

Chapter 9

Microsurfacing

From... Maintenance Technical
Advisory Guide (MTAG)

Managers Overview

From... Maintenance Technical
Advisory Guide (MTAG)

Microsurfacing

- What is microsurfacing?
- Why use microsurfacing?
- Where to use microsurfacing?
- When to use microsurfacing?



What is Microsurfacing?

- A thin maintenance treatment
- A mixture of:
 - polymer modified emulsion
 - graded aggregates
 - mineral filler
 - water
 - Additives
- Instead of breaking and curing via evaporation, like slurry, a chemical reaction causes the material to set-up.



Microsurfacing Vs. Slurry Seal

<i>Differences in:</i>	<i>MICROSURFACING</i>	<i>SLURRY SEAL</i>
Asphalt Emulsion	always polymer modified, quick set	could be polymer modified
Aggregate Quality/Gradation	Stricter spec. for sand equivalent; use only Type II and Type III	Can use Type I, II or III
Additives/Break	chemical break largely independent of weather conditions	breaking and curing dependent on weather conditions

Microsurfacing Vs. Slurry Seal

<i>Differences in:</i>	MICROSURFACING	SLURRY SEAL
Mix Stiffness/Equipment	stiffer mix, use augers in the spreader box and secondary strike-off	softer mix, use drag box
Applications	same as slurry seal + rut filling, night work, correction of minor surface profile irregularities	correct raveling, seal oxidized pavements, restore skid resistance

Why Use Microsurfacing?

- Cost Effective
- Benefits:
 - minimize oxidation/ageing, reduce water infiltration, correct raveling and weathering
 - provide skid resistance
 - improve aesthetics
 - correct rutting and minor surface profile irregularities
- Average performance life: 5 to 7 years

Caltrans District 11 -



Before



After

**Type III Micro Surfacing Project,
Contract No. 11-276004, 11-SD-76-30.2/52.9
Intermountain Slurry Seal**

Where to Use?

- Hot Mix Asphalt Pavements:
 - Roadways (All traffic levels)
 - Taxiways and Runways
 - Bridges and Over-Crossings
- Geographic Regions/Climate Zones:
 - All throughout California

When to Use?

- To correct/improve:
 - raveling and weathering
 - loss of frictional properties
 - aesthetics
 - rutting and surface profile irregularities
- To prevent/reduce:
 - ageing/oxidation of asphalt concrete
 - surface water infiltration
 - pavement degradation due to the elements

When NOT to Use?

- On pavements with structural defects:
 - Alligator Cracking
 - On-going Rutting
 - Bumps and Depressions
 - Potholes



Module 9-1

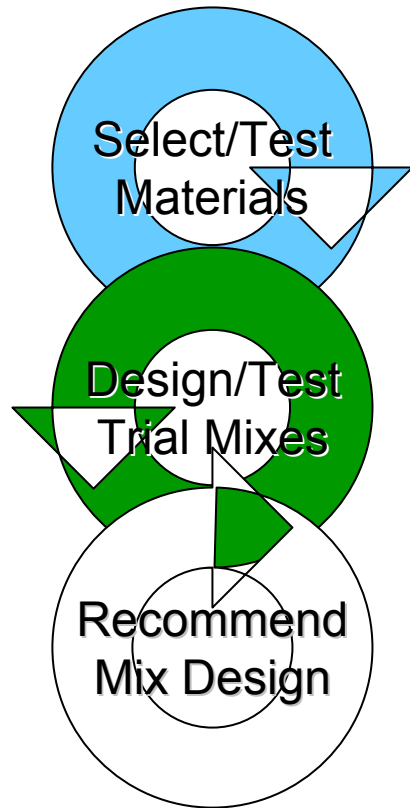
Design, Materials & Specifications

From... Maintenance Technical
Advisory Guide (MTAG)

Microsurfacing Design

- Design Process
- Specification
- Materials
- Laboratory Tests

Mix Design Process



- **Pre-screen materials**
- **Check materials compatibility**
- **Try different mixing proportions**
- **Prepare mixes at a range of emulsion contents**
- **Check for cohesion build-up**
- **Check for abrasion resistance**
- **Check for sand adhesion**
- **Select optimum emulsion content**
- **Test proposed mix to meet specification requirements**

Specification

- **Caltrans**
 - 2001 Proposed (Non-Standard) Specification, Microsurfacing Pilot Study 2001
 - [Not available for download](#)
- **International Slurry Surfacing Association (ISSA):**
 - A143 (2005) Recommended Performance Guidelines for Micro-Surfacing
 - <http://www.slurry.org/downloads/A143.pdf>
- **ASTM:**
 - ASTM D 6375-05 Standard Practices for Design, Testing, and Construction of Micro-Surfacing
 - <http://www.astm.org>

