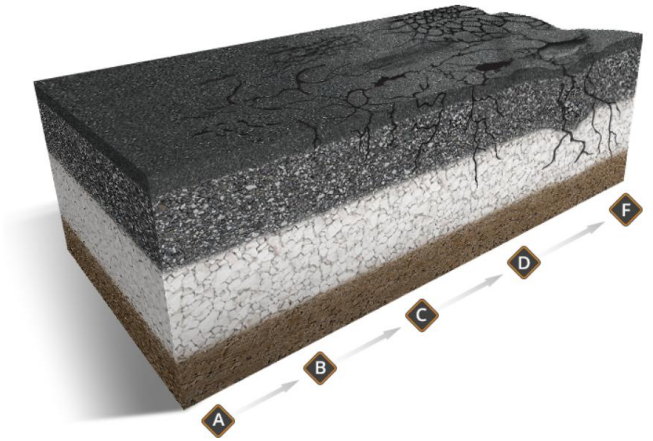
North Dakota DOT
Pavement Preservation Training
Distress Evaluation, Project Selection and Preparation

Rex W. Eberly
National Center Pavement Preservation

MICHIGAN STATE UNIVERSITY

Section 3 – Asphalt Surface Distresses and Project Selection

- Recognize the Difference Between Preservation and Preservation Maintenance.
- Identify Functional Distresses in Asphalt Pavements.
- Understand the Basics of Selecting and Designing Pavement Preservation Projects.



PRESERVATION VS. PRESERVATION MAINTENANCE

- **PRESERVATION**
  - GOAL IS TO PLACE A TREATMENT THAT PRESERVES THE SURFACE AND EXTENDS RSL (REMAINING SERVICE LIFE)
  - TIME BASED
    - EARLY AND OFTEN
  - ADD SERVICE LIFE
  - GENERALLY, LESS EXPENSIVE TREATMENTS

- **PRESERVATION MAINTENANCE**
  - GOAL IS TO REPAIR SURFACE DEFECTS, PRESERVE THE SURFACE AND EXTEND RSL (REMAINING SERVICE LIFE)
  - TIME AND CONDITION BASED
    - PLACED AS EARLY AS POSSIBLE WHEN DEFECTS OCCUR.
  - STOP THE DETERIORATION AND ADD SERVICE LIFE.
  - MORE AGGRESSIVE PRESERVATION TREATMENTS
    - COMBINATION TREATMENTS

PRESERVATION VS. PRESERVATION MAINTENANCE

- **PRESERVATION PROCESSES**
  - FOG SEAL
  - REJUVENATORS
  - CRACK SEAL*
  - CHIP SEAL
  - MICRO SURFACING
- **PRESERVATION MAINTENANCE PROCESSES**
  - CRACK SEAL / CRACK FILL / MASTIC
  - CHIP SEAL
    - SCRUB SEAL
    - FIBER MAT
  - PRESERVATION HMA OVERLAYS
  - MICRO SURFACING
  - CAPE SEALS

When Should We Not Use Thin Surface Treatments? Structural Defects Vs. Functional Distress

- Chip Seal or Micro surfacing should **NOT** be placed on a Pavement with Structural Defects.
- A Structural Defect means either the Pavement or the Base has failed.
  - Pavement Failure
    - Stripping – the asphalt no longer adheres to the rock
    - Potholes – if not repaired
    - Rutting – if continuing to rut
    - Longitudinal and Transverse Cracking – Heavy
  - Base Failure
    - Alligator Cracking – the base or sub-base has failed and no longer supports traffic loading.
    - Water and / or fines pumping – the base is failing, and Alligator Cracks will soon appear

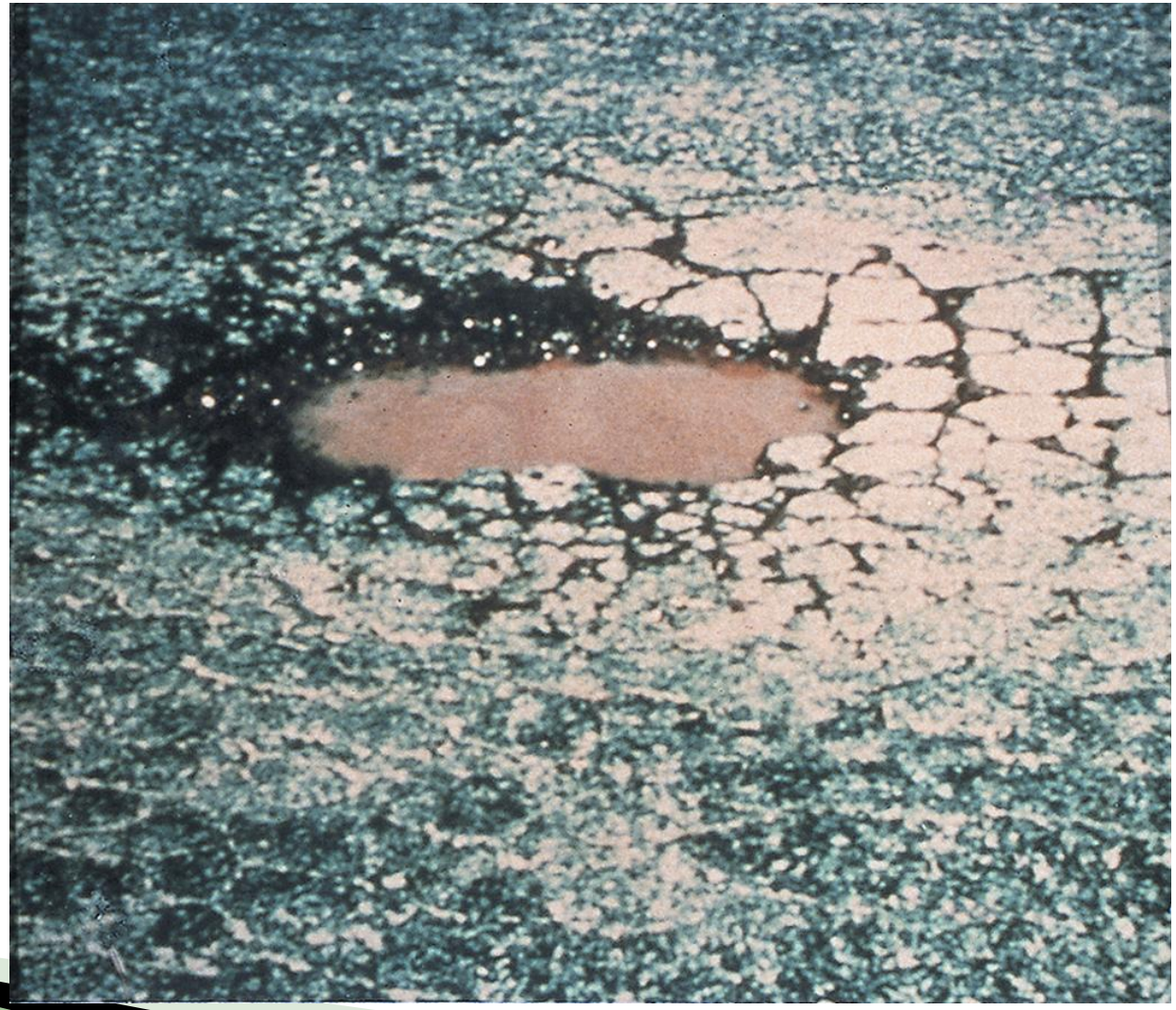
- Chip Seal or Micro surfacing can be used to treat **moderate** Functional Distresses.
- A Functional Defect, if not treated may become a Structural Defect.
- A Functional Defect is often caused by environmental or traffic conditions.
  - Rutting – if rutting has stopped
  - Bleeding
  - Longitudinal and Transverse Cracks – Light to Moderate
  - Polishing
  - Raveling

Structural

Functional (Surface)

Pavement Structural Distress – Stripping

Pavement Structural Distress – Potholes (Unrepaired or Inadequately Repaired)



Pavement Structural Distress – Rutting (Continuing to Rut)

Pavement Structural Distress – Cracking High Severity

Pavement Structural Distress – Cracking High Severity

Base Structural Distress – Fatigue Cracking – High (Alligator Cracking)

Base Structural Distress – Water or Fines Pumping

Functional Distress – Bleeding

Functional Distress – Rutting (Compaction)

Functional Distress – Cracking Light

Functional Distress – Cracking Moderate

Functional Distress – Polishing Light

Functional Distress – Raveling Light

Functional Distress – Cracking Light

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RoadResource.org

A COMPREHENSIVE RESOURCE FOR OPTIMIZING NETWORK MANAGEMENT

Rex W. Eberly – National Center for Pavement Preservation

AGENDA

1 | Background

2 | Website Features

Treatment Toolbox | User Profile | Network Optimization

RoadResource.org

Three Associations Join Together to Support the Industry at Large

AEMA™
ASPHALT EMULSION MANUFACTURERS ASSOCIATION

ISSA®
PRESERVING PAVEMENT

ARRA™
Asphalt Recycling & Reclaiming Association

FORMING THE PAVEMENT PRESERVATION & RECYCLING ALLIANCE

PPRA™
Better roads today. Stronger networks tomorrow.

Two Guiding Questions

How do we equip road owners & end users with **tools to increase the successful use** of pavement preservation and recycling?

1

How do we better disseminate research, success stories, and learning across all agencies, **making information more accessible**?

2

RoadResource.org

Which treatment is best for my road?

Input pavement criteria or select photos for treatment options

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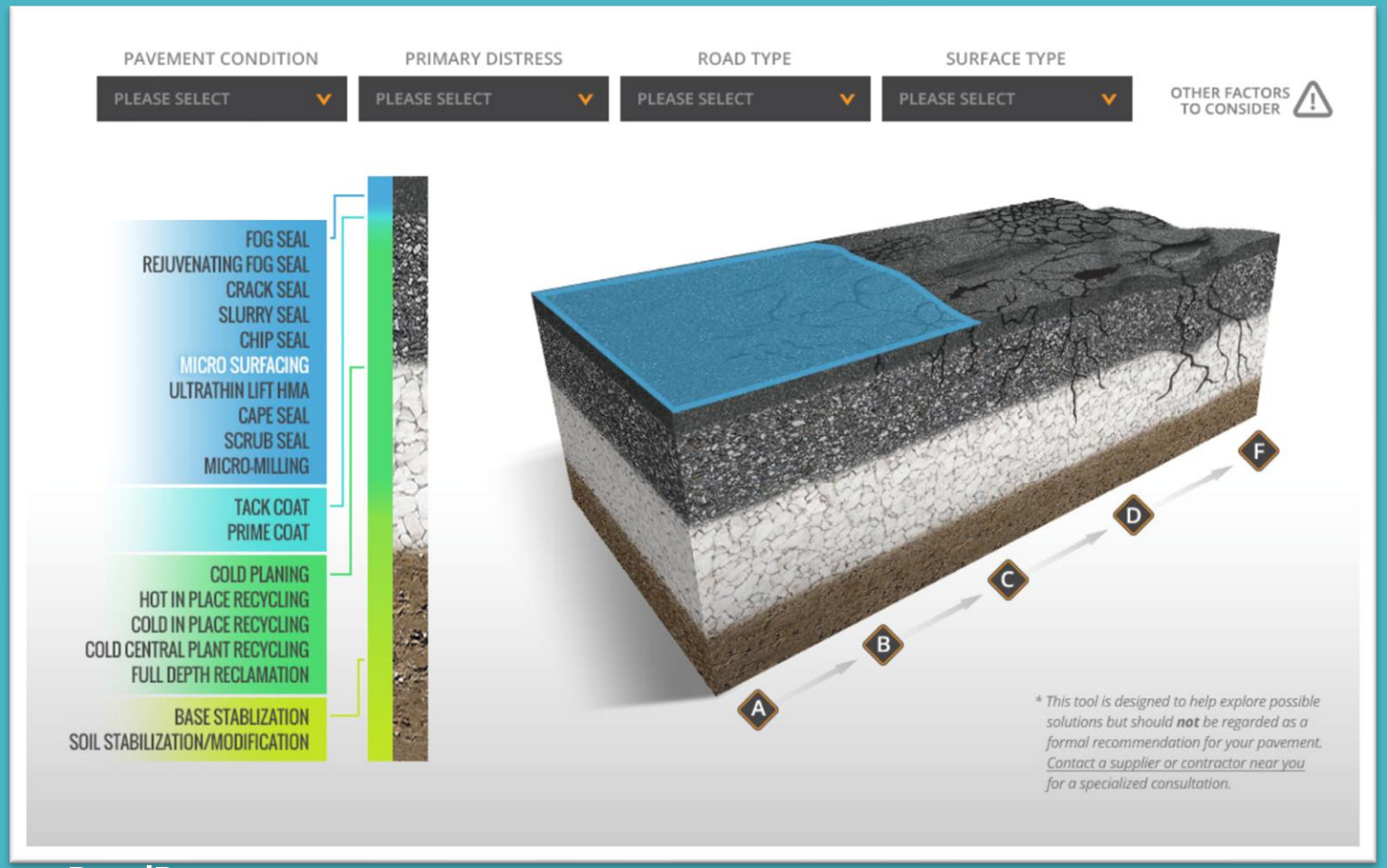

