

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

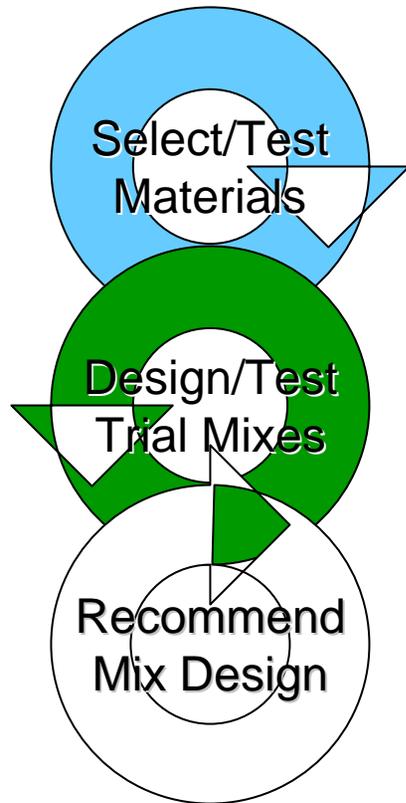
Design, Materials & Specifications

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

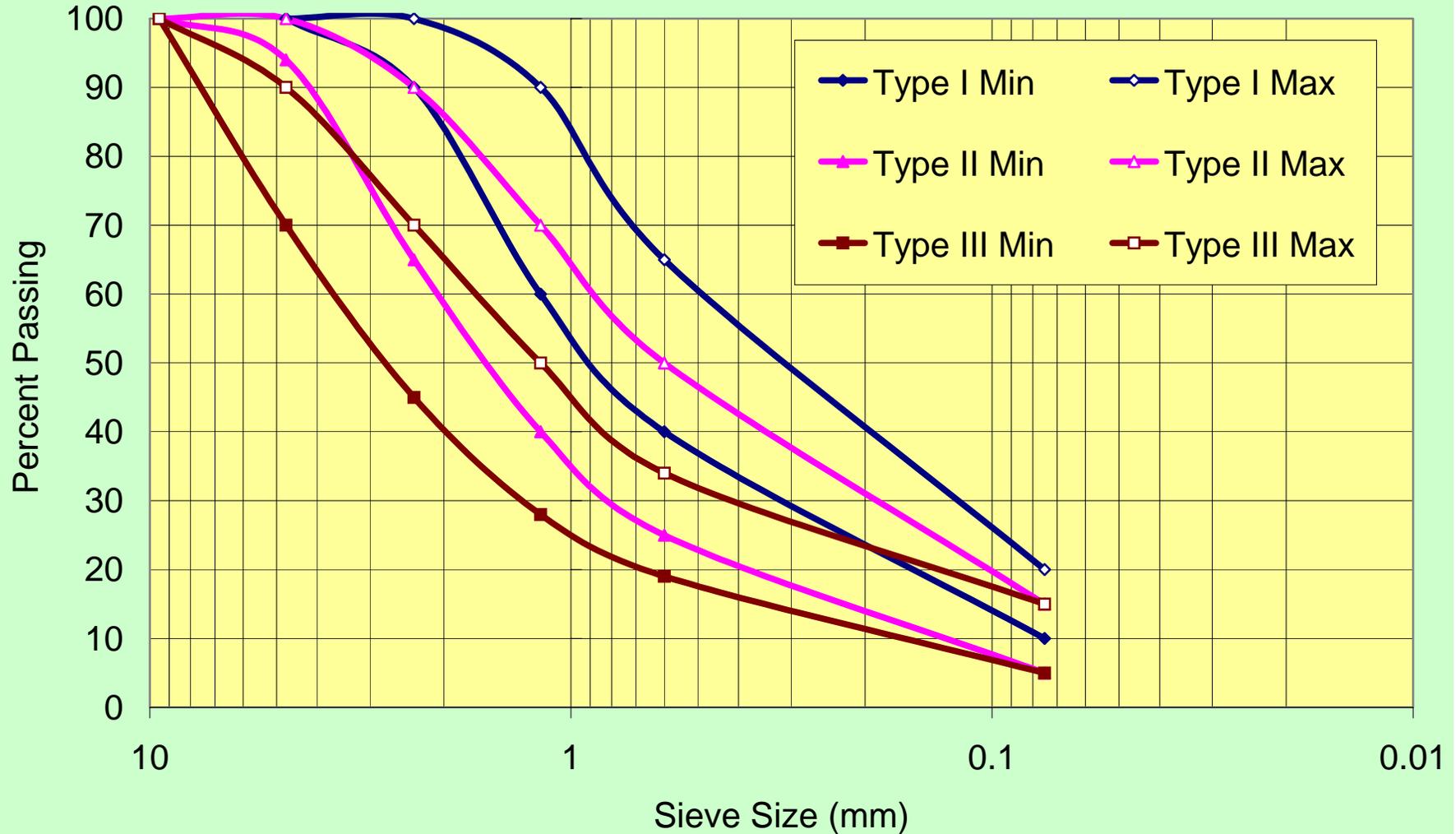
Tests on Emulsion	Typical Specification	Method
Viscosity, SSF @ 25°C, sec	15 – 90	AASHTO T 59
Settlement, 5 days, %	< 5	ASTM D 244
Storage Stability, 1 day, %	< 1	AASHTO T 59
Sieve Test, %	< 0.30	AASHTO T 59
Residue by Evaporation, %	> 62	California Test 331
Tests on Residue from Evaporation Test	Typical 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