Materials

- Asphalt Emulsion with Polymer Modification
- Aggregate
- Mineral Filler
- Water
- Additives

Asphalt Emulsion

- Type/Grade
 - Polymer Modified Anionic/Quick Set (PMQS-1h)
 - Polymer Modified Cationic/Quick Set (PMCQS-1h)
- Specification
 - CALTRANS proposed “Microsurfacing Emulsion” (MSE)
- Notes
 - Always polymer-modified. If Latex is used, the emulsion may be called latex-modified (LM)

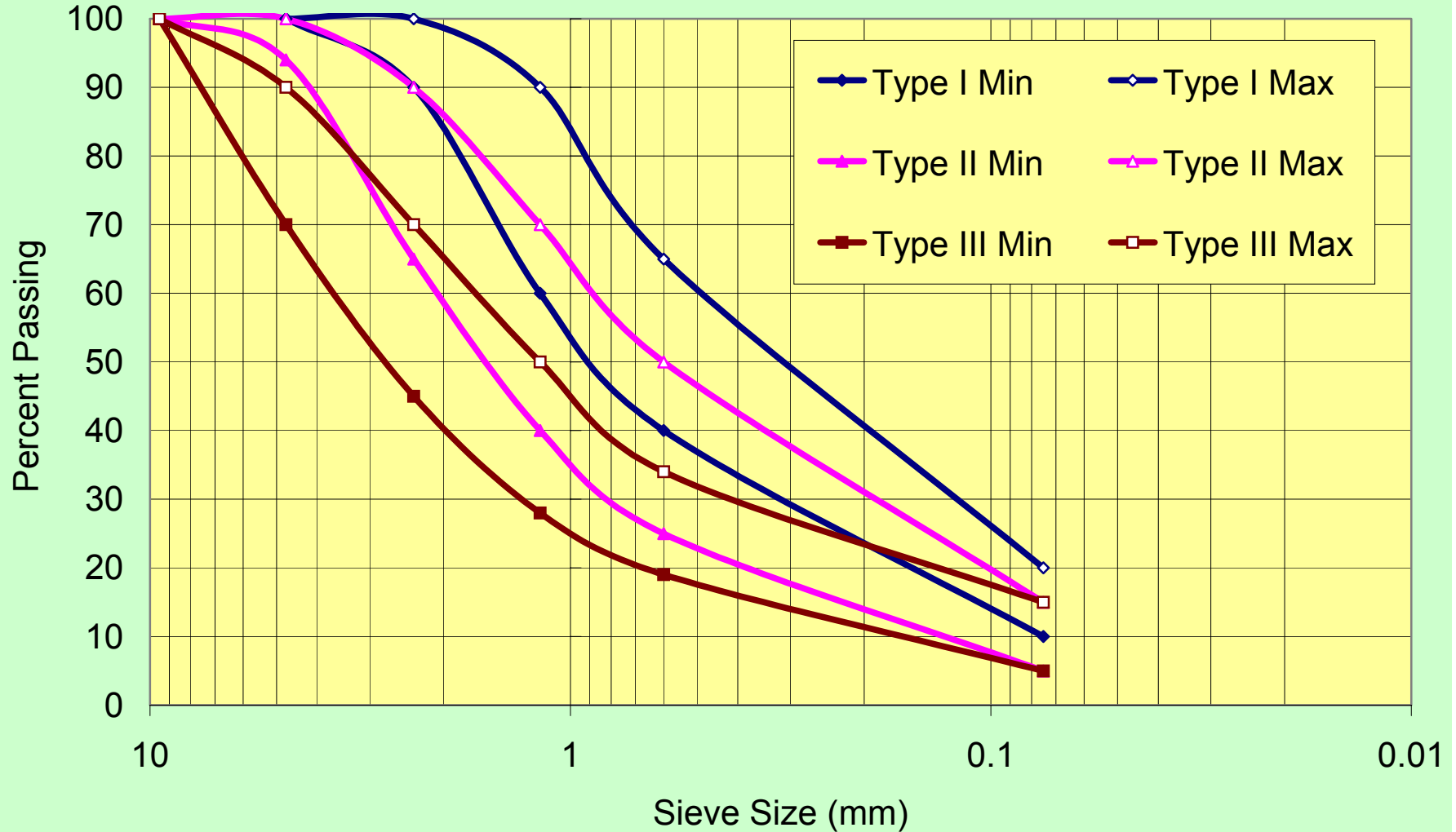
Asphalt Emulsion - Tests

Tests on Emulsion	Typical Specification	Method
Viscosity, SSF @ 25°C, sec	15 – 90	AASHTO T 59
Settlement, 5 days, %	< 5	ASTM D 244
Storage Stability, 1 day, %	< 1	AASHTO T 59
Sieve Test, %	< 0.30	AASHTO T 59
Residue by Evaporation, %	> 62	California Test 331
Tests on Residue from Evaporation Test	Typical Specification	Method
Penetration, 25°C	40 – 90	AASHTO T 49
Softening Point, °C	> 57	AASHTO T 53
G* @ 20°C, 10 rad/sec, MPa	Report Only	AASHTO TP 5
Phase Angle @ 50°C, 10 rad/sec, PA(max) – PA base	Report Only	AASHTO TP 5
Stiffness @ -12°C, MPa M-Value	Report Only	AASHTO TP 1
Torsional Recovery, %	> 18% (LMCQS-1h)	California Test 332
Polymer Content	> 2.5% (LMCQS-1h)	California Test 401

Aggregate - Gradations

Sieve	Type I	Type II	Type III
3/8 in (9.5mm)	-	100	100
No. 4 (4.75 mm)	100	94-100	70-90
No. 8 (2.36 mm)	90-100	65-90	45-70
No. 16 (1.18 mm)	65-90	40-70	28-50
No. 30 (600- μ m)	40-65	25-50	19-34
No. 200 (75- μ m)	10-20	5-15	5-15

Slurry Surfacing Systems Aggregate Gradations



Aggregate - Quality

Test	Criteria	Test Method
Sand Equivalent (min)	> 65	CT 217
Durability Index (min)	> 55	CT 229
Abrasion (LA Rattler, 500 rev.)	< 35%	CT 211
Crushed Particles	100%	CT 205

- **Other aspects of interest:**
 - Geology
 - Shape
 - Texture
 - Age and Reactivity
 - Cleanliness

Mineral Filler

- Any recognized brand of non-air entrained Portland cement or hydrated lime that is free from lumps
- Considered part of the dry aggregate
- Mixing aid, improves cohesion, absorbs water from the emulsion causing it to break faster after placement

Water

- Water should be of such quality that the asphalt will not separate from the emulsion before the microsurfacing is placed

Additives

- Emulsifier solutions, aluminum sulfate, aluminum chloride, borax
- Generally act as retardants, useful when temperatures rise during the day