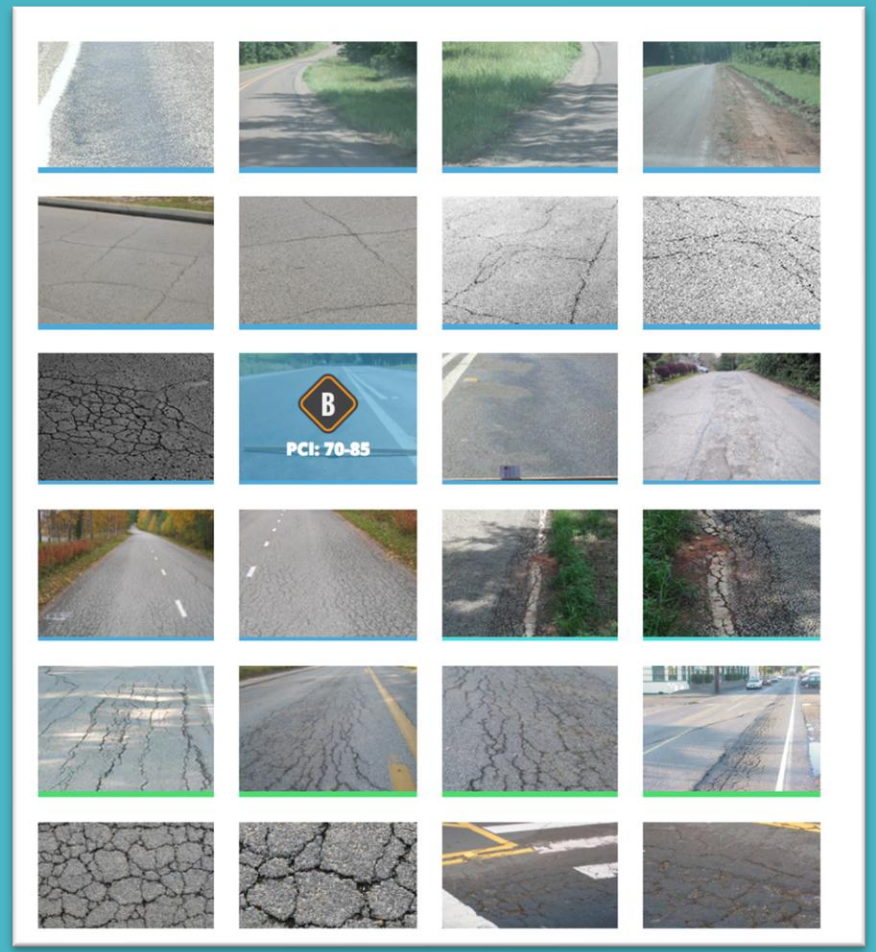

Treatment Resource Center

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Ensure treatment success with comprehensive information on 18 treatments

FOR PAVEMENT CONDITIONS C-D-F (PCI of less than 70)

A cost-effective, long-lasting, greener alternative to conventional maintenance and rehabilitation techniques. Cold In-place recycling (CIR) is a process that cold mills and recycles the top 2-5 inches of asphalt using a continuous train operation. Through the complete reuse of existing material, CIR greatly reduces trucking, time and natural resources to significantly lower project costs. Generally, any road that is a candidate for mill & fill is a candidate for CIR.

- 20%–50% less expensive than conventional maintenance and reconstruction methods
- Reduce Greenhouse emissions by Up to 90%
- Reuses 100% of existing materials
- 20%–40% faster construction times
- Adds 15–20 years (combined with appropriate wearing course)
- Most agencies use SLCs between 0.30–0.38 (Recent research indicates values from 0.36–0.44 may be more appropriate)

ISSUES ADDRESSED

- Frequent, severe, non-load distresses in top lift of hot mix
- All distresses within the recycling depth (2-5 inches)
- Reflective cracking from below CIR layer
- See all

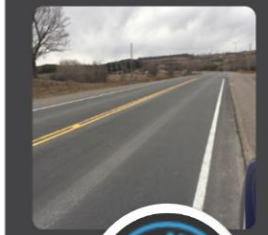
ATTRIBUTES

- Eliminates defects within the recycling depth
- Blocks or slows reflective cracking
- Reuses existing material in place
- Replaces 1 or 2 lifts of hot mix
- Allows for road widening where desired

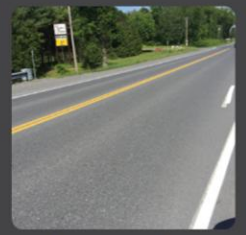
COMMON COMBINATIONS

CIR	Optimum Performance	Average Performance	Stop-Gap Performance
Types of Distress	• Transverse, longitudinal, multiple cracking • Ravelling • Oxidation	• Wheelpath cracking • Rutting (asphalt or subgrade)	• Alligator cracking from base failure • Distortion
Depth of Distress	Within treatment depth (2"–5")	1"–3" below treatment depth	More than 4"–6" below treatment depth
Life Extension	20–25 years	10–20 years	5–10 years

EXAMPLES OF ROADS THAT HAVE BEEN TREATED WITH COLD IN-PLACE RECYCLING OVER VARIOUS STAGES IN SERVICE LIFE:

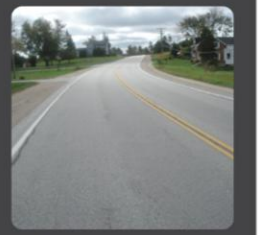


CIR 1 Y… B…



CIR 3 years later: Prescott-Russel County Road, Ontario

CIR 5 years later: Bloomington Road, Ontario



CIR 7 years later: Hwy 6, Ontario

If a CIR mix ravels excessively due to rain, the mat can be re-processed with or without adding cement to facilitate drying

Success Stories & Research

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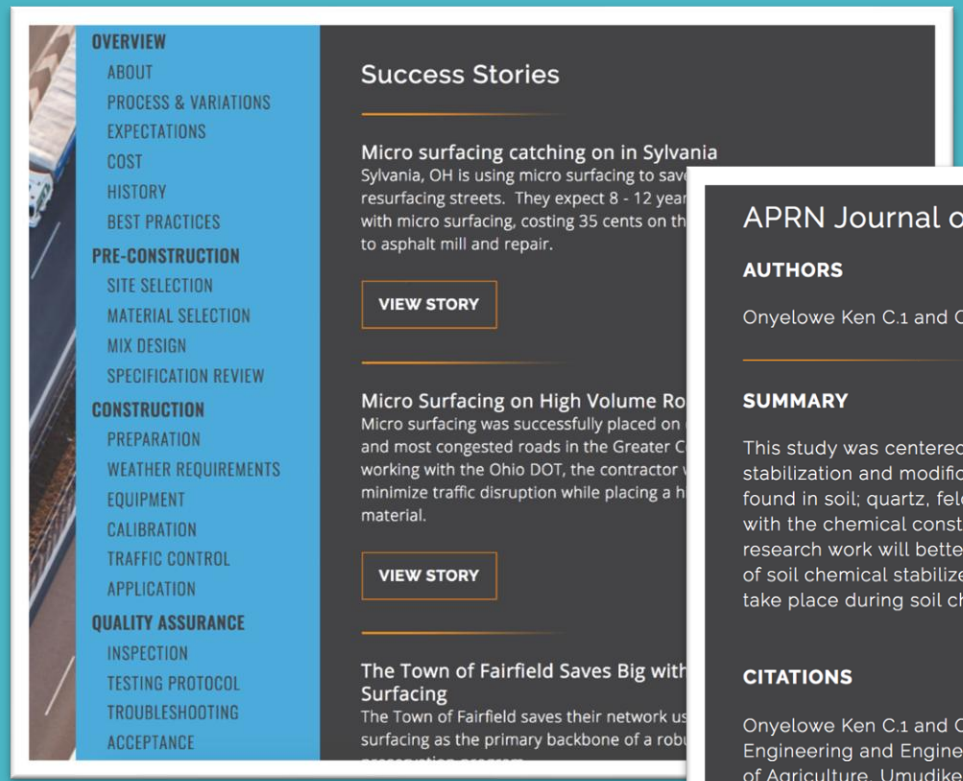
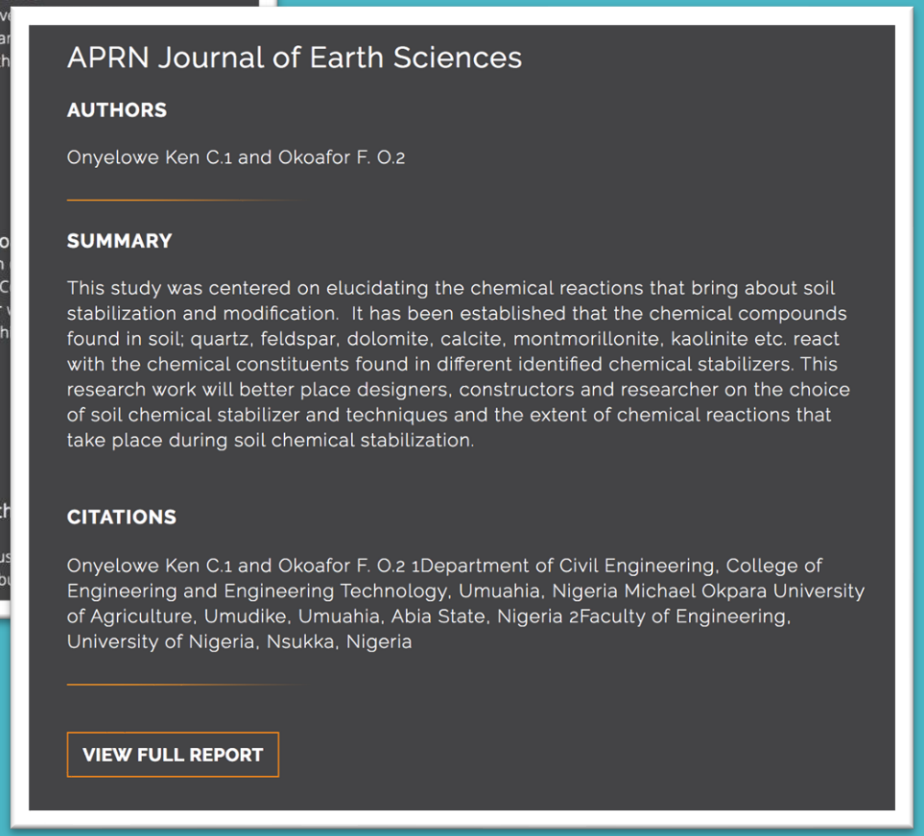
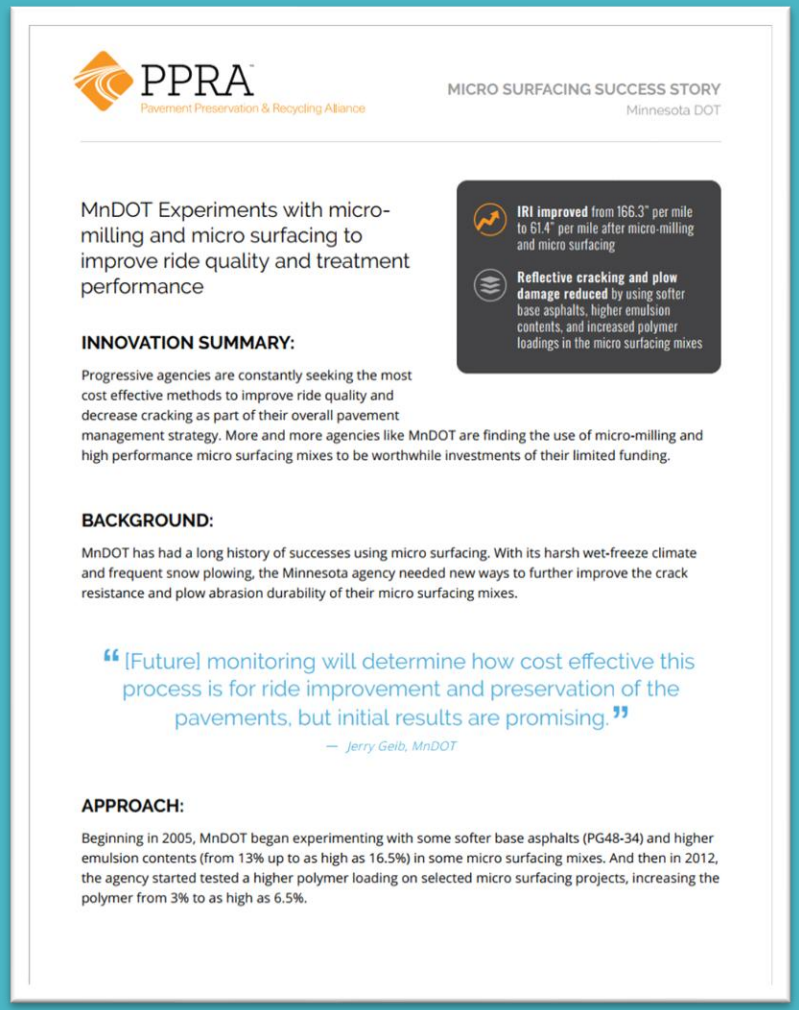
Use, performance & best practices in your region