NOT USED FOR
MICROSURFACING

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



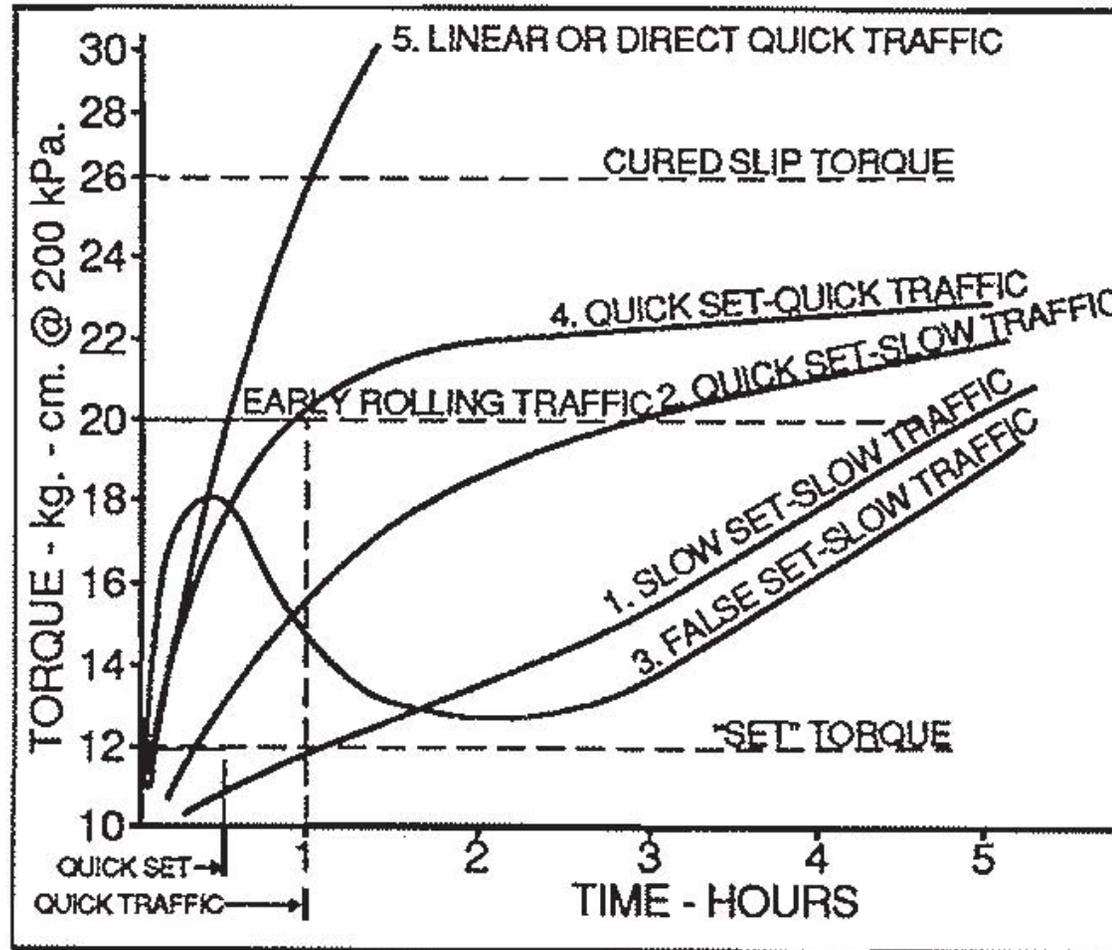
- ISSA TB 102 (Mixing Test)
 - Determine approximate proportions of component materials by trying different “recipes”
 - The amount of time the slurry can be mixed and retain its homogenous consistency is recorded (mixing time)
 - Foaming and coating are visually assessed
 - The test can be performed 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