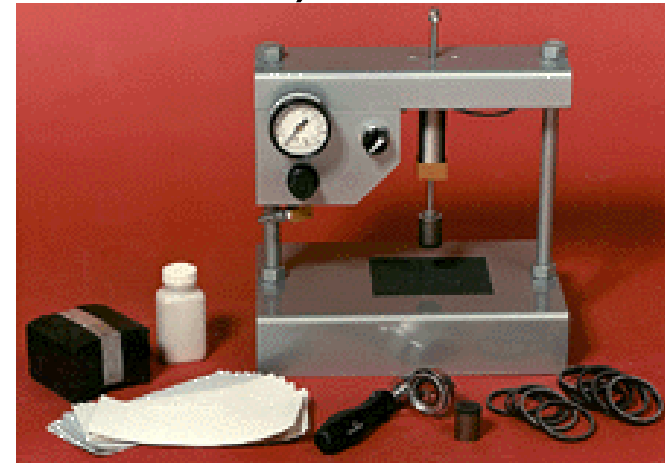
Mixing Properties



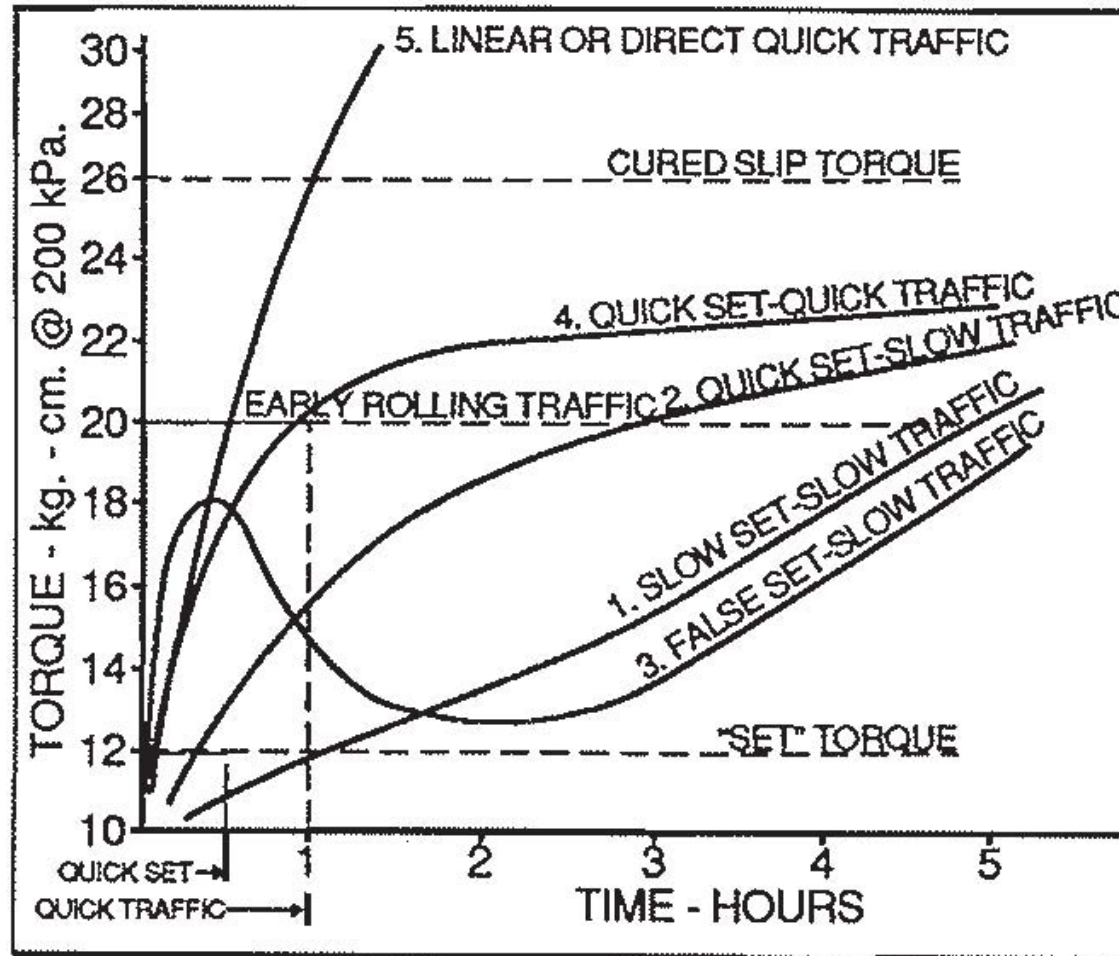
- ISSA TB 102 (Mixing Test)
 - Determine approximate proportions of component materials by trying different “recipes”
 - The amount of time the slurry can be mixed and retain its homogenous consistency is recorded (mixing time)
 - Foaming and coating are visually assessed
 - The test can be performed at expected field humidity and temperature conditions
 - Select the proportions that result in mixing times over 120 seconds and good coating over the range of humidity and temperature condition expected at placement

Cohesion Build-Up

- ISSA TB 139 (Modified Cohesion Test)
