A Look into the Future Considering the “Tuff Economic Times”

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The Future

- **The Problem**
  - Too many roads
  - Not enough funds

- **The Opportunity**
  - A sound pavement preservation program to optimize paving funds
  - Securing dedicated funding

Can your agency continue to do more with less?
The Future

- Funding situation
  - Need for change
  - Existing system seems to be broken

- Challenges
  - Competing needs
    - Managing our assets
    - Capacity issues
    - Safety
  - How to prioritize

- Alternative: Turning paved roads into gravel
Possible Solutions

- Using Pavement Preservation Concepts
  - Surface Seals
  - Thin bonded wearing courses
  - In-place surface recycling
- Using warm mix asphalt
  - Rubber chip seals
  - Thin lift rubberized asphalt mixes
Pavement Preservation Concept

- **Overview**
  - When, where, what
  - Choosing the right treatment

- Better use of existing and improved technologies
Pavement Preservation

“Strategy including all activities to provide & maintain serviceable roadways”

- Lower life cycle costs
- Higher quality pavements
- Keeping good pavements good
- Greener solutions

The right treatment on the right pavement at the right time
Types of Pavement Maintenance

- **Pavement Preservation (Proactive)**
  - Extend the pavement life
  - Protect investment
  - Lower life cycle costs

- **Corrective (Reactive)**
  - After deficiency occurs
  - More expensive
Effective Pavement Preservation

- $1 for preventive maintenance here
- Costs 6-10 times or more when it’s done as rehab
What’s the “Right” Road?

- Start by looking at overall road network
- Keep pavement condition such that rehabilitation is deferred as long as possible
“Right” Treatment Depends Upon

- Existing pavement
  - Distresses
  - Structure and drainage
- Environment
  - Climate, traffic, etc.
- Life cycle costs
  - Initial, maintenance, rehab & downtime costs, service life, etc.
- Locally available treatments
  - Materials, contractors, quality, performance, costs, etc.
Pavement Preservation Techniques for Flexible (Bituminous) Pavements

- Crack Seal
- Fog Seal
- Slurry Seal
- Chip Seal
- Thin HMA Overlay
Pavement Preservation Techniques for Flexible (Bituminous) Pavements

- High Performance Chip Seal
- Scrub Seal
- Recycling
- Micro-Surfacing
- Ultrathin Bonded Wearing Course
Crack Sealing

- Routine maintenance
- Cleaning & sealing
- Prevents intrusion of water and incompressible materials from entering cracks
  - Retards deterioration
  - Retards cupping deformation
Fog Seal

- Light application of diluted, slow-setting asphalt emulsion without aggregate cover
  - Seals pavement
  - Inhibits raveling
  - Enriches oxidized asphalt
  - Provides delineation
Surface Treatments

Typically used to:

- Seal cracks
- Waterproof surface
- Improve friction
- Improve rideability
- Rejuvenate surface
Chip Seal

- Application of asphalt and aggregate chips rolled onto the pavement
  - Seals pavement
  - Enriches hardened/oxidized asphalt
  - Retards reflection cracking on HMA overlays
  - Improves skid resistance
Scrub Seals

- Application of sand or small sized aggregate on broomed layer of polymer modified asphalt
  - Fill and seal small cracks and voids
  - Enriches oxidized asphalt
Slurry Seal

- Mixture of well-graded aggregate & slow setting asphalt emulsion
  - Type I: Seal surface cracks
  - Type II: Correct raveling/oxidation
  - Type III: Fill minor surface irregularities and restore surface macro-texture & skid
Micro-Surfacing

- Mixture of high quality aggregates and polymer modified emulsion binder
  - Inhibit raveling and surface oxidation
  - Improve skid resistance
  - Fill ruts/minor surface irregularities
  - Seal pavement surface
Thin Bonded Wearing Courses

- Gap or open graded, polymer-modified HMA placed on a heavy, polymer-modified emulsified asphalt tack coat
  - Increase surface texture
  - Address surface distress
  - Reduce back-spray
  - Reduce noise
Recycling Treatments

