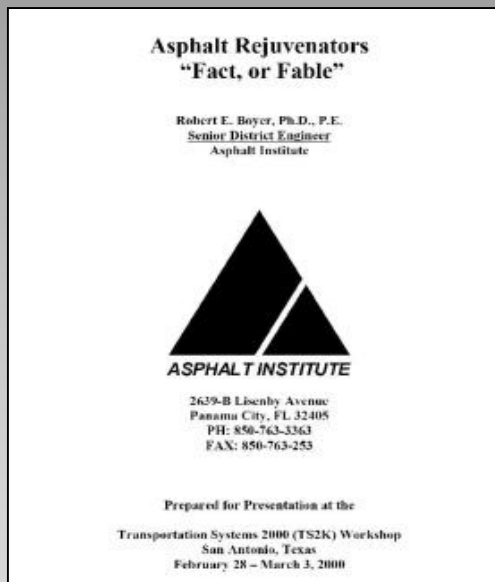
Relation Between Asphaltenes & Maltenes

Soluble Relations of Asphalt Components



- In a 2000 report on rejuvenators prepared by the Asphalt Institute's Dr. Robert Boyer he discusses this and noted :

In tests conducted by Rostler and White, it was reported that the "A" and "P" asphalt components were the most stable; and the "N", "A1", and "A2" components were more subject to oxidation in descending order, respectively.

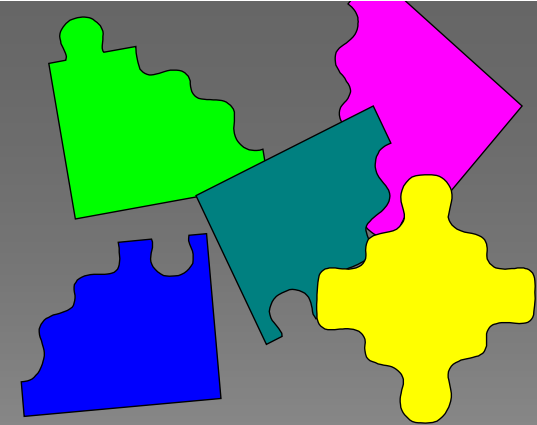


- Simply stated, the report confirmed what other reports and studies had shown which is that the **Asphaltenes are the stable component** in asphalt cement and are unaffected by oxidation, air, UV rays, water, temperature change, etc.



- **Maltenes are the unstable component of asphalt binder and they are affected by air, UV rays, water, temperature changes, etc.**
- **It is the loss of the maltenes from the asphalt binder in the upper 3/8"-1/2" of asphalt pavements that start the asphalt deterioration process.**