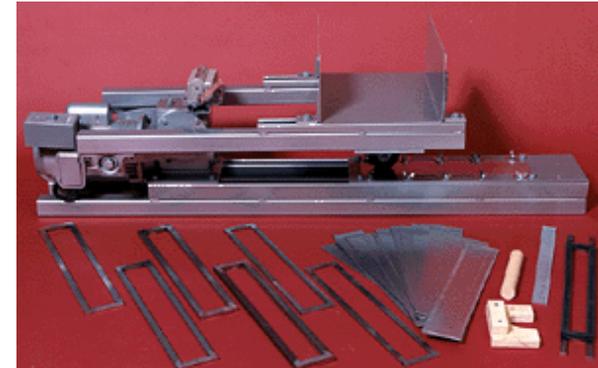
- ISSA TB 100 (Wet Track Abrasion Test)
- Fabricate 3 test specimens:
 1. At selected emulsion content
 2. -2% emulsion content
 3. +2% emulsion content
- Cure specimens for 16 hrs, than soak for 1 hr
- Determine abrasion loss under water
- Plot abrasion loss versus emulsion content



Sand Adhesion

- Fabricate 3 test specimens:

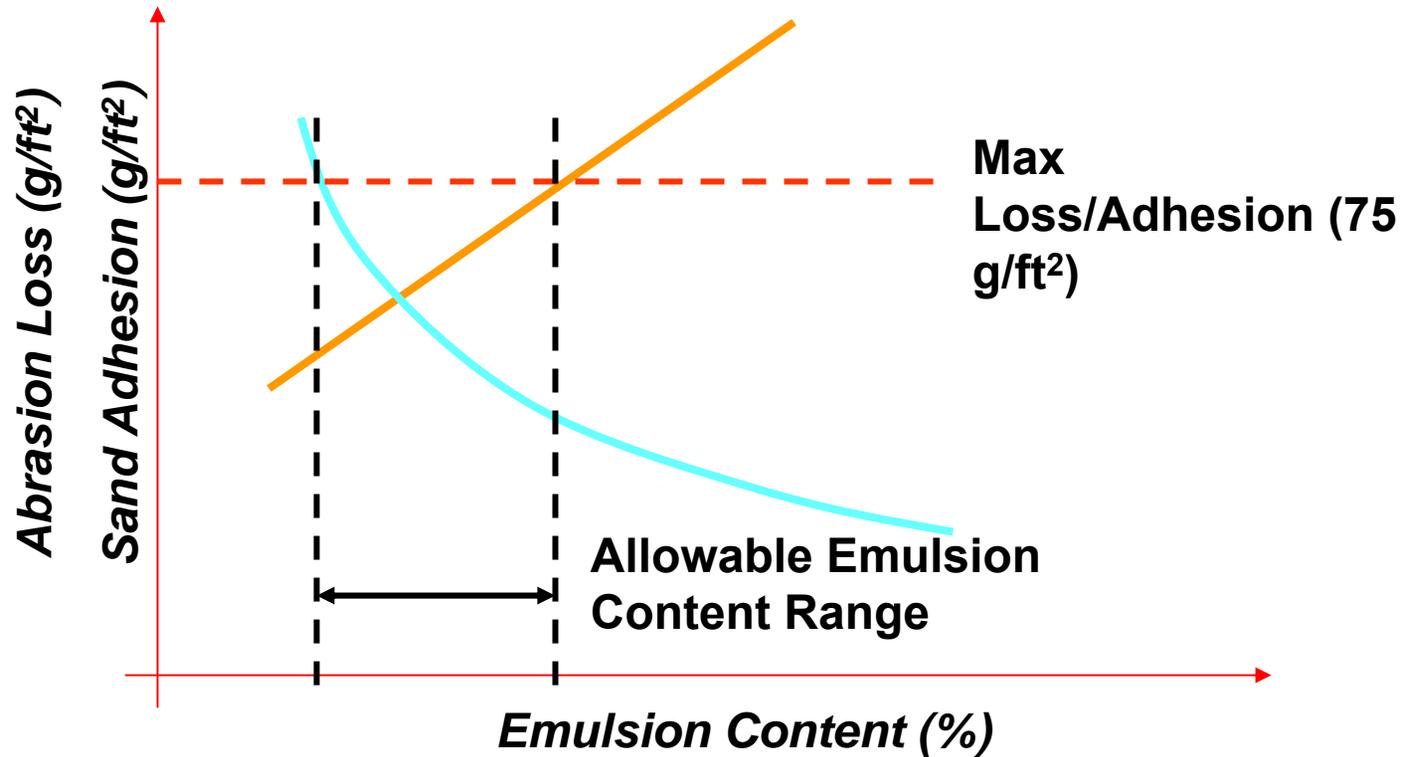
1. At selected emulsion content
2. -2% emulsion content
3. +2% emulsion content