- Fabricate 3 test specimens:
 1. At selected emulsion content
 2. -2% emulsion content
 3. +2% emulsion content
- Determine the build-up of cohesion with time
- Differentiate between “Quick Set” and “Slow Set”; “Quick Traffic” and “Slow Traffic” mixes

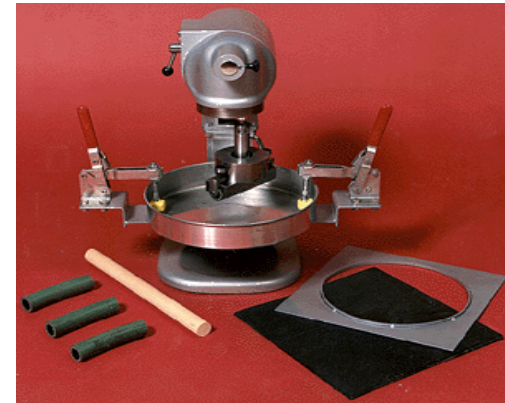


Cohesion Build-Up



Abrasion Loss

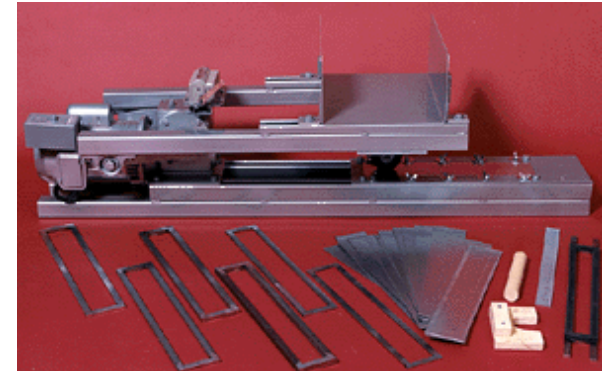
- ISSA TB 100 (Wet Track Abrasion Test)
- Fabricate 3 test specimens:
 1. At selected emulsion content
 2. -2% emulsion content
 3. +2% emulsion content
- Cure specimens for 16 hrs, than soak for 1 hr
- Determine abrasion loss under water
- Plot abrasion loss versus emulsion content



Sand Adhesion

- Fabricate 3 test specimens:

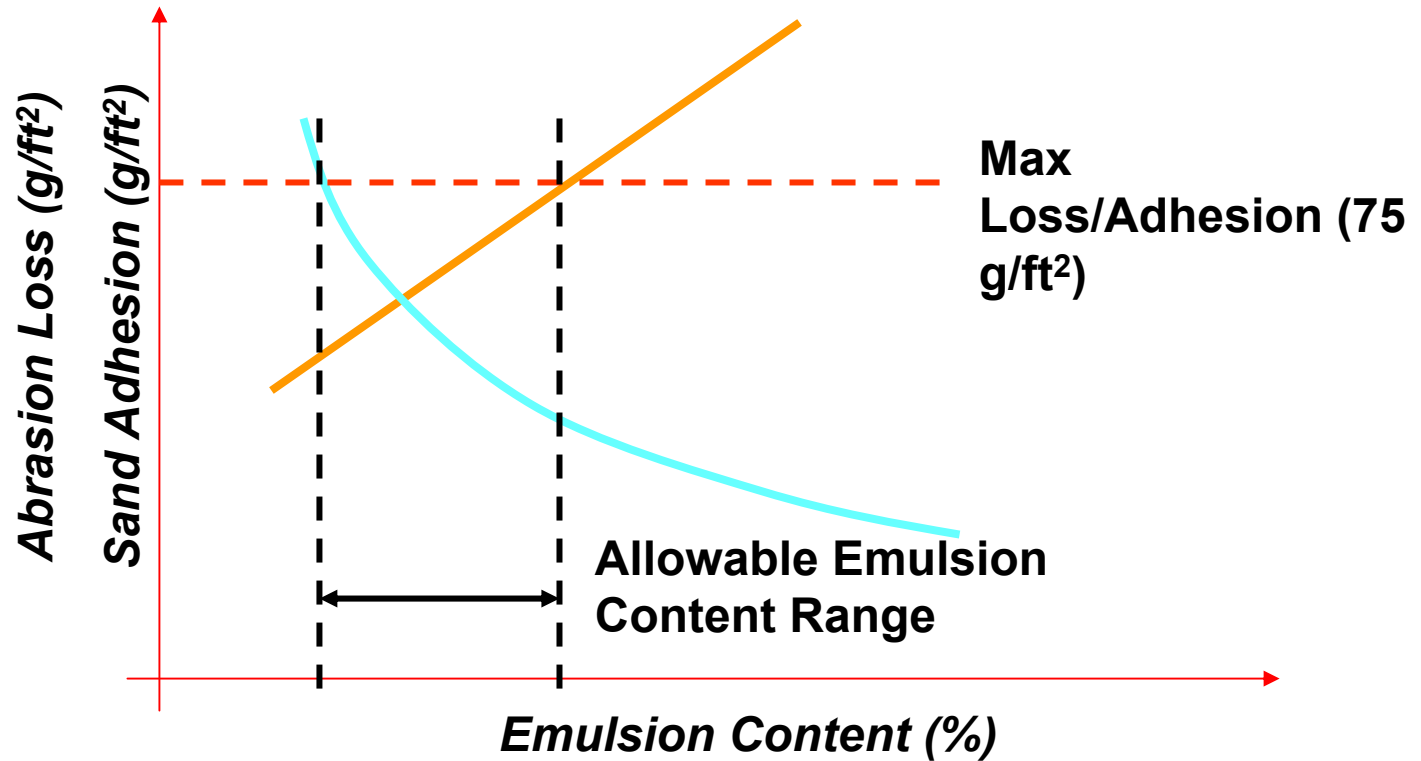
1. At selected emulsion content
2. -2% emulsion content
3. +2% emulsion content



- ISSA TB 109 (Loaded Wheel Test)

- Measure increase in weight of the specimen due to sand adhesion
- Plot sand adhesion versus emulsion content

Emulsion Content Selection



Proposed MSE Specification Requirements

Property	Test	Requirement
Wet Cohesion	ISSA TB 139	12 kg-cm @ 30 min. 20 kg-cm @ 60 min.
Sand Adhesion	ISSA TB 109	< 540 g/m ²
Wet Stripping	ISSA TB 114	> 90%
Wet Track Abrasion Loss, 6-day soak	ISSA TB 100	< 810 g/m ²
Displacement Specific Gravity	ISSA TB 147A	< 5% lateral < 2.1 @ 1000 cycles of 57 kg
Classification Compatibility	ISSA TB 144	(AAA, BAA) 11 grade points
Mix Time @ 25°C	ISSA TB 113	> 120 sec.