**Reactive components deteriorate
causing an imbalance with
the asphaltenes.**

**The Result:
"A Failed Glue!"**

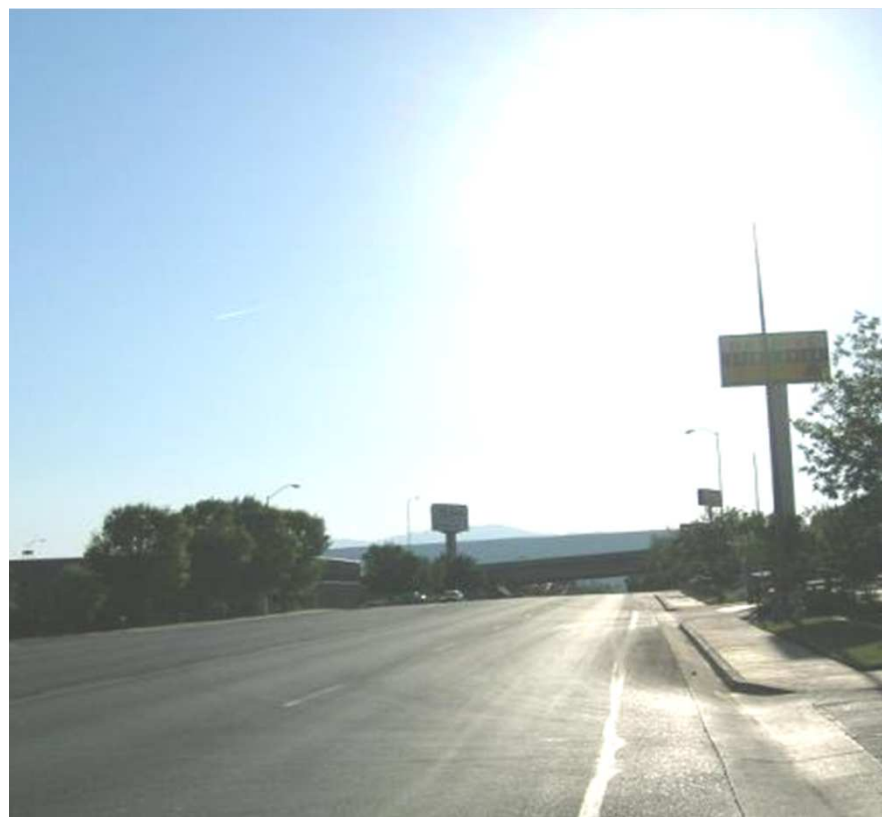


- The aging and breakdown of asphalt cement and loss of maltenes actually begins at the hot-mix plant due to the extreme heating necessary to blend asphalt with stone and to get it to the job site in a pliable state.



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

- Constant exposure to the Sun's UV rays
- Environmental temperatures
- Oxidation
- Stripping action of storm water and melting snow
- Traffic wear



- The constant UV ray exposure and heating effect from the sun cause the maltene fractions to be oxidized from the pavement's asphalt binder.



Benefits of Rejuvenators & Sealers



Rejuvenators

- These products also work to provide a long lasting seal of the pavement's surface preventing the intrusion of air and moisture into it.



Rejuvenators

- Pure maltene based rejuvenators are translucent and leave pavement markings visible with no need for restriping.



Rejuvenators

- Test areas demonstrate the long term effectiveness of a maltene based rejuvenator.



Sealers

- Maltene based, fog seal applied longitudinal joint stabilizers provide sealing and increased density along joints.



Concerns of Using Rejuvenators & Sealers



Impact on Skid Resistance

- Rejuvenators can lower skid numbers.
- Experience has shown that the maltene base rejuvenators cause a shorter lasting and often less reduction in skid numbers.
- Temporary application of sand at 1 to 2 lb/sy can normally improve skid resistance.

Impact on Skid Resistance

- **CAUTION** must be used in choosing the pavements to be treated with the selected fog seal rejuvenator and in its application rate.
- 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.

Impact on Skid Resistance

- Excessive application rates can cause unacceptable skid numbers and is sometimes difficult to correct.



Cost of Treatments



Rejuvenators

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

\$0.65 - \$0.75 Per SY

or

\$4,500 - \$5,000 Per Lane Mile (12'wide)



APPLICATION PRACTICES

Project Pavement Selections

“IDEAL” LOCATIONS (Safest):

- Lower speed urban streets and rural roads
(Less than 40 mph)
- Chip sealed surfaces (lighter volumes of rejuvenator may be necessary)
- Highway paved shoulders, particularly those containing milled or depressed rumble strips.
- Open Graded Mix surfaces

Multiple studies have indicated that pavements to be treated should have a minimum 7%-8% voids in the total mixture (VTM) to allow proper penetration.