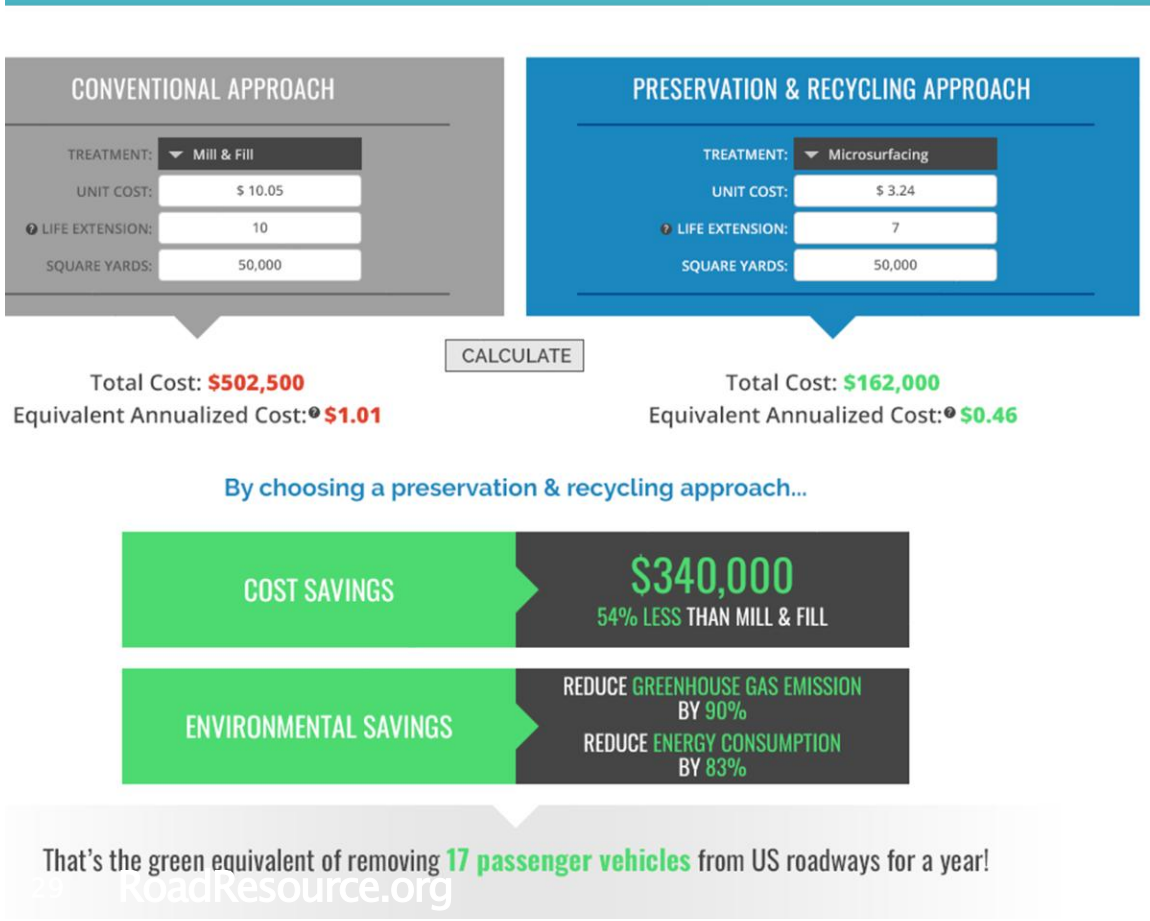






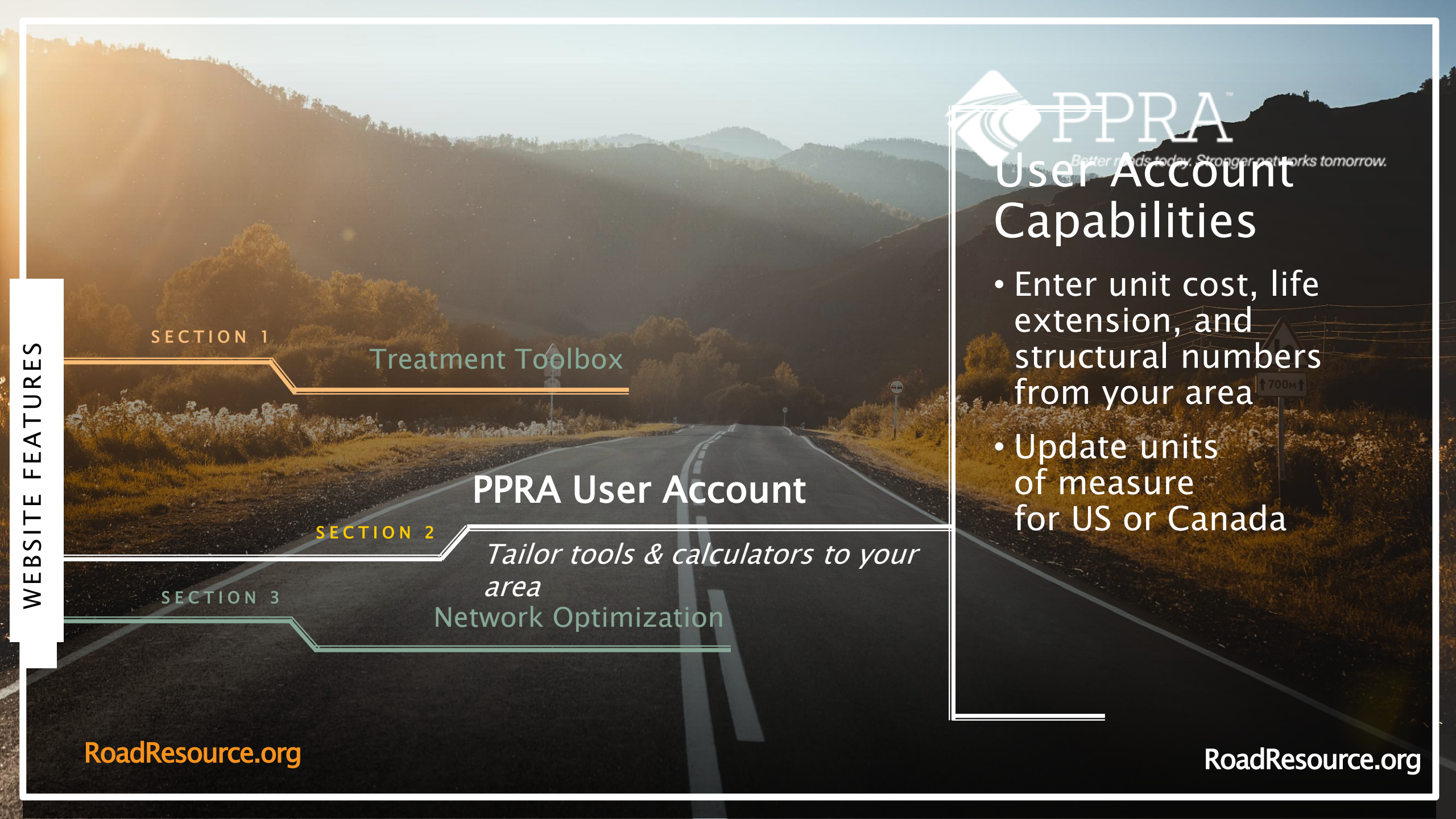
Compare Treatments

Project Cost & Environmental Benefits



NOTE ON COST:

Every calculator gives users the ability to use average life extension numbers and cost data from an internationally aggregated cost survey (US & CA) **or input their own costs and life extension relevant to their region.**


