CRACK SEALING AND FILLING TREATMENTS FOR ASPHALT CONCRETE PAVEMENTS

Jim Chehovits
Vice President Operations
Crafco, Inc
August 27-30, 2012

Presentation Topics

- Cracking and Effects in AC Pavements
- Review of Research Findings
- Crack Sealing Process Design
- Sustainability
- Use in Pavement Preservation

Cracks In AC Pavements

- Cracks Happen
- Cracks Move
- Cracks Grow
- Cracks Get Worse
- Cracks Accelerate Pavement Deterioration

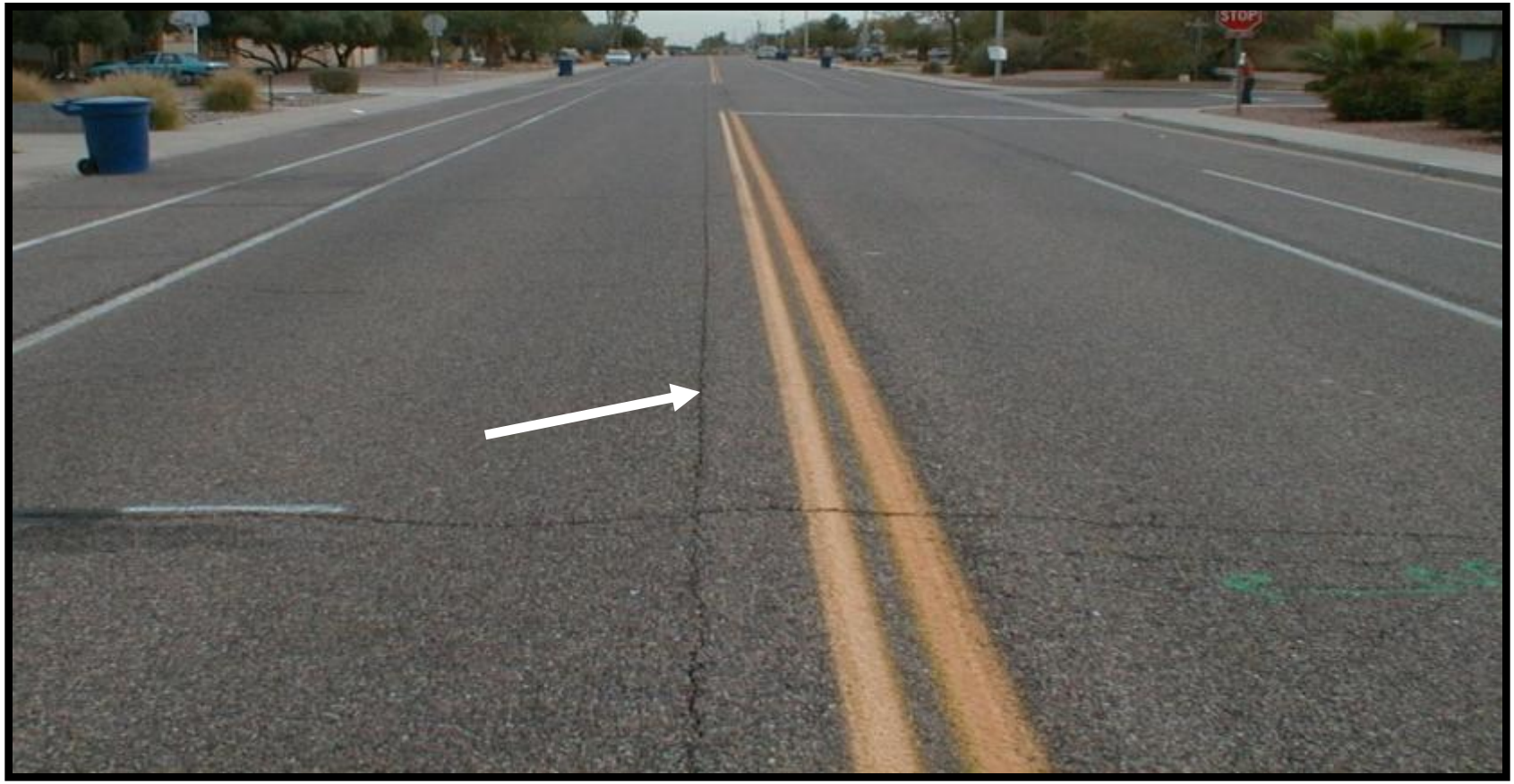
Cracks Formation and Types

- Cracks occur as the AC mix ages and can no longer resist stress and strain from temperature changes and traffic loadings
- Crack Types