- Typically used to rework AC to a depth of 25 to 100 mm (1 to 4 inches)
  - Cold in-place (CIR)
  - Hot in-place (HIR)
Cold In-Place Recycling

- Milling, rejuvenating, and replacement of the top portion of the bituminous surface (without heat)
- Rework HMA to depth of 50 to 100 mm (2-4”) to
  - Correct surface distresses
  - Improve profile and cross-slope
Hot In-Place Recycling

- Heating, scarifying, milling, rejuvenating the existing surface
- Rework HMA to depth up to 100mm (1-3”)
  - Correct surface distresses
  - Improve profile and cross slope
Thin HMA overlays: Mill and Fill

- Application of a new HMA wearing course
  - After milling existing surface
  - Reduces hydroplaning and tire splash
  - Improve profiles, crown and cross-slope
When Should The Treatments be Applied?

- Fog; Chip Seals
- Micro-surfacing
- Ultrathin bonded wearing course; Crack sealing
- Reflective crack relief system
- In-place recycling
- Base stabilization

Curve shape determined by quality, traffic, climate, etc.
<table>
<thead>
<tr>
<th>Surface Treatment</th>
<th>Good Condition (PCI=80)</th>
<th>Fair Condition (PCI=60)</th>
<th>Poor Condition (PCI=40)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fog Seal</td>
<td>3 - 5</td>
<td>1 - 3</td>
<td>1 - 2</td>
</tr>
<tr>
<td>Chip Seal</td>
<td>7 - 10</td>
<td>3 - 5</td>
<td>1 - 3</td>
</tr>
<tr>
<td>Slurry Seal</td>
<td>7 – 10</td>
<td>3 - 5</td>
<td>1 - 3</td>
</tr>
<tr>
<td>Micro-surfacing</td>
<td>8 – 12</td>
<td>5 - 7</td>
<td>2 - 4</td>
</tr>
<tr>
<td>Ultrathin Bonded Wearing Course</td>
<td>10+</td>
<td>5 - 10+</td>
<td>2 - 6</td>
</tr>
<tr>
<td>Thin HMA</td>
<td>10 - 12</td>
<td>5 - 7</td>
<td>2 - 4</td>
</tr>
<tr>
<td>Treatment</td>
<td>Years</td>
<td></td>
<td></td>
</tr>
<tr>
<td>----------------------------</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Crack Sealing</td>
<td>2 – 4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fog Sealing</td>
<td>2 – 4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Chip Seals</td>
<td>4 – 8</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Slurry Seals</td>
<td>4 – 10</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Micro-Surfacing</td>
<td>6 – 12</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Thin &amp; Ultrathin HMA</td>
<td>8 – 15</td>
<td></td>
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</tr>
</tbody>
</table>
Improved Pavement Preservation Technologies

- Polymer modified asphalt binders
- New asphalt emulsion chemistries
- Improved aggregate tests & specs
- Improved construction equipment
- New performance-related tests & specs.
- Warm mix technology for binders
Formulated for
- Chemical break/solvent free
- Timed cures for early strength, quick construction & traffic release
- Improved adhesion, workability, coating, durability, moisture resistance
- Higher asphalt content
  - Good dispersion with higher film thickness
  - Durable flexibility
- Climate-specific binder
Conventional vs. Engineered Emulsion
for Cold In-Place Recycling

New chemistry coats both fines & coarse materials allowing higher asphalt content
## Aggregate Performance-Related Specification Tests