WEBSITE FEATURES
SECTION 1
Treatment Toolbox
PPRA User Account
SECTION 2
Tailor tools & calculators to your area
SECTION 3
Network Optimization
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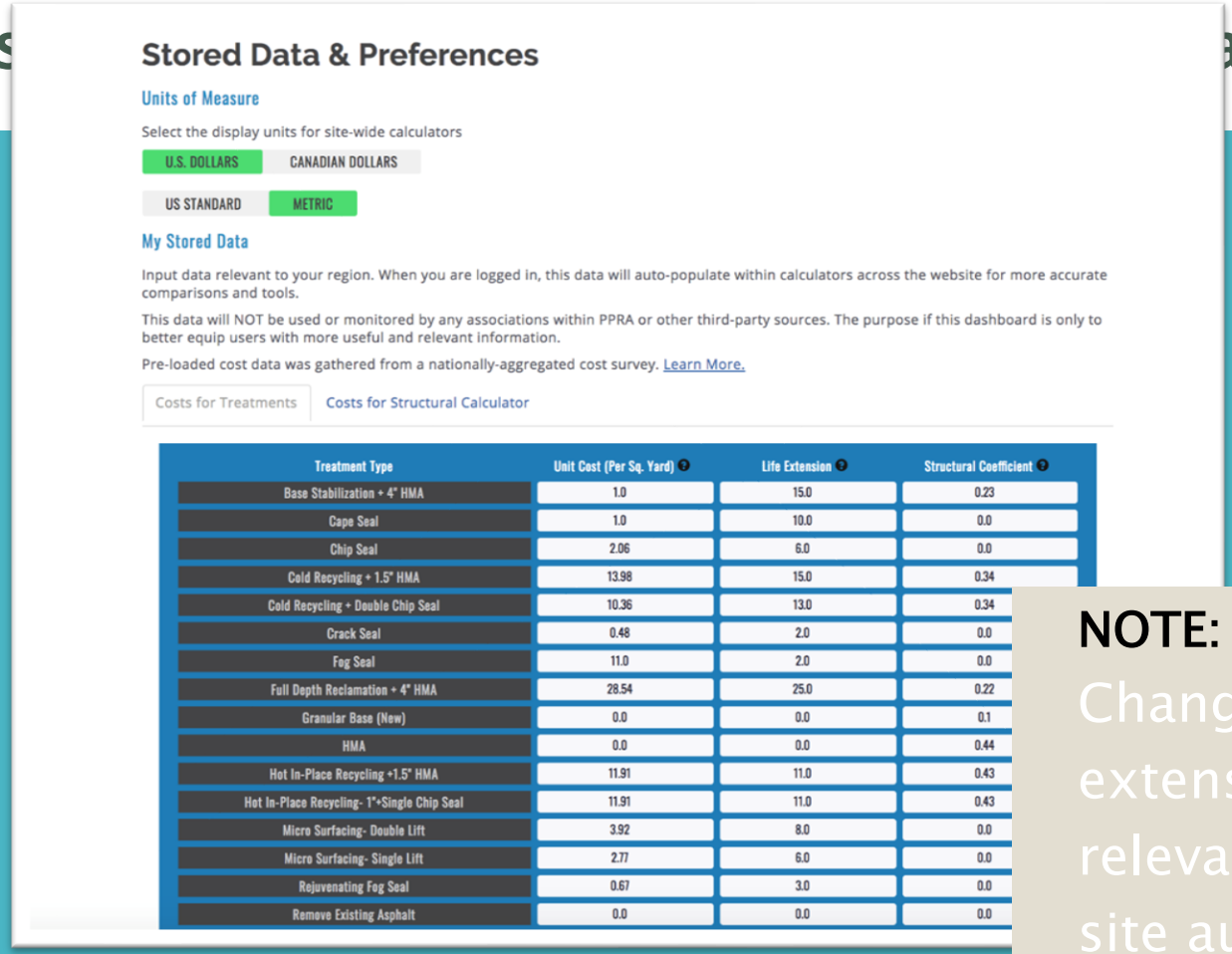
User Account Capabilities
• Enter unit cost, life extension, and structural numbers from your area
• Update units of measure for US or Canada
RoadResource.org

My PPRA Account

Input cos ake the most of the site & tools



Stored Data & Preferences

Units of Measure

Select the display units for site-wide calculators

U.S. DOLLARS | CANADIAN DOLLARS

US STANDARD | METRIC

My Stored Data

Input data relevant to your region. When you are logged in, this data will auto-populate within calculators across the website for more accurate comparisons and tools.

This data will NOT be used or monitored by any associations within PPRA or other third-party sources. The purpose if this dashboard is only to better equip users with more useful and relevant information.

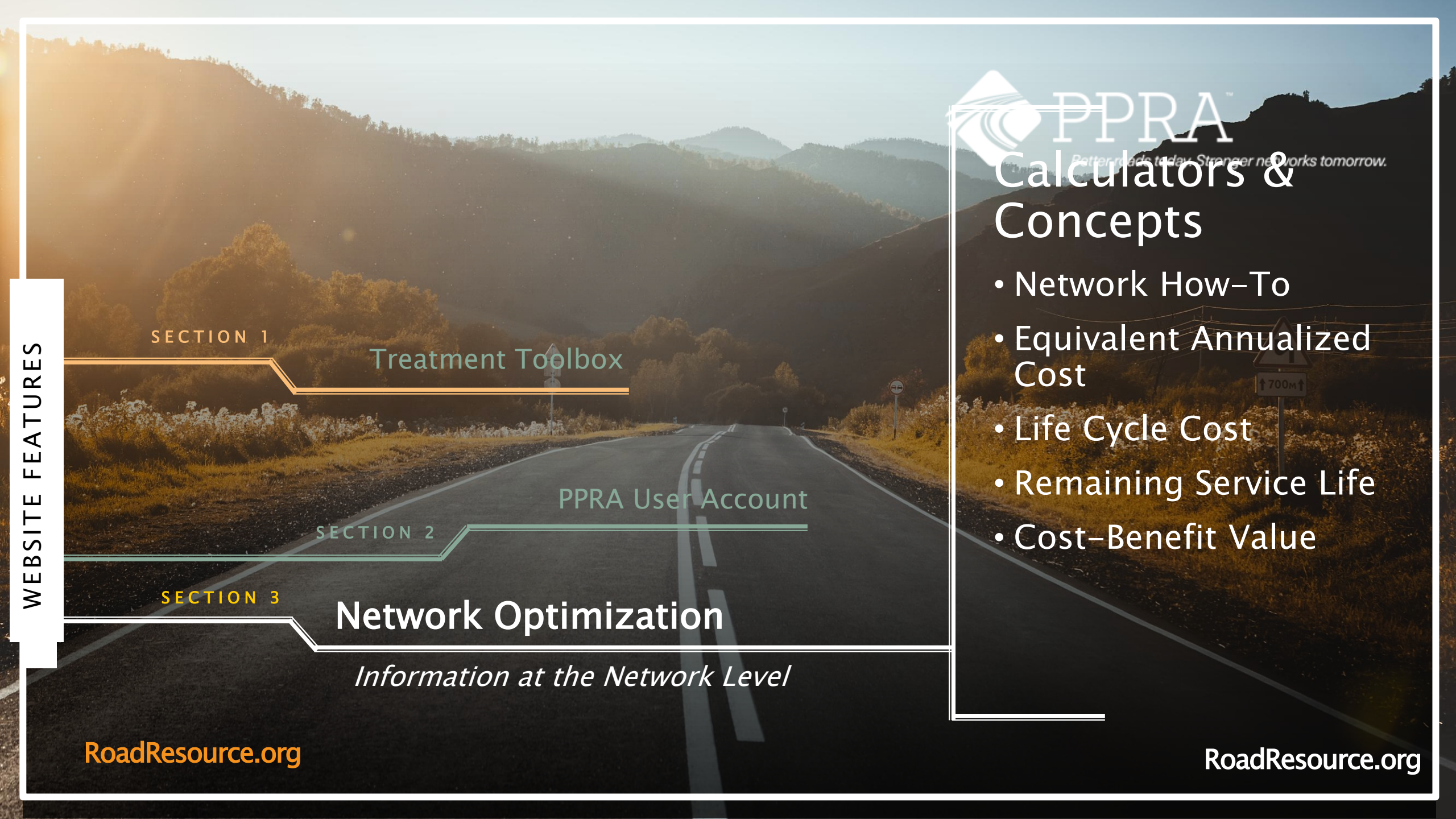
Pre-loaded cost data was gathered from a nationally-aggregated cost survey. Learn More.

Costs for Treatments | Costs for Structural Calculator

Treatment Type	Unit Cost (Per Sq. Yard)	Life Extension	Structural Coefficient
Base Stabilization + 4" HMA	1.0	15.0	0.23
Cape Seal	1.0	10.0	0.0
Chip Seal	2.06	6.0	0.0
Cold Recycling + 1.5" HMA	13.98	15.0	0.34
Cold Recycling + Double Chip Seal	10.36	13.0	0.34
Crack Seal	0.48	2.0	0.0
Fog Seal	11.0	2.0	0.0
Full Depth Reclamation + 4" HMA	28.54	25.0	0.22
Granular Base (New)	0.0	0.0	0.1
HMA	0.0	0.0	0.44
Hot In-Place Recycling +1.5" HMA	11.91	11.0	0.43
Hot In-Place Recycling- 1"+Single Chip Seal	11.91	11.0	0.43
Micro Surfacing- Double Lift	3.92	8.0	0.0
Micro Surfacing- Single Lift	2.77	6.0	0.0
Rejuvenating Fog Seal	0.67	3.0	0.0
Remove Existing Asphalt	0.0	0.0	0.0

NOTE:

Change aggregate data into costs, life extension, and structural numbers relevant to you. Tools throughout the site automatically re-populate with your data every time you log in.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SECTION 3
Network Optimization
Information at the Network Level
Calculators & Concepts
• Network How-To
• Equivalent Annualized Cost
• Life Cycle Cost
• Remaining Service Life
• Cost-Benefit Value
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Equivalent Annualized Cost

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Compare treatment cost based on Life Extension

Use our nationally aggregated data or enter your own data

Treatment Type	Cost Per Sq Yard	Life Extension	EAC $ SY/YEAR
Crack Seal	$0.50	2	$0.25
Fog Seal	$1.00	3	$0.33
Single Surface Tr,	$2.00	5	$0.40
Double Surface Tr.	$4.25	8	$0.53
Thin Overlays	$7.00	10	$0.70
Mill-and-Fill	$12.00	12	$1.00
Cold In Place	$17.00	15	$1.13
Reconstruction	$25.00	20	$1.25
-	-	-	-