Transverse	Longitudinal
Fatigue	Block
Construction	Reflective

Transverse Thermal Crack

Longitudinal Crack



Fatigue Cracks

Crack Movements

Horizontal – temperature changes

- up to 1 inch +

Vertical – Traffic loadings

- greater deflection after cracking

Crack Growth

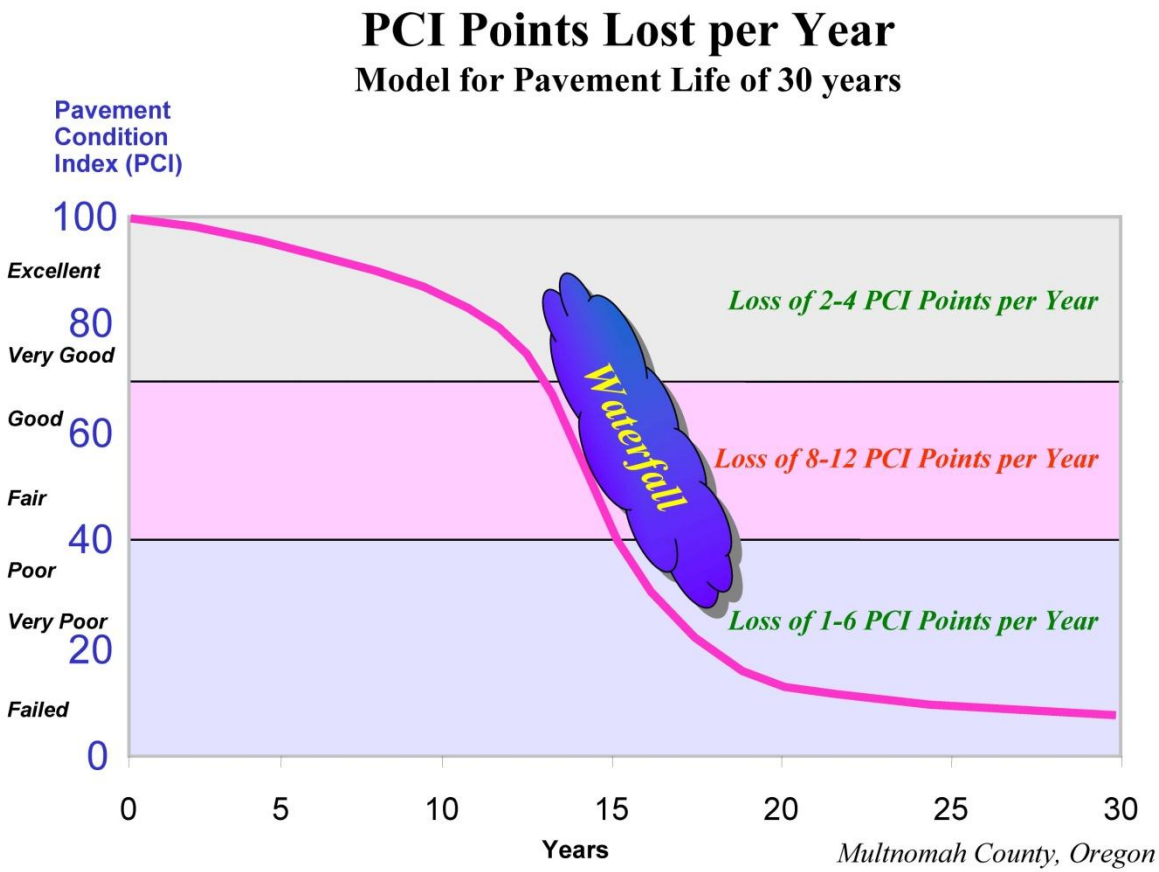
- Cracks widen as they age
- Crack face deterioration, raveling
- AC mixture shrinkage
- Incompressible intrusion
- Widening of approx 10% of annual movement per year