Final Notes

- Design is generally performed by outside laboratory, CALTRANS will only review and approve
- Designer needs to have extensive experience with microsurfacing

Module 9-2

Construction and Inspection

From... Maintenance Technical
Advisory Guide (MTAG)

Microsurfacing Construction

- Project Selection
- Applications
- Safety and Traffic Control
- Equipment
- Construction
- Quality Control
- Troubleshooting
- Field Considerations

Project Selection

- A pavement preservation treatment: protect the pavement before distresses appear
- Can correct: raveling, oxidized pavement, friction loss
- Can be used for rut filling
- Cannot correct: cracking, base failures, any structural deficiencies
- When applied correctly, it may increase pavement life by 5 – 7 years

Distress Conditions

Pavement Distress	Slurry*	Micro*
Surface cracking		
Early longitudinal	X	X
Hairline	X	X
Full depth cracking		
Thermal or Transverse	-	-
Fatigue or Alligator	-	-
Block	-	-
Reflective	-	-
Late longitudinal	-	-
Slippage (tack failure)	-	-
Corrugation or Shoving (wash boarding)	-	X

Distress Conditions (cont.)

Pavement Distress	Slurry*	Micro*
Rutting		
Sound base	-	X
Unsound base	-	-
Raveling	X	X
Bleeding	-	X
Polishing (loss of skid resistance)	X	X
Patched pothole		
Pavement patch only	-	-
Base repaired patch	X	X
Loss of profile (crown, edge, etc.)	-	X

Applications

Application	Aggregate Type II	Aggregate Type III
Void Filling	•	
Wearing Course AADT < 100	•	
Wearing Course AADT < 1,000	•	•
Wearing Course AADT < 20,000	•	•
Minor Shape Correction 0.4 – 0.8 inch (10 – 20 mm)		•
Application Rates in lbs of dry aggregate per square yard	10 - 15	20 - 25

Safety and Traffic Control

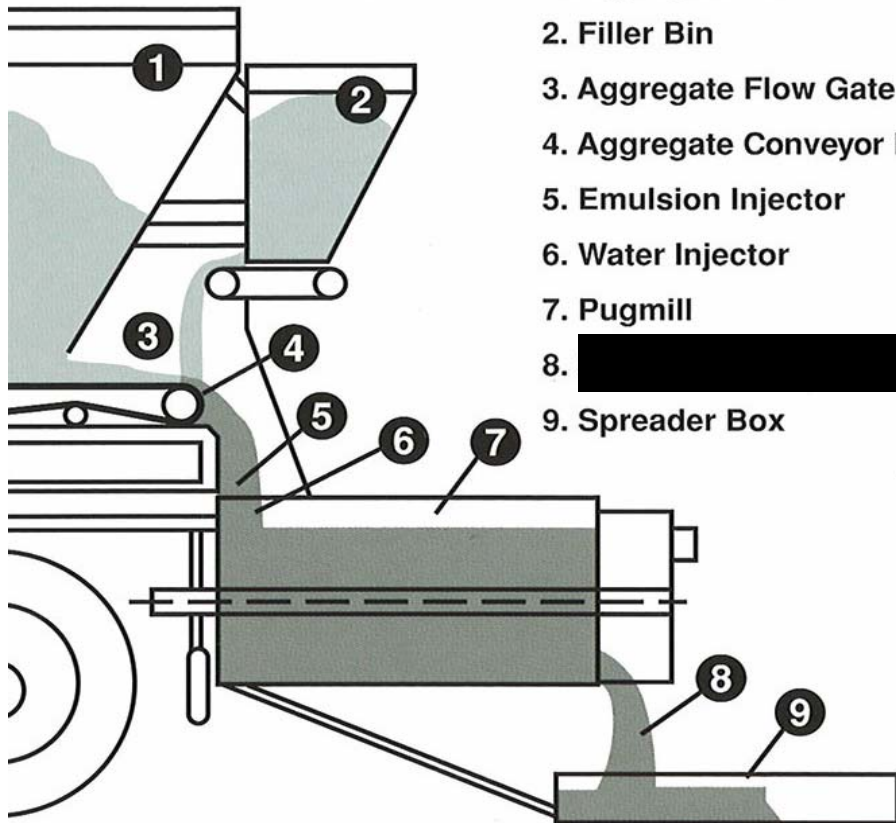
- Ensure that the microsurfacing has had adequate time to cure prior to reopening to traffic - very often drivers assume that the microsurfacing is drivable despite of the warning signs and cause damage to the fresh placed treatment
- Notify the residents and provide information on how to accommodate the construction activities
- Protect both employees and public
- Have signs/barricades in place before commencing work

Equipment



- Requirements similar to those for slurry seal, covered in Caltrans Standard Specification Section 37
- Types:
 - Continuous, self propelled unit
 - Truck-mounted unit
- All equipment should be properly calibrated as per CT 109