Clear Data / Chart Your Own

CHART IT

Life Cycle Cost Calculator

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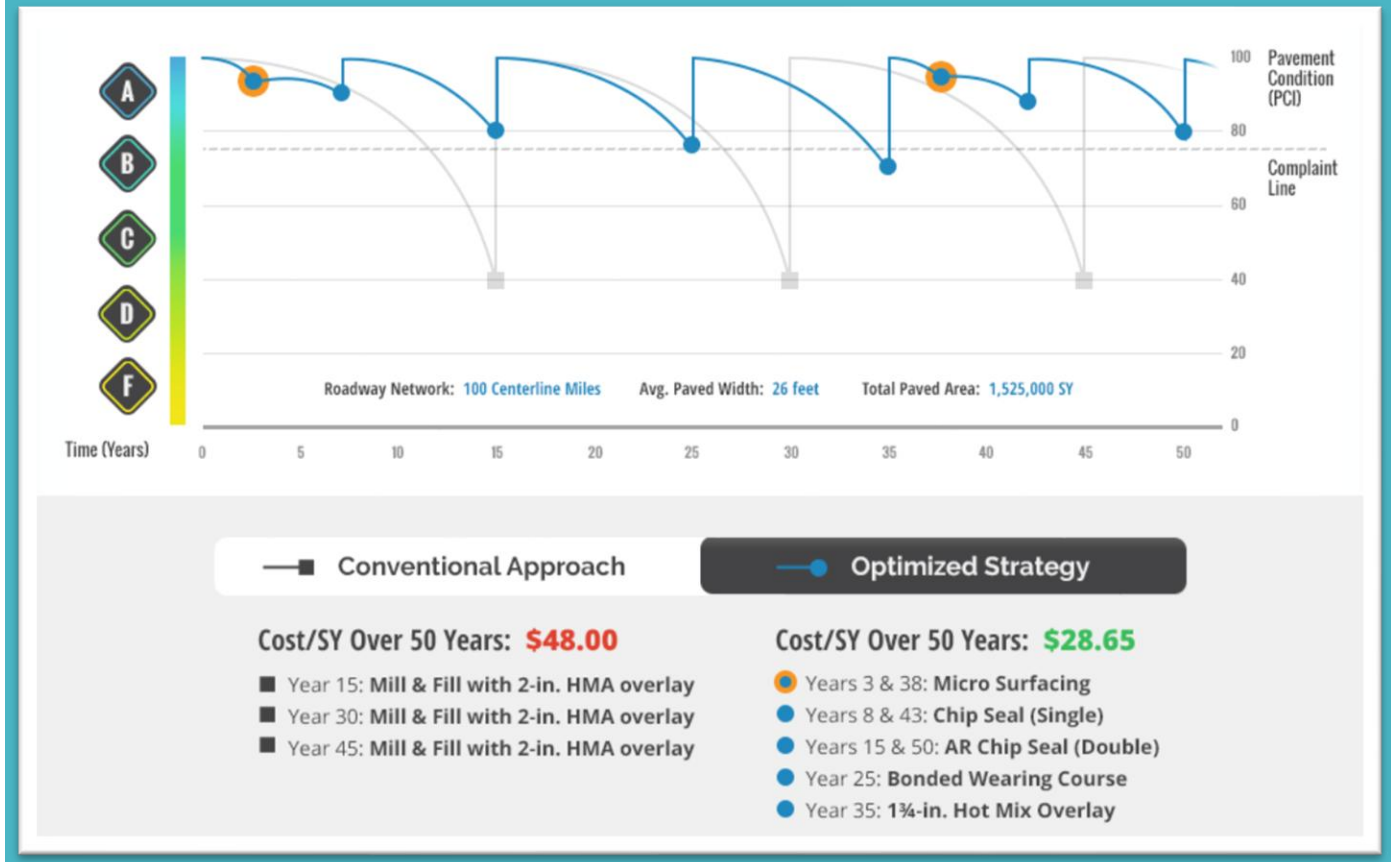
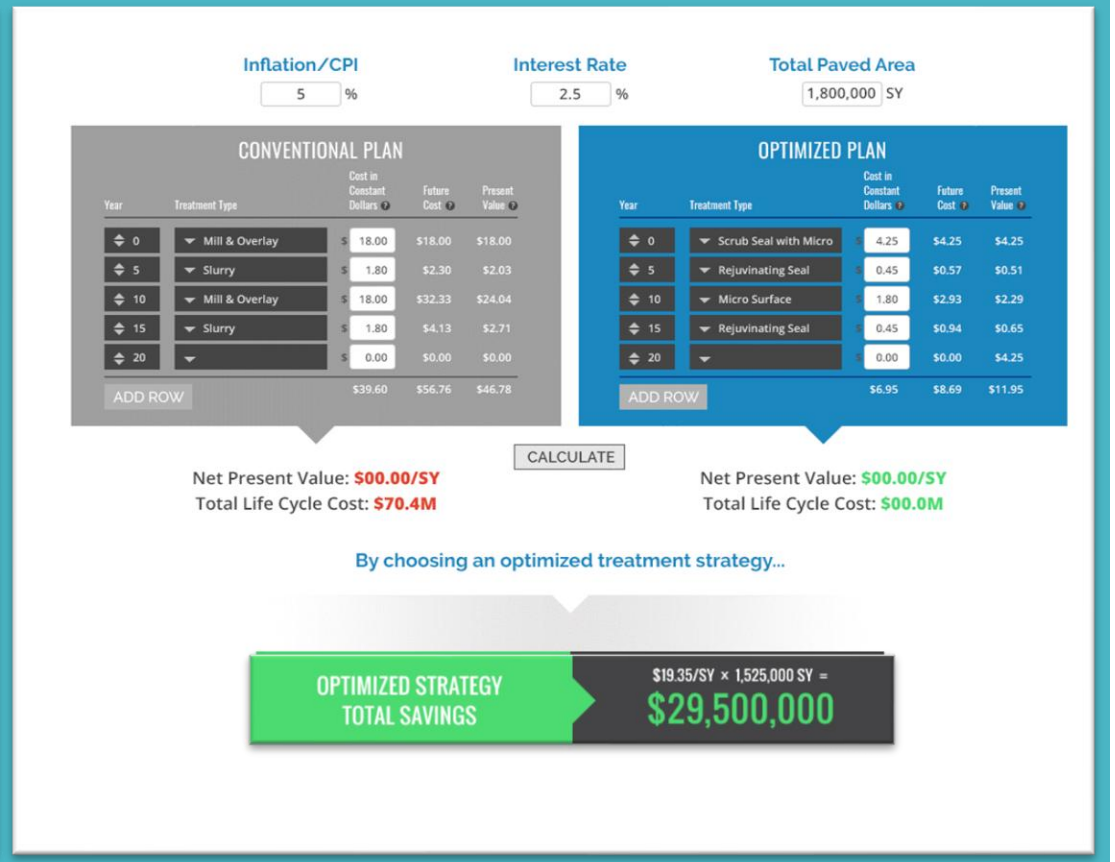
Save big over the life of your pavement with progressive maintenance





Remaining Service Life

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How much life is your network gaining or losing each year?

ABOUT | CALCULATOR

Remaining Service Life

Is your network gaining or losing life each year?

Understanding Remaining Service Life (RSL) is critical to designing a treatment plan that stretches your budget further and reverses the trend of a deteriorating network.

Download the FHWA RSL pub IF-07-006

CRITICAL CONCEPT

A 500-mile network loses 500 mile-years of life annually.

Every year, every mile of your network loses 1 mile-year of life. To avoid losing ground, the roadway owner must design a treatment plan that adds 500 mile-years of life or more!

See how this agency reallocated funds to inject more life into their network, using the same budget

RSL Calculator

How to use this Tool

Use the calculator below to explore how different treatment combinations can be varied to inject maximum life into your network and use your resources more wisely. See examples and learn more about remaining service life here.

Total Network Lane-Miles	Average Lane Width (ft)	Total Budget	Remaining Budget
1000	15	$ 5000000	$2,920

yd

Treatment Type	Category	Life Extension	Lane-Miles* Treated	Lane-Mile-Years	Unit Cost	Total Cost
Rejuvenating Fog Seal	Preservation	3.0	25	75	0.67	$147,400
Micro Surfacing- Double Lift	Preservation	8.0	34	272	3.92	$1,172,864
Chip Seal	Preservation	6.0	40	240	2.06	$725,120
Cape Seal	Preservation	10.0	24	240	5.20	$1,098,240
Minor Mill & Fill	Rehabilitation	11.0	2	22	9.80	$172,480
Cold Recycling + 1.5" HMA	Rehabilitation	15.0	4	60	13.98	$492,096
Full Depth Reclamation + 4" HMA	Reconstruction	25	2	50	28.54	$502,304
Full Depth Remove & Replace	Reconstruction	25.0	2	50	39.01	$686,576

ADD ROW

YOU ADDED 1,009 LANE-MILE-YEARS OF LIFE

9 LANE-MILE-YEAR NET GAIN

13% OF ROADS ADDRESSED

Cost–Benefit Value

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Which projects will give the “biggest bang for the buck?”

Cost-Benefit Value

With limited funding, how do I prioritize my projects?

CBV offers roadway managers a way to prioritize projects while accounting for the variables relevant to you and the realities of traffic, cost and life extension.

$$CBV = \frac{(\text{Traffic} / \text{Constraint Factor}) \times (\text{Life Extension})}{(\text{Unit Cost}) \times (\text{PCI})}$$

Two road comparison: Which road should I treat first?

ROAD 1	**Worst First** Reconstruction	AADT: 5000 PCI: 30	$\frac{(5000\ \text{AADT} / 7\ \text{CF}) \times (25\ \text{YEARS})}{(\$39\ \text{PER SY} \times 30\ \text{PCI})}$	= 15 CBV
ROAD 2	**Pavement Preservation** Chip Seal	AADT: 5000 PCI: 75	$\frac{(5000\ \text{AADT} / 7\ \text{CF}) \times (6\ \text{YEARS})}{(\$2\ \text{PER SY} \times 75\ \text{PCI})}$	= 29 CBV

CRITICAL CONCEPT

For Equal Traffic, Preservation Has A Higher Benefit.

Total Network Lane-Miles: 500

AADT Constraint: 7

Total Budget: $ 2500000

yd

Road Name	Segment From / To	PCI	AADT	Length (ft)	Width (ft)	Treatment	Life Extension	Unit Cost	Segment Cost	Cumulative Cost	CBV
Midway road	Oakland to Folsom	86	8500	26400	15	Rejuvenating Fog Sea	3.0	0.67	$29,480	$29,480	63.22
Thom Ave.	Oak to Rowland	84	5500	105600	15	Crack Seal	2.0	0.48	$84,480	$113,960	38.97
Beach Street	Baxter to Clayton	64	7500	36850	15	Cape Seal	10.0	5.20	$319,367	$433,327	32.19
Adams Street	First to 17th	72	6500	47520	15	Micro Surfacing- Dou	8.0	3.92	$310,464	$743,791	26.32
Williams Ave.	Clayton to Market	68	3500	42680	15	Chip Seal	6.0	2.06	$146,535	$890,325	21.42
Arthur Ave.	Condor to Southwi	43	7000	32650	15	Full Depth Reclamati	25.0	28.54	$1,553,052	$2,443,377	20.37
Canal Street	Cherry to Park	62	3000	7920	15	Minor Mill & Fill	11.0	9.80	$129,360	$2,572,737	7.76
South Road	Redding to Shenar	47	1500	16500	15	Full Depth Remove &	25.0	39.01	$1,072,775	$3,645,512	2.92
						Select...			$0	$3,645,512	0.00

Budget Line

ADD ROW

Project Selection and Preparation for Pavement Preservation

Questions to Guide Project Selection

- Is the intent Preservation or Preservation Maintenance?
- Do I have any untreated light to moderate cracking?
- Do I have isolated base repairs?
- Is a Chip Seal feasible for this location?
  - Traffic, Night Work, High Speed, Political
- If Preservation Maintenance:
  - What are the Primary and Secondary Distresses?
  - How Quickly is the Deterioration Happening?
  - Is the Pavement Dry and Oxidized or Flushed and Slick?
  - Is there Light (< 1/2”) or Moderate (>1/2”) Rutting?

Preparation for Preservation Projects

- Early Stage-
  - Crack Treatments
  - Structural Leveling
  - Full Depth Repairs
  - Tree Trimming
  - Herbicide Treatment
  - Edge Milling
  - Micro Milling

- Final Stage
  - Surface Cleaning
  - Structure and Casting Protection
  - Pavement Marking Removal
    - Thermoplastic and Buttons
    - Paint is not generally removed unless it is very thick.
    - Pre-Tacking prior to Chip Seal.
  - Gutter Protection
  - Railroad Crossing Protection

Crack Treatments

- Crack Treatments Should Always Precede a Surface Treatment
- All Crack Treatments Should be Completed At Least 30-Days Prior to Surface Treatment.
- Overband Thickness Should be Less Than 1/8”
- Mastic Applications Should be Flush or Slightly Below the Surface.