Pavement Deterioration From Cracking

- Water intrusion weakens subgrade
  - 2% w/c increase, 100% strength reduction
- AC mix damage, 50% thickness reduction
  - Damage approx 1m each side of crack
- Increased deflections from traffic

  -Potholes, secondary cracking

Pavement Condition Curve



Multnomah County, Oregon
DBCS/Transportation Division

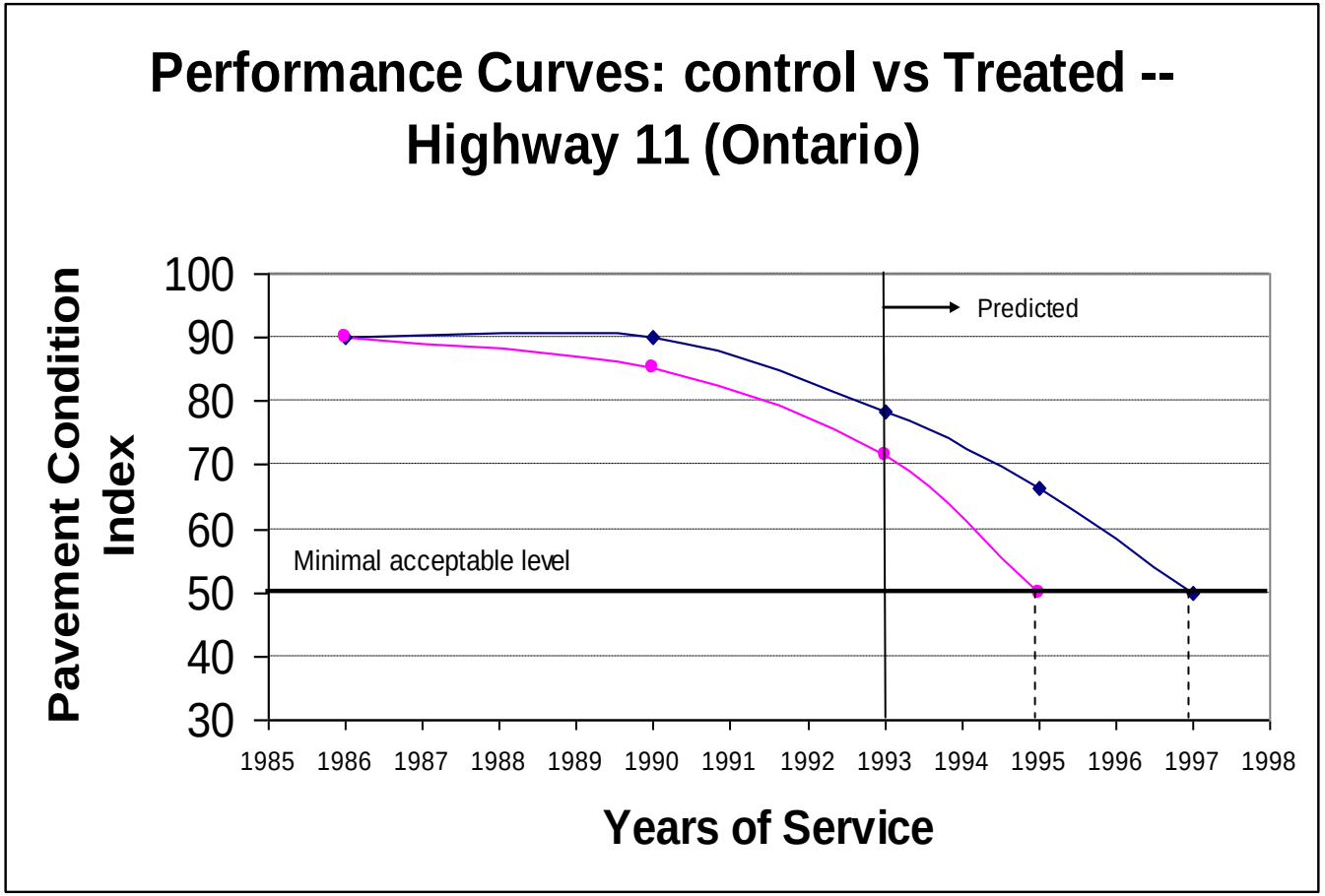
Crack Treatment Functions

- Reduce water penetration
- Preserve base strength near the crack
- Reduce incompressible entrance
- Reduce crack growth
- Seal crack surfaces
- Reduce crack raveling

Crack Treatment Effects on Pavement Condition

- Slows pavement deterioration
- Slows roughness increases
- Reduces pothole and depression formation
- Slows crack spalling
- Extends pavement life, up to 5 years

Slows Pavement Deterioration



Crack Sealing Research

- Research dates back to 1950's
- Agency projects – late 70's through 90's
- SHRP H-106 – 1990's
- 2000 on - Consortium, NTPEP

Agency Projects

- Over 20 projects performed
- Typical Objectives
  - What product
  - How to install
  - Does it work
  - Is it cost effective

Agency Projects

- Oklahoma, Utah, Ontario, Pennsylvania, Kansas, Minnesota, Manitoba, Montreal, Alberta, Montana, Indiana, Michigan, North Dakota, Ohio, Illinois, Wisconsin, Nevada, Arizona, Texas, others

Agency Research Findings

- **Sealants**--Different sealants perform different and properties must be matched to climate and crack movements
- **Installation**--Cracks must be clean and dry, reservoirs for moving cracks
- **Effectiveness**--Crack sealing can improve pavement life and is cost effective

Agency Research Findings

- Agencies that have done field research projects and adapted the crack treatment process (sealant properties and installation geometry) to local conditions (pavement condition, climate, traffic) have achieved improved performance.

SHRP H-106 Project

- SHRP -1993, LTPP through 1999
- 5 test sites in different climates, 15 materials, 8 installation configurations