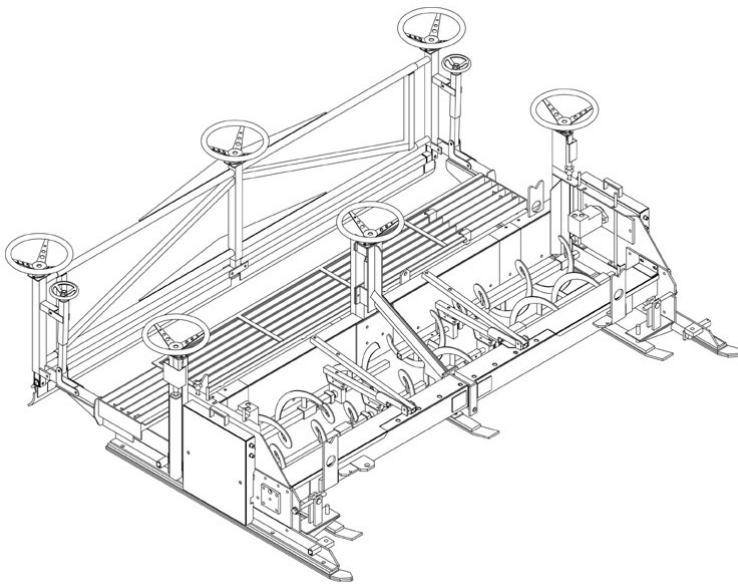
Typical Setup



1. Aggregate Bin
2. Filler Bin
3. Aggregate Flow Gate
4. Aggregate Conveyor Belt
5. Emulsion Injector
6. Water Injector
7. Pugmill
8. [REDACTED]
9. Spreader Box

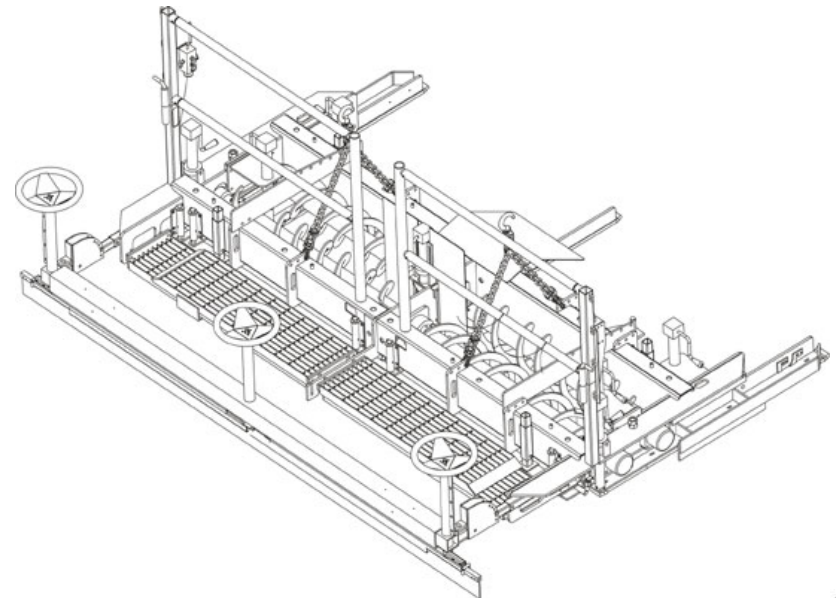


Spreader Boxes for Microsurfacing



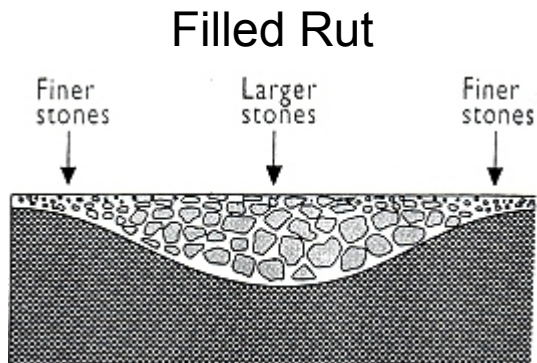
Microsurfacing spreader box with augers and secondary strike-off

Variable width spreader box for shoulders and longitudinal joints

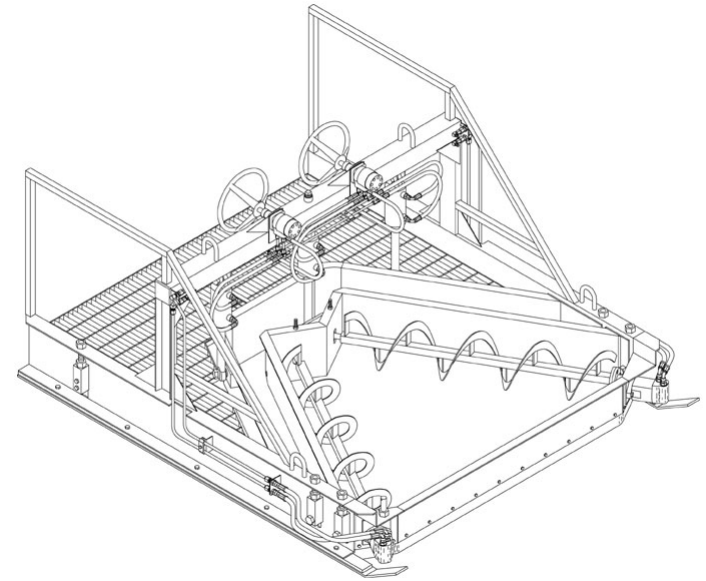


Spreader Boxes for Microsurfacing (Cont'd)