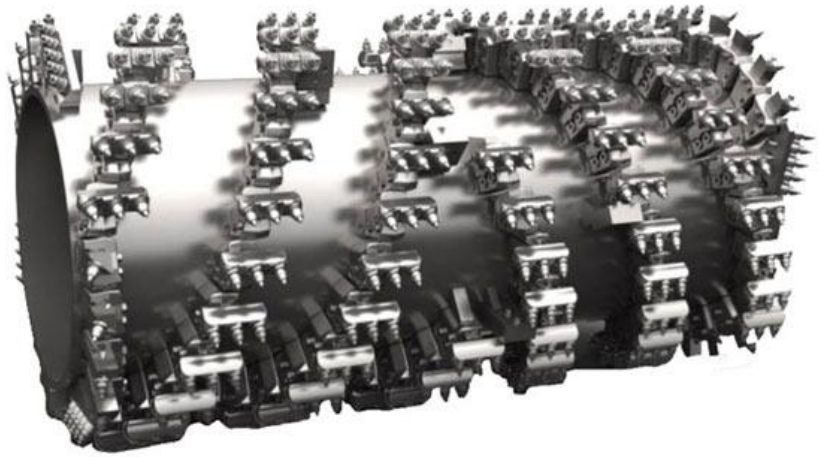
Leveling and Full Depth Repairs

- Surface Repairs Should Be Completed at Least 30-Days Prior to Surface Treatment.
  - Cold Mix Patches Should be Given Additional Cure Time
- Patches Should Be Left Flush or Slightly Below the Surface.
- Ride Quality of Leveling and Patches Must Equal the Desired Ride Quality of the Finished Pavement.

Important Note: Chip Seal and Micro surfacing May Level Slight Depressions in the Pavement. A Bump Will Always Be a Bump!

Edge Milling / Micro Profile Milling

- Severe Edge Drop Offs on Curb and Gutter Sections should be Edge Milled before Preservation Treatments.
- Rough, Flushed or Highly Oxidized Surfaces Can be Profile Milled with a Micro Milling Head.



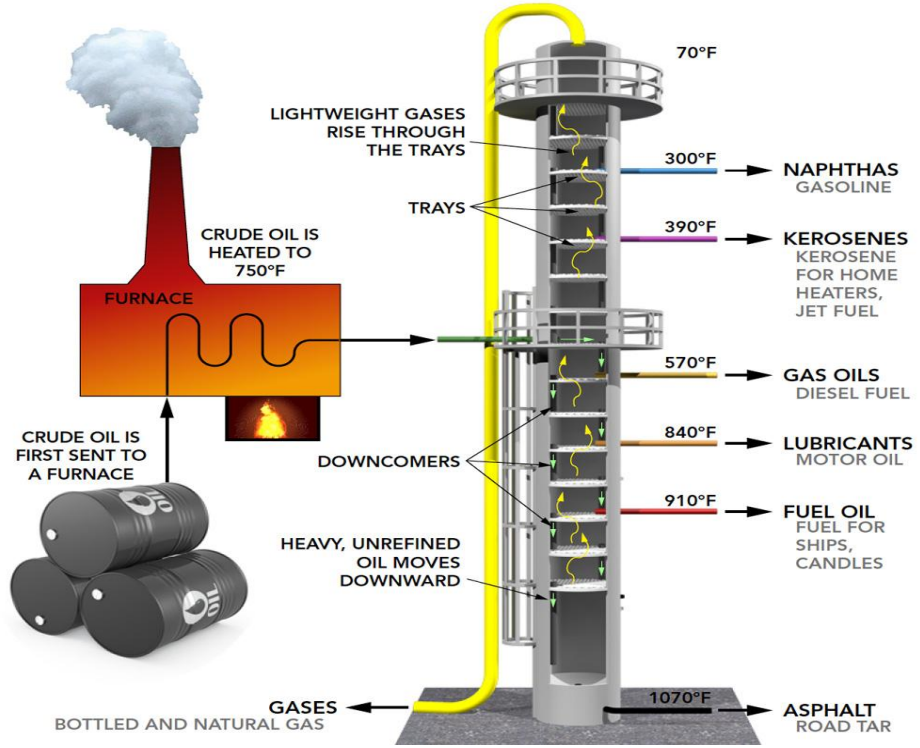
Micro Milled Surface *Fine Milled Surface*

Keystone Mfg.

Emulsion 101

Why Emulsify Asphalt?

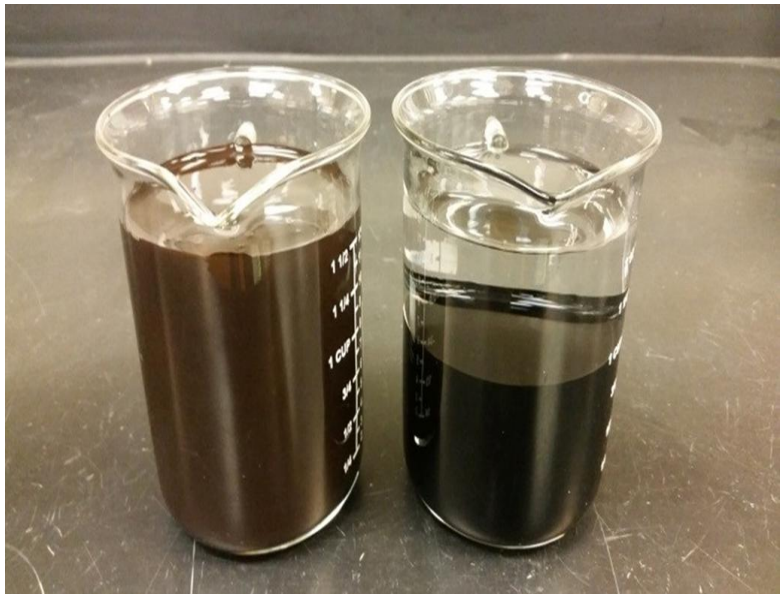
- Asphalt Cement can occur naturally or is refined from crude oil.



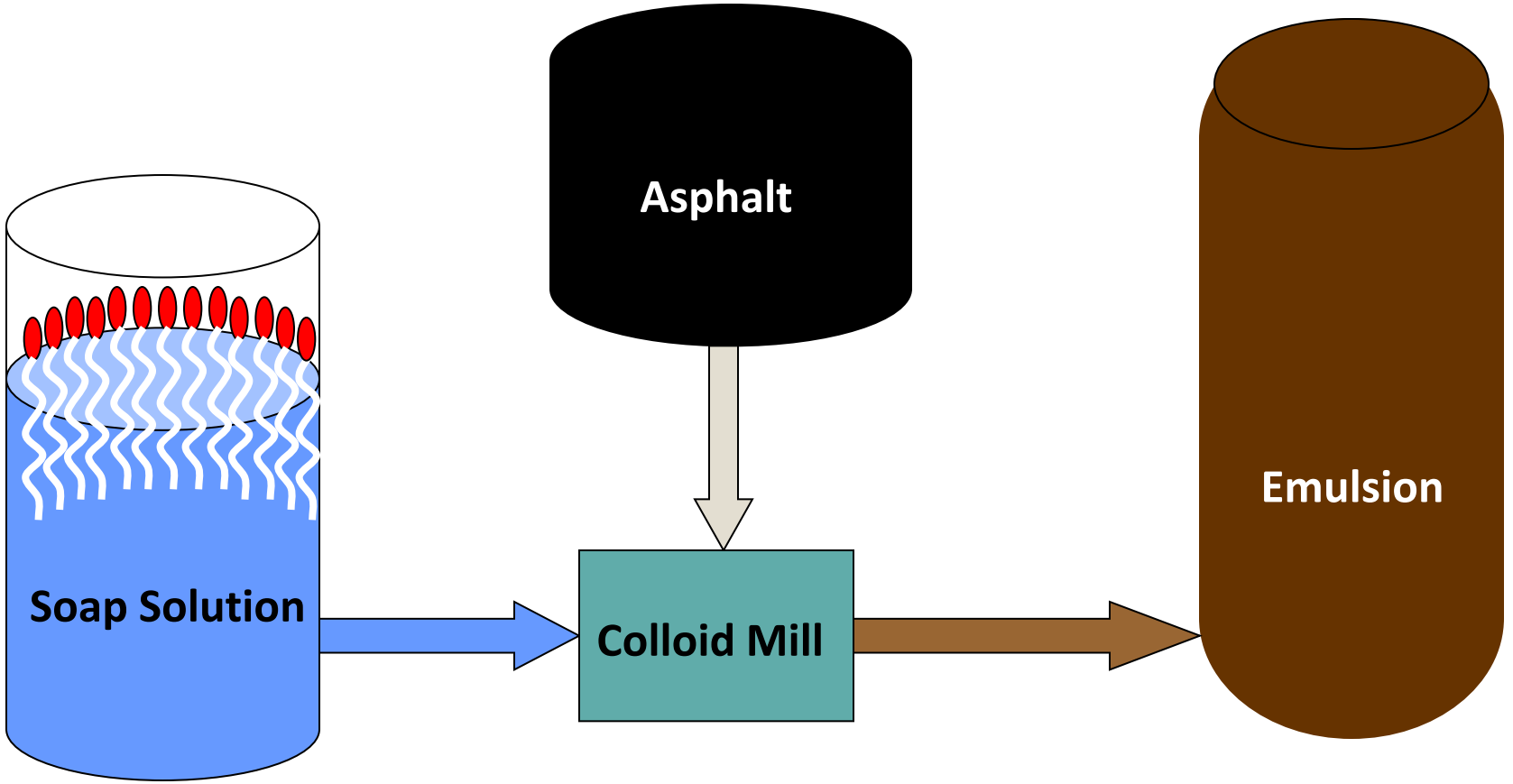
What is an Emulsion?

An emulsion is a homogeneous mixture of two immiscible liquids.

- Immiscible liquids:
  - Liquids that normally don't mix
    - Oil (or, in this case, asphalt) and water
- Homogeneous:
  - The mixture is the same throughout
  - No layering