- Monitored for 7 years
- Determined service life and cost comparisons

SHRP H-106 Findings

- Different treatments are required for high and low movement cracks
  - **Crack Seal** >3mm movement, transverse cracks in cooler climates- softer, high extensibility sealants in reservoirs
  - **Crack Fill** < 3mm movement, longitudinal or close spaced transverse– stiffer materials, overband installation

SHRP H-106 Best Performance

- **Crack Seal** -- High Movement Cracks
  - Rubberized asphalts installed in reservoirs with cap, 5-7 year life
- **Crack Fill** -- Low Movement Cracks
  - Rubberized asphalt installed in overband, 5-7 year life

SHRP H-106 Findings

- Differences at sites influenced results- climate, crack type, spacing, traffic
- High elongation, low strength materials had best performance in working cracks
- Reservoir installations provided longest life in working cracks

SHRP H-106 Findings

- With appropriate project design-- sealant, installation geometry, installation procedures, and quality control, service lives of at least 7 years can be achieved with both crack seal and crack fill processes

Crack Sealing Treatments Need to Resist

-Temperature extremes
-Traffic loadings
-Horizontal and Vertical Movements
-Aging
-Water
-Abrasion

WITHOUT

-Debonding, Cracking, or Tracking

Crack Treatment Design Process

- Pavement Evaluation
- Process Selection
- Temperature Ranges
- Sealant Selection
- Installation Geometry
- Installation

Pavement Evaluation

- Intact, defined crack faces
- Maximum crack width of 1.5 inch
- Not significant base damage
- PCI range 40-90
- Pavement condition can be too bad for crack sealing or filling

Process Selection

- Determine crack type and movements
- **Working** - >1/8 inch movement,
  - Typically transverse at over 15- 20 ft.
  - **Use Crack Seal Process**
- **Non-Working** - < 1/8 inch movement,
  - Typically longitudinal, transverse or other at less than 15- 20 ft.
  - **Use Crack Fill Process**