Residential streets are excellent candidates for rejuvenators or seals



Paved Shoulders are excellent candidates for rejuvenators



Urban collector streets are excellent candidates for rejuvenators



Low volume rural roads can be excellent candidates for rejuvenators



Surface Texturing and Rejuvenation

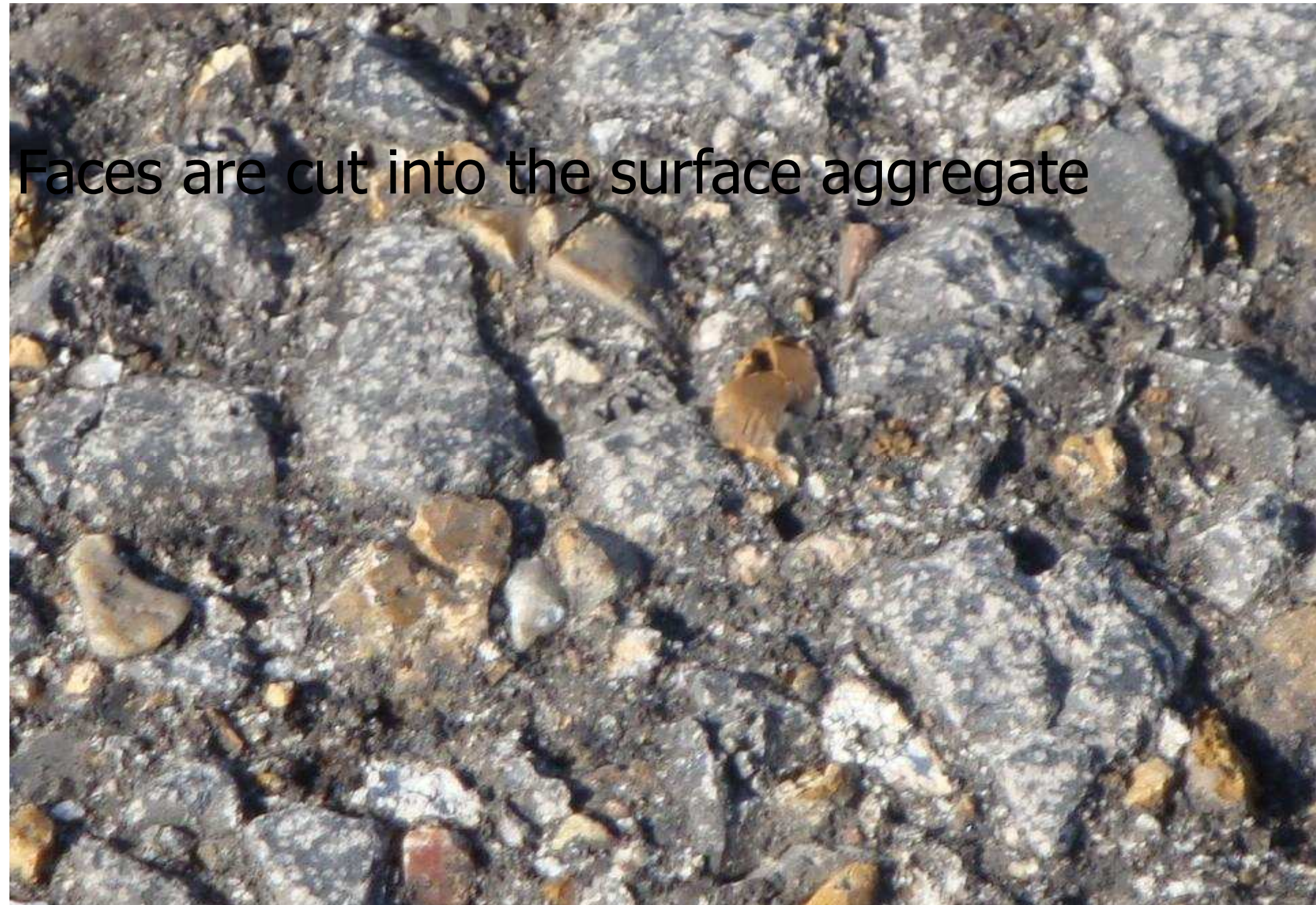


Skidabrader system retextures the surface at one and one half lane miles per hour

RT 51, HAMMOND, La.