<table>
<thead>
<tr>
<th>Property</th>
<th>Performance</th>
<th>Specification Test</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hardness</td>
<td>Degradation resistance</td>
<td>-LA Abrasion&lt;br&gt;-Micro-Deval</td>
</tr>
<tr>
<td>Shape</td>
<td>Macrotexture Matrix Strength</td>
<td>-Flat &amp; Elongated&lt;br&gt;-% Crushed Faces&lt;br&gt;-Flakiness</td>
</tr>
<tr>
<td>Water Sensitivity</td>
<td>Stripping</td>
<td>-Sand Equivalent&lt;br&gt;-Methylene Blue&lt;br&gt;-Deleterious Materials</td>
</tr>
<tr>
<td>Adhesion</td>
<td></td>
<td>-Sulfate Soundness</td>
</tr>
<tr>
<td>Soundness</td>
<td>Durability</td>
<td>-Water Absorption</td>
</tr>
<tr>
<td>Film Thickness</td>
<td>Raveling</td>
<td>-Uncompacted Void Content</td>
</tr>
<tr>
<td>Shape</td>
<td>Microtexture Structural integrity</td>
<td></td>
</tr>
</tbody>
</table>
Performance-Related Specs & Pavement Preservation

- Increase performance
- Decrease risks
- Better roads at lower life cycle costs
Corrective Maintenance Treatments

In-Place Recycling

Base Stabilization / Full Depth Reclamation
Engineered CIR

- Sampling & design with special chemistry emulsion for faster set times
- Milling, rejuvenating & replacing aged road surface with equipment train
  - Corrects surface distresses
  - Improves profile, crown & cross-slope
  - Engineered for reliability
  - Low user delays
  - Cost-effective rehabilitation
Cold In-Place Recycling

- Performance Needs
  - Resistance to raveling
  - Resistance to thermal cracking
- Performance related tests
  - Raveling
  - Indirect Tensile
Less Raveling – Lab & Field

Samples & field photos from CSAH No. 20, Blue Earth County, MN

Conventional CIR
25.7% mass loss

Engineered CIR
1.6% loss

Raveling in the field
Engineered CIR Project
Cathedral City CA
Engineered HIR Emulsion

- Formulated with
  - Rejuvenator and Elastomeric polymer modified asphalt
  - Grade selected for project
- Rejuvenates aged, oxidized asphalt
- Excellent aggregate/RAP coating
- Polymer improves
  - flexibility & durability
  - adhesion
  - temperature susceptibility
  - strength & rutting resistance
  - cracking resistance
Asphalt Rubber Products

- Chip seals
- HMA-gap and open
- With or without warm mix
Rubber modification of asphalt has a long history.

In the 1950’s Goodyear, Firestone, U.S Rubber among others promoted the use of various rubber modifiers in asphalt.

In the mid 1960’s Charlie McDonald, an engineer with the City of Phoenix, developed a process for blending rubber from waste tires with asphalt.
His formula produced a binder that used about 18-20% tire rubber. Based on positive performance experiences over the ensuing years, ADOT adopted the use of these materials. These products have been used in over 40 states in the US and over 25 countries worldwide.
Rubber Facts

- As concerns with tire waste escalated, various techniques for incorporating emerged.
- Three basic methods for modifying asphalt include:
  - Wet process.
  - Dry process.
  - Terminal blend process.
Asphalt Rubber—Wet Process

- Base asphalt is typically PG 64-16
- Materials are heated up to 425 F with reaction times at a minimum of 45 minutes.
- Rubber swells to increase the compatibility with the asphalt.
- Extender oils are used sometimes.
- After reaction times ends, materials are transferred to spreader unit.
Advantages of Asphalt Rubber Chip Seals

- Higher applications rates with improved long term performance.

§ Typical Application Rates (based on ½ inch cover aggregate):

§ CRS-2P
  0.38 to 0.45 Shot Rate
  0.27 to 0.32 Residual

§ Terminal Blend
  0.38 to 0.45 Shot Rate/ Residual

§ Asphalt Rubber
  0.62 to 0.70 Shot Rate/ Residual
What is Warm Mix?

- WMA technology
  - Foaming process which is water based to promote foaming
  - Chemical modifiers that use chemical modifies or surfactants
  - Additives that use wax based products
Why Use Warm Mix Additives?