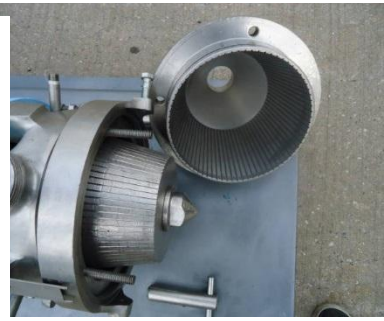
Batch process diagram

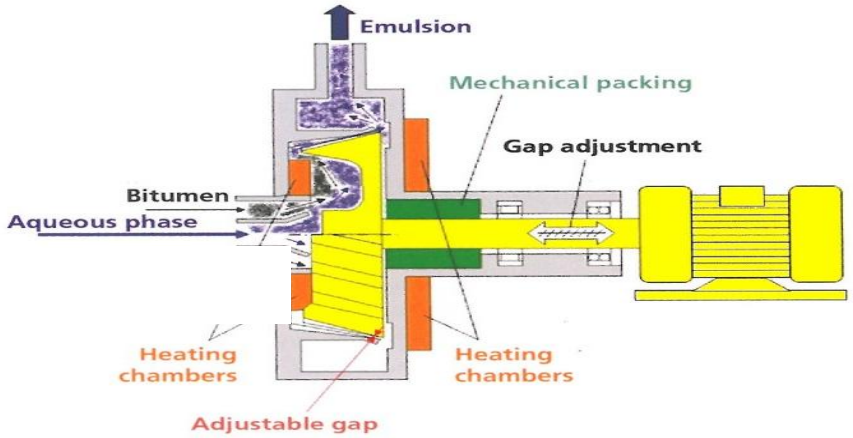


--Debbie Deep, Ingevity, ISSA presentation

Equipment needed

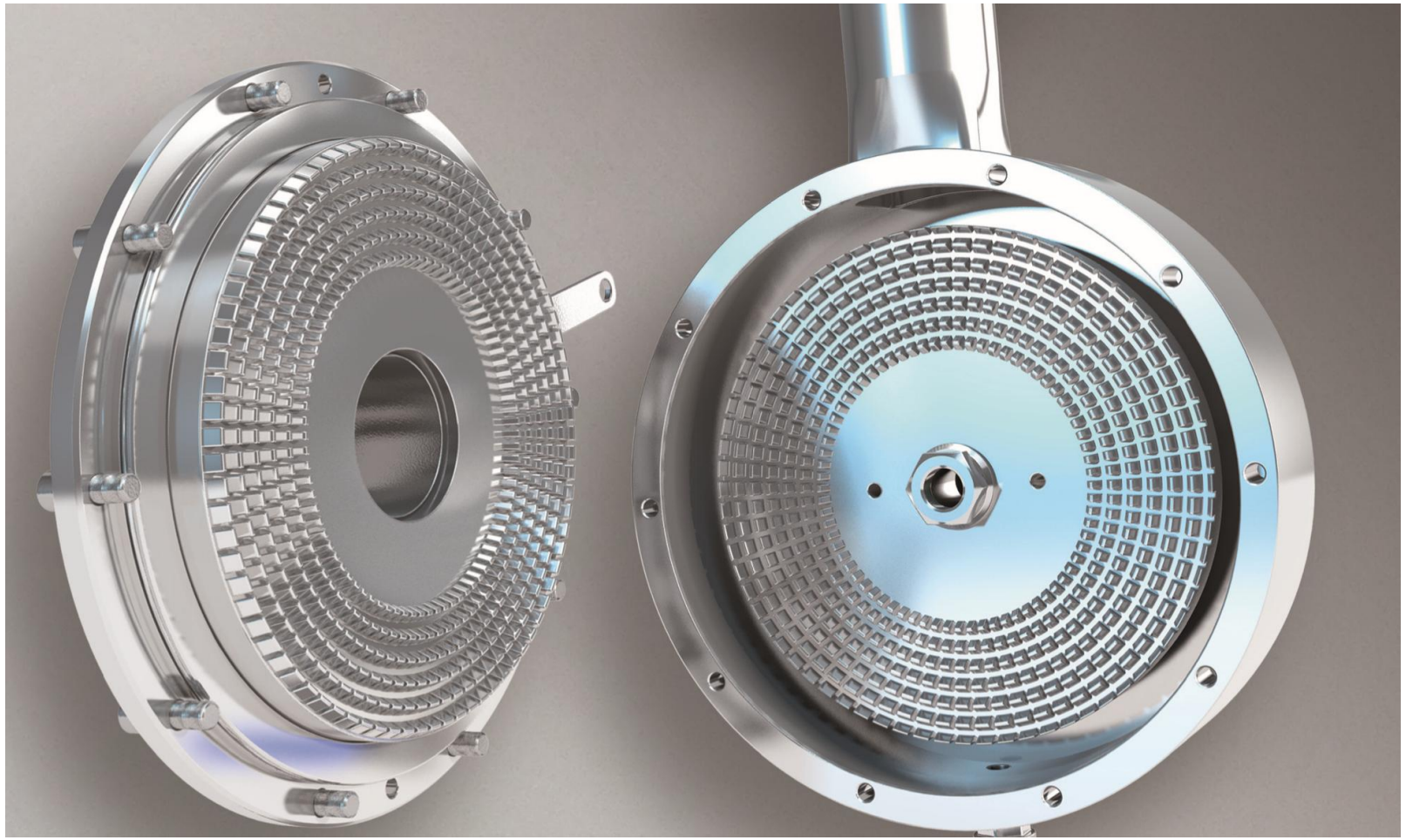
- Colloid Mill and motor
  - Motor is the source of the energy
  - Rotor-Stator translate that energy into the
  - Different geometries with different motors
  - Not all colloid mills are the same





Bitumen Emulsions, SFERB

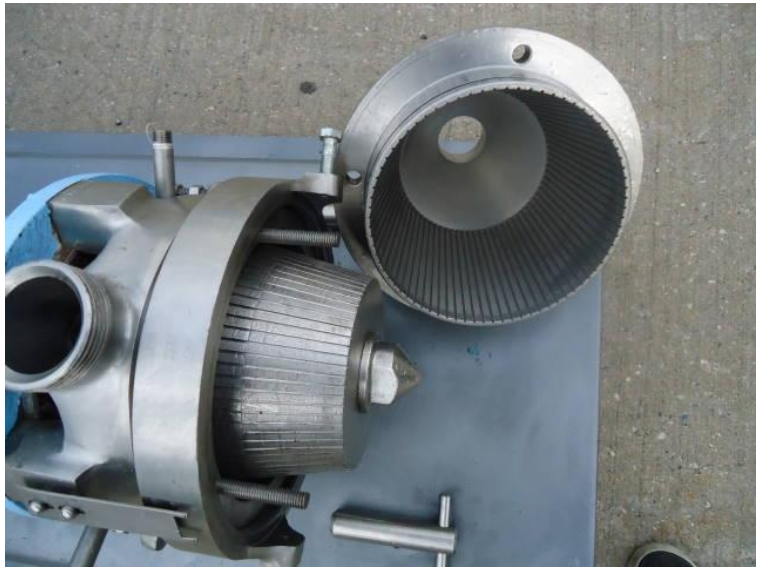
Mill Rotor/Stator



Stator

Rotor

Stator

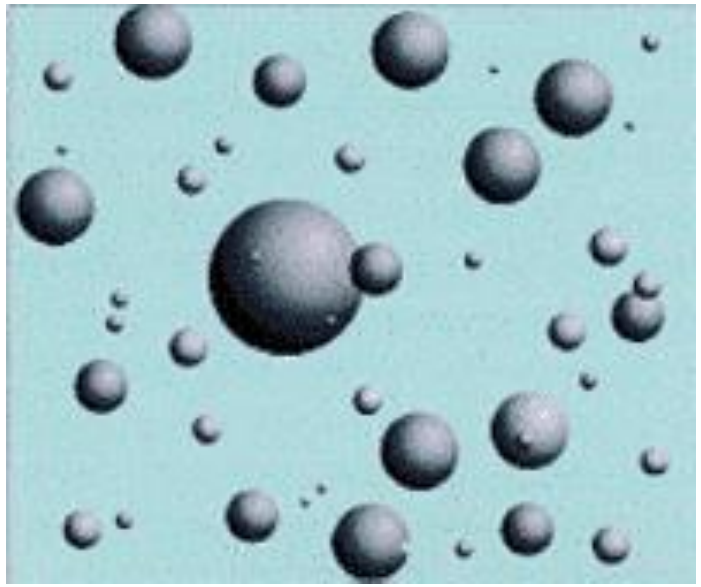


Rotor

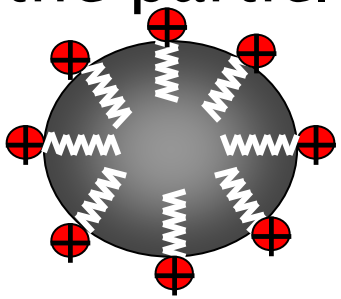
"Gap" is the clearance between the rotor and stator

Two steps

1. Asphalt is sheered into many small particles by a colloid mill



2. The soap chemistry (emulsifier) stabilizes the particles



The smaller and more single-sized the particles are, the better the emulsion

EMULSION CLASSIFICATIONS

IONIC CHARGE

Formulated for compatibility with specific aggregates and components

- **C** CATIONIC
- ANIONIC
- NONIONIC

AGGREGATE COATING THICKNESS

Utilizes a chemical formulation that promotes a gel quality to the emulsion, increasing performance

- **HF** HIGH FLOAT
- NOT HIGH FLOAT

SPEED AT WHICH EMULSIONS ARE SET

Engineered for optimal break time and workability

- **RS** RAPID SET
- **MS** MEDIUM SET
- **SS** SLOW SET
- **QS** QUICK SET

VISCOSITY & HARDNESS

To accommodate specific application methods and climates

- **1** LOWER VISCOSITY
- **2** HIGHER VISCOSITY
- **H** HARDER BASE
- **S** SOFTER BASE

POLYMERS & ADDITIVES

To achieve strength, adhesion, elasticity, durability or other performance demands

- **P** POLYMERS
- **L** LATEX POLYMERS
- **s** POLYMERS

EXAMPLES:

CRS-1H
- CATIONIC
- RAPID SET
- LOWER VISCOSITY
- HARDER BASE

CHFRS-2P
- CATIONIC
- HIGH FLOAT
- RAPID SET
- HIGHER VISCOSITY
- POLYMERS

SS-1
- ANIONIC/NONIONIC
- SLOW SET
- LOWER VISCOSITY

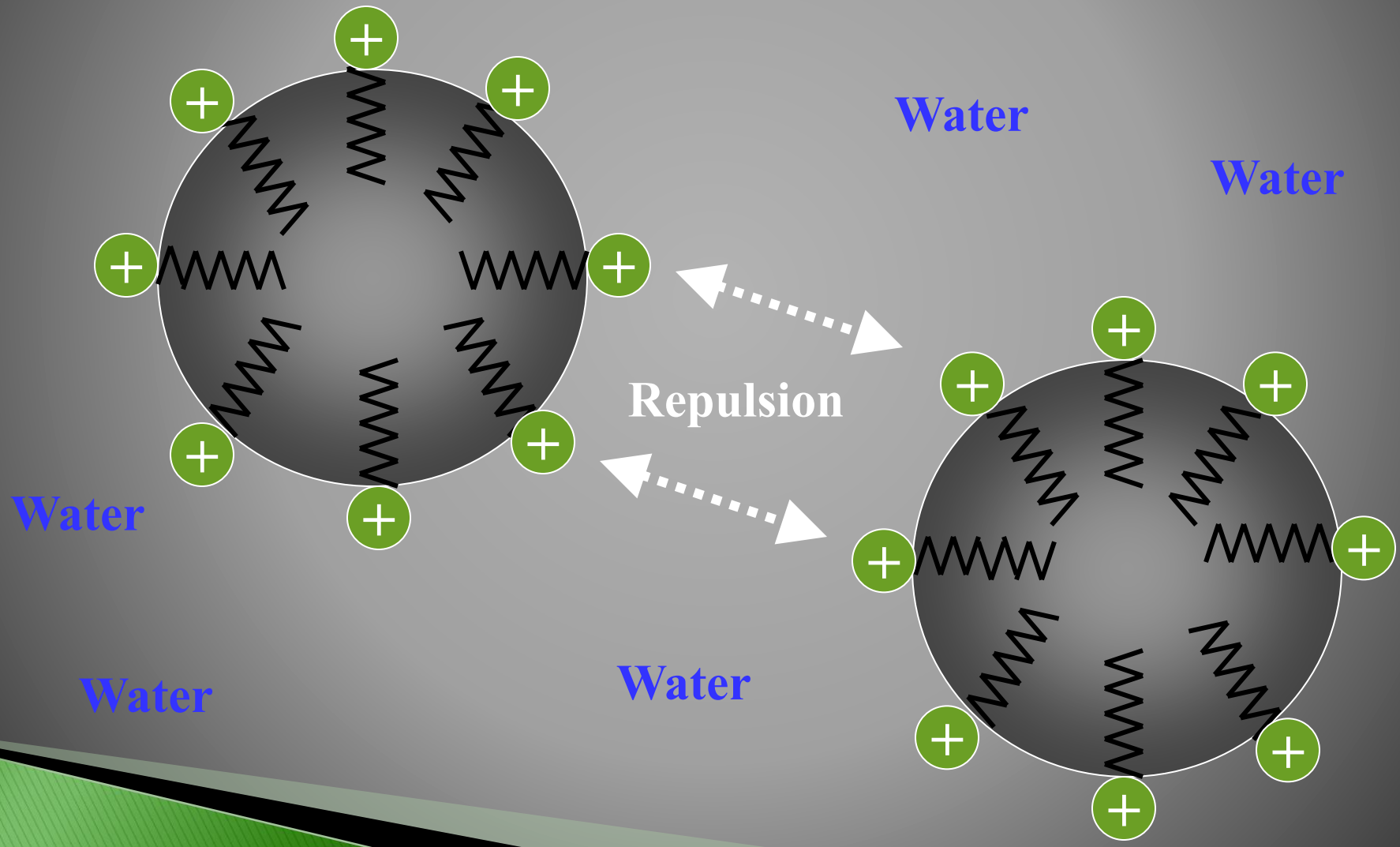
Why Do We Use Polymer (Latex) in Emulsion?