Crack Seal Process

- Extensible sealants that can withstand annual temperature extremes and crack movements
- Installed in widened reservoirs, designed for the expected movement
  - Widened reservoirs reduce sealant extension percentages as the crack widens from summer to winter

Crack Fill Process

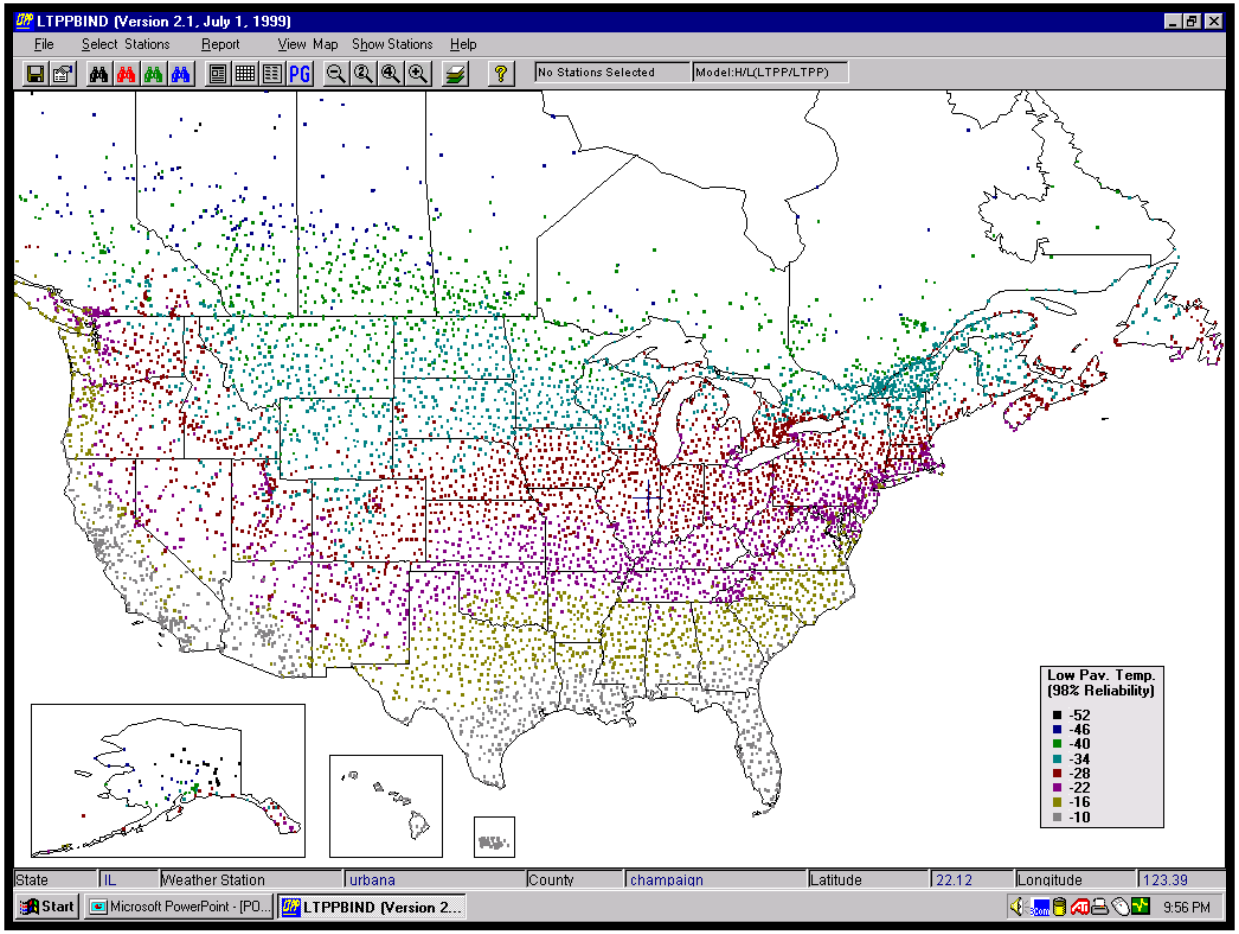
- Stiffer sealants that can withstand annual temperature extremes and remain flexible
- Installed in cleaned existing cracks, or in routed reservoirs for improved life
- Typically installed in a fill with overband configuration