- Warm mix allows one to retain the binder viscosity while using lower temperatures.
- Allow us to reduce the spray apply temperature from 385F to 335F.
- Reduces emissions.
- Improves worker safety.
AR Warm Mix Without Emission Controls
Hot Pre-coated Chips
Chip Seal Train
Finished Surface - Coarser Chip
Finished Surface - Finer chip
Los Angeles County-Cape Seal
Pre-condition
Asphalt Rubber Warm Mix
Application of Micro
Finished Surface
Asphalt Rubber Chip Seals

Advantages

- Flexible Treatment
- Provides Impermeable Membrane
- Wards off Reflective Cracking
- High binder application rates
- Cost Effective
Asphalt Rubber Chip Seals using warm mix technology and Micro Surfacing are proven, viable and economic tools for your “Toolbox” for preventative maintenance or asphalt repair.

Systems Can Be Selected To Tackle a Large Array of Conditions.
Benefits of Thin Overlays Using RWHA

- Allows paving in cooler temperatures extending the paving season
- Allows for longer haul distances
- Longer time to roll for improved compaction
- Lowers emissions
- Safer work environment
- Lower energy costs = Cost Savings
  - Mixing 280 – 300 F
  - Compaction 250 – 275 F
## SELECTED AR WITH WARM MIX TECHNOLOGIES CONSTRUCTED IN CALIFORNIA

<table>
<thead>
<tr>
<th>Road Name</th>
<th>Location (PM: n/n)</th>
<th>Date Constructed</th>
<th>Warm Mix Additive</th>
</tr>
</thead>
<tbody>
<tr>
<td>Santa Clara Rte. 152</td>
<td>Santa Clara</td>
<td>March 2006</td>
<td>Sasobit</td>
</tr>
<tr>
<td>Interstate 5</td>
<td>Santa Nella (105.9/106.4)</td>
<td>September 2008</td>
<td>Astec DBG &amp; Evotherm</td>
</tr>
<tr>
<td>Interstate 5</td>
<td>Orland</td>
<td>May 2009</td>
<td>Evotherm</td>
</tr>
<tr>
<td>Interstate 5</td>
<td>Near Firebaugh, Fresno Co. (PM 37.2 to PM 45.0)</td>
<td>September 2010</td>
<td>Astech PER &amp; Engineered Additives WMA</td>
</tr>
<tr>
<td>CA-94</td>
<td>San Diego</td>
<td>June 2009</td>
<td>Advera, EVOtherm, Sasobit</td>
</tr>
<tr>
<td>SH 70</td>
<td>Marysville</td>
<td>July 2009</td>
<td>EVOtherm</td>
</tr>
<tr>
<td>SR-101</td>
<td>Fortuna (54.2/56.3)</td>
<td>September 2009</td>
<td>EVOtherm</td>
</tr>
<tr>
<td>SH 99</td>
<td>Sutter County</td>
<td>November 2009</td>
<td>EVOtherm</td>
</tr>
<tr>
<td>Various</td>
<td>City of Roseville</td>
<td>September - October 2010</td>
<td>Engineered Additives WMA</td>
</tr>
</tbody>
</table>

More than 20 products currently available
Completed RWMA Projects

Manthey Rd.
Stockton, CA

I-5, Near Orland, CA

SR 94, San Diego County, CA
Completed Warm Mix Projects

AR Chip Seal on Shoulder, I-5, Fresno County, CA (2010-2011)

RWMA-G, I-5 Near Dunnigan, CA (2011)
Completed Projects in 2011

- Over 1,000,000 tons
  - D-3
    - I-5- Several projects
    - US-99
    - US-70
    - I-80 at Truckee
  - D-1- numerous projects
Future of Warm Mix Applications

- Use is growing in California and elsewhere
- Applications are good for night work and late season work
Summary: Benefits of Pavement Preservation

- Extended life or serviceability
- Lower life-cycle costs (cost effectiveness)
- Lower user costs
- Improved safety
- Gaining considerable public support
Overall Summary

- What does the future hold?
- Pavement Preservation
  - Preventive
  - Corrective
- Warm mixes
  - Chip seals
  - Hot mixes
Questions

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