Faces are cut into the surface aggregate

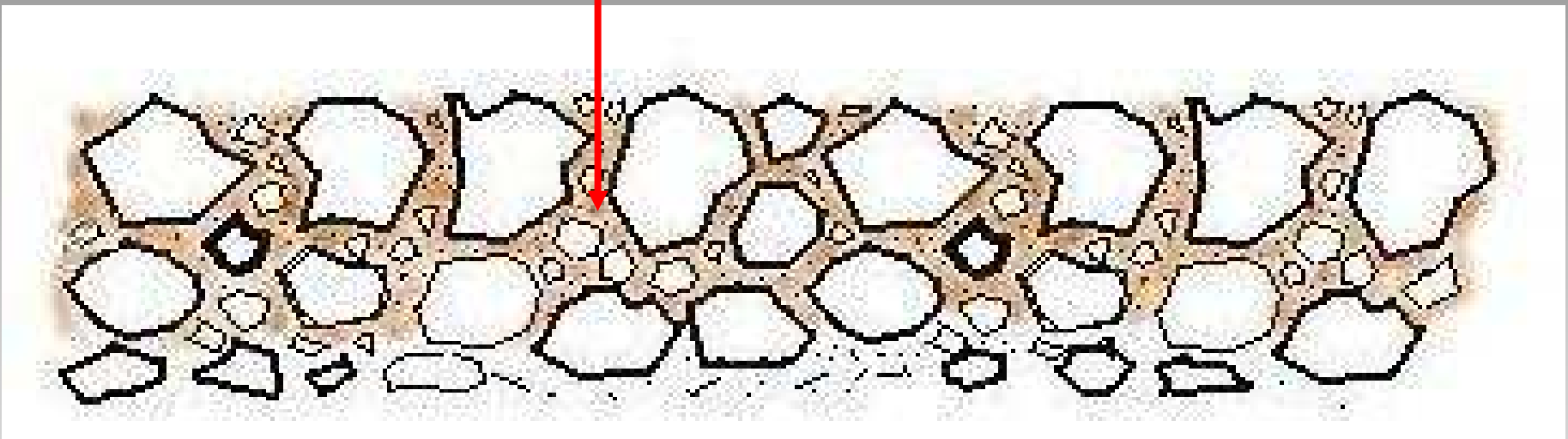




The Rejuvenator APPLIED BEHIND THE SKIDABRADER

Penetrate Into the Pavement

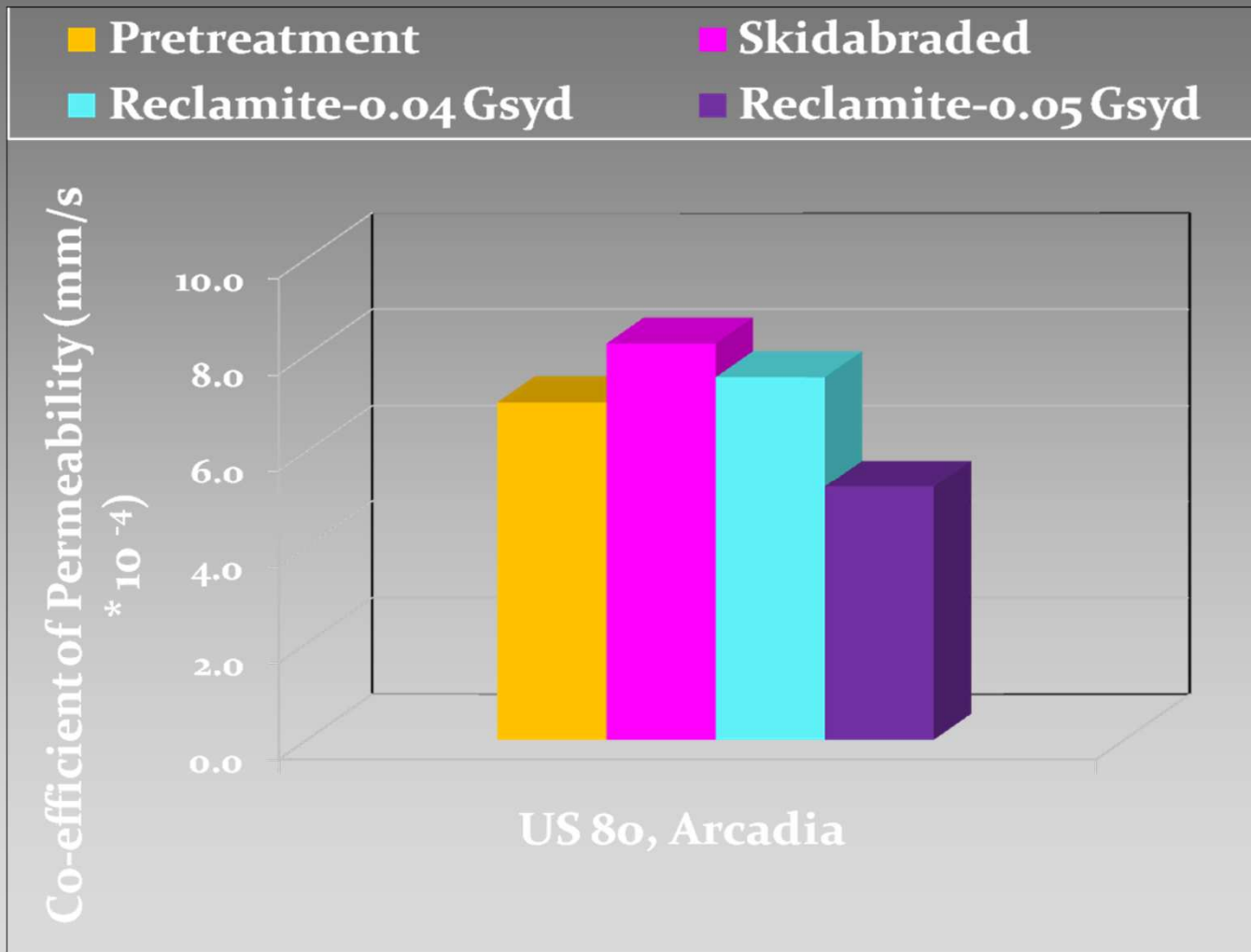
Maltenes must penetrate into the pavement **TO COMBINE**
WITH THE EXISTING ASPHALT BINDER