Temperature Ranges

- Determine temperature extremes
- LTPPBIND, at surface level
- Ranges from 76-10 to 64-40
- FHWA Application Note- RD-03-080

  Using LTPPBIND V2.1 to Improve Crack Sealing in Asphalt Concrete Pavements

LTPPBIND


LTPPBIND (Version 2.1, July 1, 1999)
File
Select Stations
Report
View Map
Show Stations
Help
No Stations Selected
Model:H/L(LTPP/LTPP)
Low Pav. Temp.
(98% Reliability)
-52
-46
-40
-34
-28
-22
-16
-10
State
IL
Weather Station
urbana
County
champaign
Latitude
22.12
Longitude
123.39
Start
Microsoft PowerPoint - [PO...
LTPPBIND (Version 2...
9:56 PM

Sealant Selection

- Sealant material performance is controlled by low temperature, high temperature, adhesive and elastic properties over the entire range of temperatures and strains experienced.

Sealant Selection

- Low Temperature
  - **Crack Seal** -- Pass bond extension test at the determined low temperature – 50-200% extension Experience
  - **Crack Fill** -- pass a mandrel bend test at the determined low temperature -10% extension Experience

Sealant Selection

- High Temperature
  - **Crack Seal** -- Meet D6690 Softening Point requirements - 80 C minimum
  - **Crack Fill** -- Minimum D36 Softening Point of 25C above determined high temperature Experience

General Specification Applicability

- -34,-40 areas D6690 Type IV
- -22,-28 areas D6690 Type II,III
- -16 areas D6690 Type I
- -10 areas State, local specs

Installation Geometry

- **Crack Seal**
  - Widened reservoir to accommodate expected annual crack movement
  - Recess, flush or overband cap
- **Crack Fill**
  - Existing crack, flush or overband cap
  - Routed Reservoir- improved life.

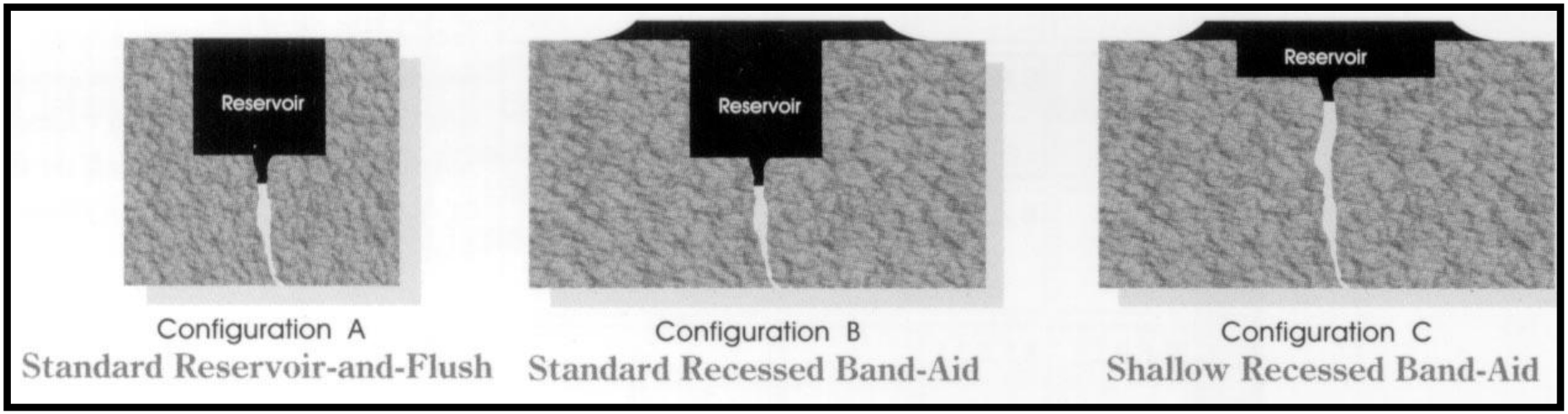
Reservoir Size- Crack Seal

Width based on temperature range and crack spacing to limit extension

Temp Range	Width	Depth
<80C	½ in	¾ in
86C	¾ in	¾ in
92C	1 1/8 in	½ in
96C+	1 ½ in	½ in