- First – Latex and polymer are often used interchangeably. Kind of like tissue and Kleenex.
- The industry started using Natural Latex from Rubber Trees. That got expensive so someone invented Synthetic Latex (Polymer) which has then morphed to other forms of Polymers (SBS, SBR) which are used in emulsion.
- Polymer is added to emulsion to change the normal properties of the base asphalt.

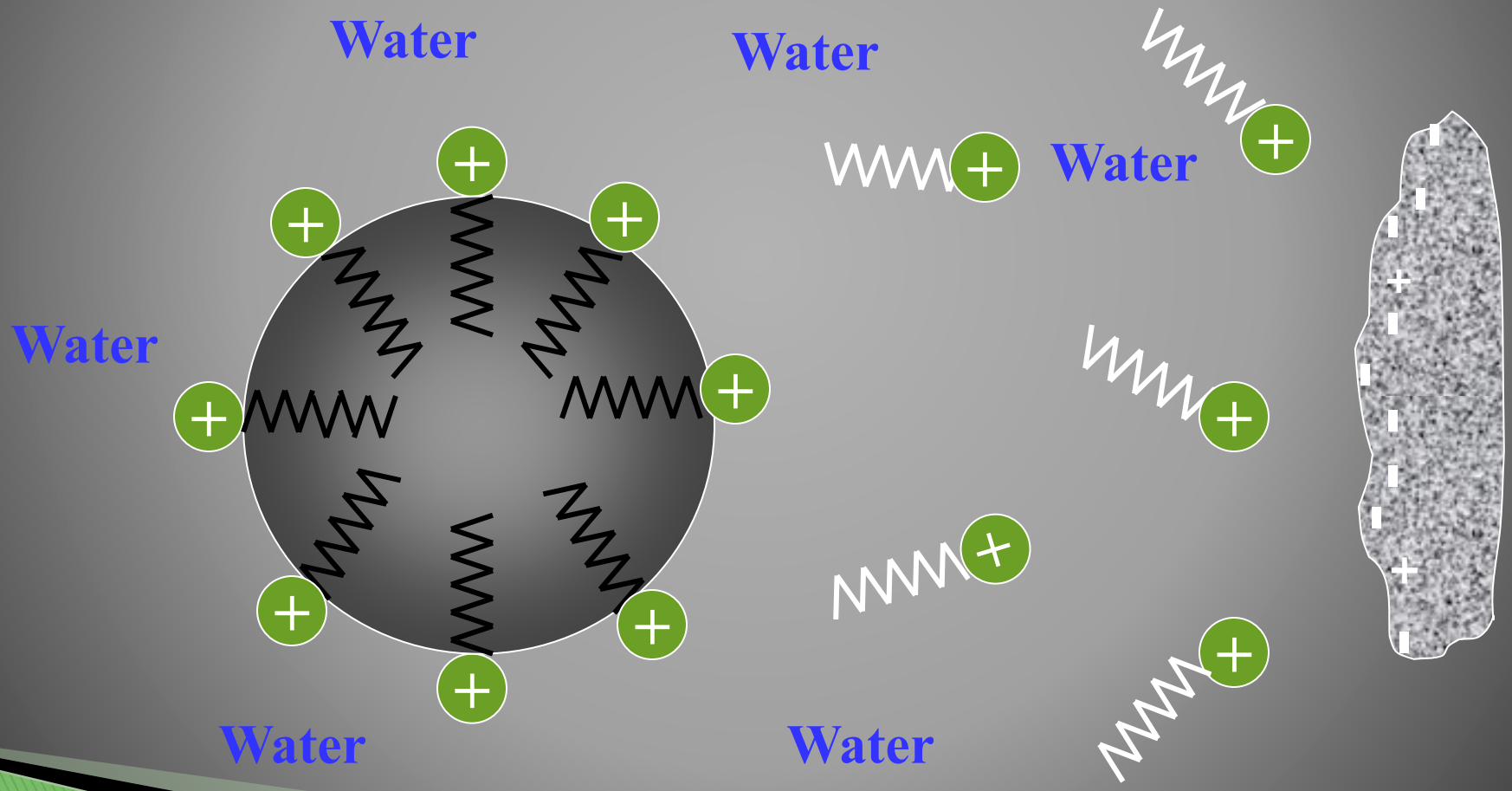
Why Do We Use Polymer (Latex) in Emulsion?

- Polymer coats the asphalt particles while they are in suspension. It does not evaporate with the rest of the chemical package.
- The Polymer:
  - Lowers the temperature at which the asphalt gets brittle.
  - Raises the temperature at which the asphalt softens
  - It can also add strength to the asphalt / aggregate bond

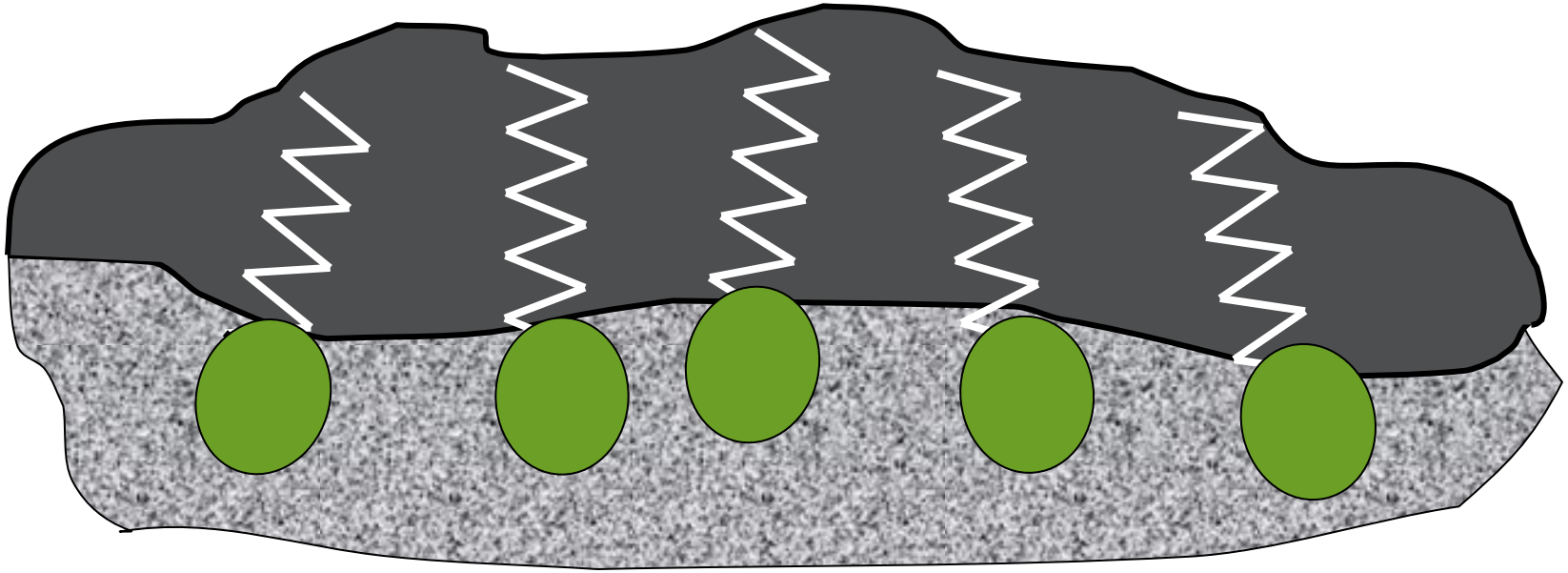
Stabilized asphalt droplets



The chemistry of mix time

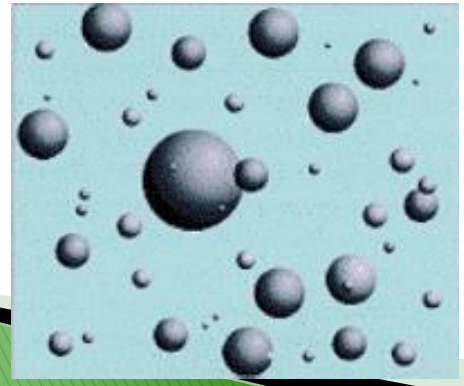


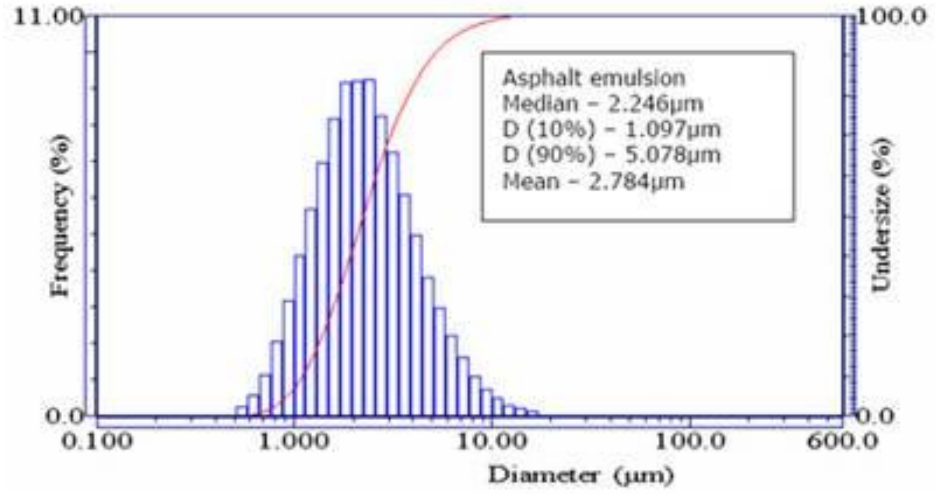
Chemical break



Emulsion QA and handling

- Emulsion is stored according to type of product (specs)
  - Some emulsions stored at ambient, some 140°F, others
  - Stored in insulated, heated tank, with mild, occasional agitation
  - Emulsion must cool before shipped or used
- Run tests for certification
  - Viscosity, distillations, etc.
- Particle size analysis
  - Not for certification but very important information
  - Samples during the run from the mill and tank samples





Storage and Handling of Emulsions

- **Storage temperatures generally range from 52°C to 85°C (125°F to 185°F) depending on the intended use and specific product**
- **Do not heat above 85°C (185°F) due to evaporation of water**
- **Do not let emulsion freeze**
- **Agitate gently when heating**
- **Avoid repeated pumping and recirculating**

QUESTIONS?