- Steel strike-off used for scratch course when rut depth is less than 0.5 inch
- Rut box used when rut depth is higher than 0.5 inches



Rut Box



Rut Filling



BEFORE



Surface Preparation

- Restore pavement structural integrity and functional performance characteristics:
 - Patching
 - Crack sealing
- Clean pavement surface
 - Sweeping or High Power Pressure Washing
 - Remove rubber crack sealant and thermo-plastic markings
 - Cover utility inlets with heavy paper or roofing felt

Utility Inlets



BEFORE



AFTER



Application Conditions

- Temperature: 50°F (10°C) and rising
- May be applied at night
- DO NOT start work if:
 - Rain is imminent
 - Freezing anticipated within 24 hours

Starts/Stops

- All starts, stops, and handwork on turnouts should be done on roofing felt to ensure sharp, uniform joints and edges



Longitudinal Joints

- May be overlapped or butt jointed
- Should be straight or curve with the traffic lane
- Overlaps should not be in the wheel paths and should not exceed 3 in (75 mm) in width
- Typically 3 passes required on a 2-lane roadway

Transverse Joints

- Transitions at these joints must be smooth to avoid creating a bump in the surface
- The joints must be butted to avoid these bumps and handwork should be kept to a minimum
- Do not over wet - this leads to poor texture and scarring at the joints.
- Start transverse joints on roofing felt to eliminate these problems

Transverse Joints Examples



GOOD QUALITY

POOR QUALITY



Edges and Shoulders

- The edge of the spreader box should be outside the line of the pavement
- Edge boxes should be used when shoulders are covered

Edges and Shoulders Examples



GOOD QUALITY

POOR QUALITY



Uneven Mix and Segregation

- Non-uniform mixes that appear to be setting very slowly
- Black and flush looking surface with poor texture
- “False Slurry” - where the emulsion breaks onto the fine material
- Causes: too much water or not enough cement
- Result: segregation and delamination



Smoothness

- Washboarding – mix too stiff or spreader box incorrectly set up
- Drag marks – dirty strike-off
- Original surface too rough



Premature Opening to Traffic

- The microsurfacing must build sufficient cohesion to resist abrasion due to traffic. Otherwise, it will ravel off quickly, particularly in high stress areas
- Early stone shedding is normal, but should not exceed 3%
- General rule of thumb for a microsurfacing is that it can be opened to traffic when it has turned black



Post-Construction Treatments

- Rolling with pneumatic rollers may be incorporated to limit the amount of stone loss
- Sweeping should be done just prior to opening to traffic and at periods determined by the level of stone loss to avoid windshield damage
- Sanding may be used to reduce the times that cross streets or intersections are closed

Post-Construction Conditions

- Heavy traffic coupled with heavy rain within hours of placement will most likely damage the slurry surfacing
- Freezing weather within 2 weeks of placement may cause the water in the system to freeze and damage the microsurfacing

Troubleshooting

- See Tables in MTAG, Volume I, 2nd Edition
- Problems addressed:
 - Brown Mix, Whitish Mix
 - Mix Won't Set
 - Poor Coating
 - Delayed Opening to Traffic
 - Mix Breaks in Spreader Box
 - Mix Ravels
 - Mix Flushes
 - Delamination
 - Segregation
 - Uneven surface, Washboarding
 - Poor joints

Field Considerations

- See Tables in MTAG, Volume I, 2nd Edition
- Project Responsibilities
 - Project Review
 - Document Review
 - Materials Checks
- Pre-Seal Inspection Responsibilities
 - Surface Preparation

Field Considerations (Cont'd)

- Equipment Inspection
 - Sweeping
 - Slurry Seal Unit (Truck Mounted or Continuous)
 - Rollers
 - Stockpile
- Site Considerations
 - Weather requirements
 - Traffic Control
- Application Considerations
 - Application Rates

Field Considerations (Cont'd)

- Project Inspection
 - Slurry Surfacing
 - Rolling
 - Truck Operation
 - Longitudinal Joints
 - Transverse Joints
 - Sweeping
 - Opening to Traffic
 - Clean Up

Thank You

Questions?