For spacing over 50 ft, consider wider size

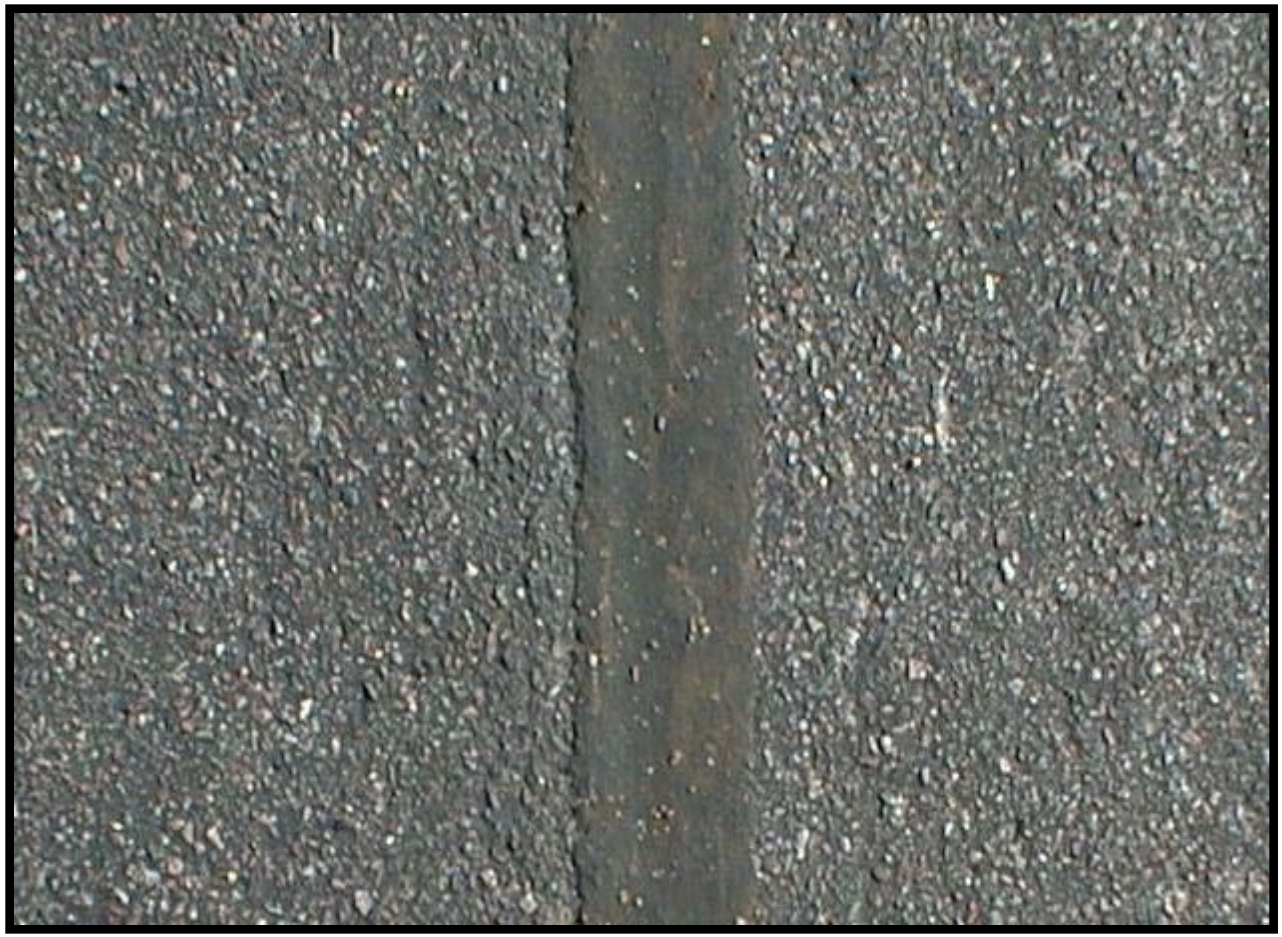
Reservoir Configurations



Installation Configuration- Non Working Cracks

- Fill existing cleaned crack, and/or
- Use overband, 1/16 in max by 4 in wide, or
- Can also use reservoir for longer life, typically 1/2 in by ¾ in.