A close-up photograph of an asphalt surface. The surface is dark grey and composed of small, irregular aggregate particles. A vertical line of abraded material runs down the center of the image. The abraded area is lighter in color and shows a rougher texture. The text 'REJUVENATOR ABSORBED INTO THE ABRADED SURFACE' is overlaid in yellow on the right side of the image.

**REJUVENATOR
ABSORBED
INTO THE ABRADED
SURFACE**

Restoring Surface Friction/Extending Service Life



APPLICATION PRACTICES

Weather Limitations

AMBIENT TEMPERATURES

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.



APPLICATION PRACTICES

Weather Limitations

AMBIENT TEMPERATURES

Rejuvenator applications should be avoided when low temperatures below 32° F are expected.



APPLICATION PRACTICES

Weather Limitations

PRECIPITATION

- Rejuvenators require dry pavement.
- Application of rejuvenators should be avoided when rain chance is above 50%.



APPLICATION PRACTICES

Pavement Surface Conditions

Pavement surfaces to be treated should be dry and free of all dirt, sediments and other debris prior to application of the fog seal product.

Contract documents should specify whether the agency or the contractor is responsible for sweeping and cleaning of the pavement surface prior to the fog seal application.



APPLICATION PRACTICES

TRAFFIC CONTROL

- **Lane closure permits and notices should be acquired and distributed in advance of the work.**
- **Work Zone signage and traffic control should be conducted in accordance with MUTCD and other agency required guidelines.**



APPLICATION PRACTICES

SPRAY APPLICATION RATES

Typically diluted with a 2:1 product to water ratio, but other dilutions may be used depending on temperature and humidity conditions.

Normal Application Rates:

0.05 to 0.15 gal/SY depending on the pavement absorption level.

A simple “ring test” can be performed prior to application to determine needed application rate.



APPLICATION PRACTICES

SPRAY APPLICATION RATES

A simple “ring test” can be performed prior to application to determine needed application rate.



APPLICATION PRACTICES

SPRAY APPLICATION RATES

A simple “ring test” can be performed prior to application to approximate needed application rate.



Performance Specifications for Rejuvenators



Evaluation of Seal Coat Runway 16-34 Lajes Field, Azores

by
J. E. Pickett

Geotechnical Laboratory
U.S. Army Engineer Waterways Experiment Station
P.O. Box 631
Vicksburg, Mississippi

March 1983



Summary



SUMMARY

- Rejuvenators are inexpensive and very cost effective means for extending the life of asphalt pavements.
- Maltene based rejuvenator application has been used for over 40 years and has a documented and proven history of effectiveness.



SUMMARY

- Maltene based rejuvenators work by changing the chemistry of the asphalt binder to new or nearly new condition.
- Rejuvenators seal the pavement's surface, restore its flexibility and restore the asphalt binder's cohesive ability to act as a glue and retain aggregate.



SUMMARY

- Rejuvenators can be a cost effective and safe means of extending pavement life when properly applied by qualified contractors and/or personnel.
- Rejuvenators cost approximately \$4,000 - \$5,000 per lane mile applied.



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.



A Last Word

“ good things happen when a rejuvenator is used on the right pavement at the right time “

Questions?