Recommended Overband



Not Recommended

Installation

- Weather Conditions – Dry, 40F +
- Sealant Preparation - Proper heating
- Reservoir Cutting - Centered, dimensions
- Crack Cleaning - intact, dry, clean
  - Compressed Air
  - Heat Lance
  - Vacuum

Clean Cracks

Failure Modes & Causes

- **Adhesion Loss-** cleaning, moisture, cold weather, install temperatures, weak mix, sealant properties, geometry
- **Cohesive Fracture-** sealant properties, overheating, geometry
- **Pullouts/Tracking**- sealant properties, cleaning, moisture, excess application, early traffic

Sustainability

- Recycled Content
- Packaging
- Energy/GHG

Recycled Content

- **Recycled Tire Rubber**
  - Post Consumer
  - Used in many sealant types
  - Up to 25% content
  - Provides beneficial properties
  - Used alone, or with other modifiers
  - Millions of tires per year

Packaging

- Pallets
- Pallet Wrapping
- Containers

Pallets

- Wood pallets from renewable resources
- Recycled Pallets used
- Pallets can be reused or recycled

Pallet Wrap

- Stretch wrap and other plastic weatherproofing can be recycled

Containers

- **Cardboard Boxes**
  - Made from renewable resources
  - Have recycle content
  - Can be recycled
- **Meltable/Consumable Containers**
  - Available from multiple suppliers
  - Reduce jobsite labor
  - Reduce disposal or recycling

Energy and GHG Emissions

- **Energy Use Considerations**
  - Raw Materials - obtain, transport, processing
  - Production, Mixing, Heating
  - Jobsite Transportation
  - Jobsite Installation

Total Energy and GHG

- **Crack Seal** 1 lf/sy
  - 870 btu/sy and 0.14 lb CO2/sy
- **Crack Fill** 2 lf/sy
  - 1860 btu/sy and 0. 25 lb CO2/sy
- **4 Inch AC Overlay** 420 lb/sy
  - 112,800 btu/sy and 24.1 lb CO2/sy

Annualized Energy and GHG

- **Crack Seal** 1-3 yr life extension
  - 290-870 btu/sy/yr
  - 0.05-0.14 lb CO2/sy/yr
- **Crack Fill** 1-2 yr life extension
  - 930-1860 btu/sy/yr
  - 0.13-0.25 lb CO2/sy/yr
- **4 Inch AC Overlay** 15 yr life
  - 7500 btu/sy/yr
  - 1.3 lb CO2/sy/yr

Crack Treatments in Pavement Preservation

- Crack Sealing and Filling are standard pavement preservation treatments
- Commonly used in conjunction with other preservation processes as a pretreatment

Pretreatment for Pavement Preservation Processes

- Used for larger and moving cracks, that exceed sealing and movement capabilities of surfacing process
- Prior to Seal Coats, Slurry Seals, Chip Seals, Microsurfacing, and thin overlays
- Improves crack resistance of the surfacing

Pavement Management

- Crack treatments incorporated in PCI determinations by reducing severity ratings for sealed cracks
- Sealed crack - rated as low severity
- Unsealed crack - moderate, high severity
- Slow pavement roughness increases

Summary

Crack Seal and Fill Treatments

- Slow pavement deterioration rate
- Must use correct materials and installation
- Need to be designed for pavement and climate conditions
- Are cost effective
- Are energy efficient
- Extend Pavement Life

.

Crafco, Inc
420 N. Roosevelt Ave
Chandler, AZ 85226
ph: 602-276-0406
FAX: 480-940-0313
jim.chehovits@crafco.com
www.crafco.com