- 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

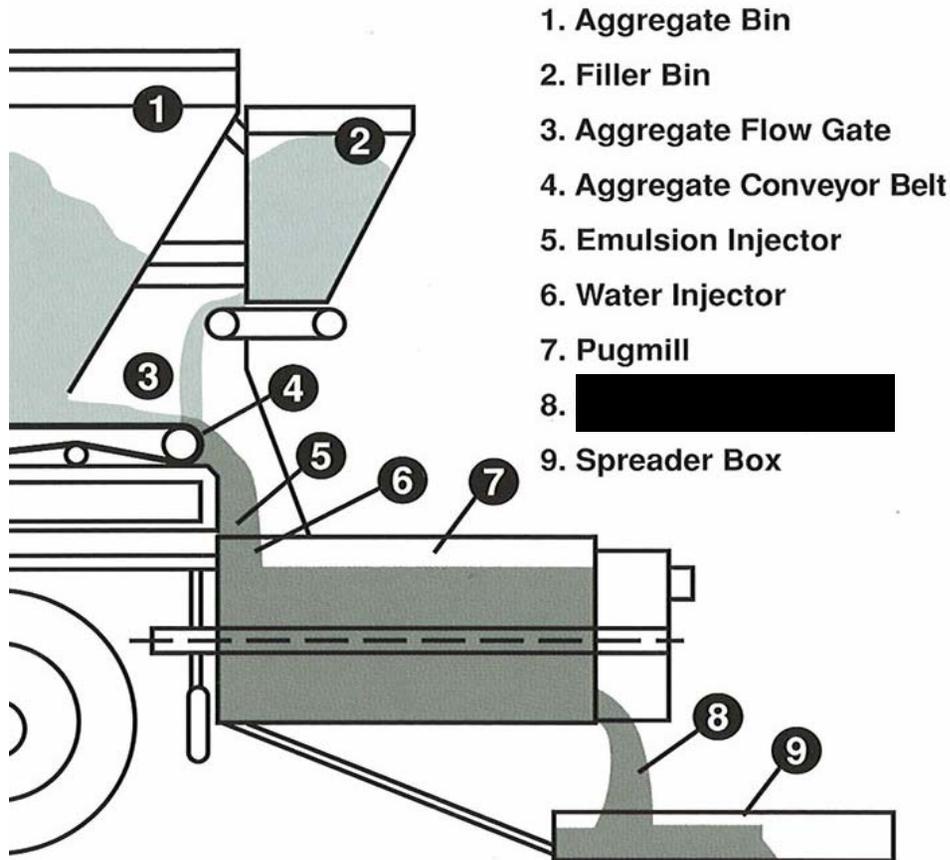
- Ensure that the microsurfacing has had adequate time to cure prior to reopening to traffic - very often drivers assume that the microsurfacing is drivable despite of the warning signs and cause damage to the fresh placed treatment
- Notify the residents and provide information on how to accommodate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

Equipment

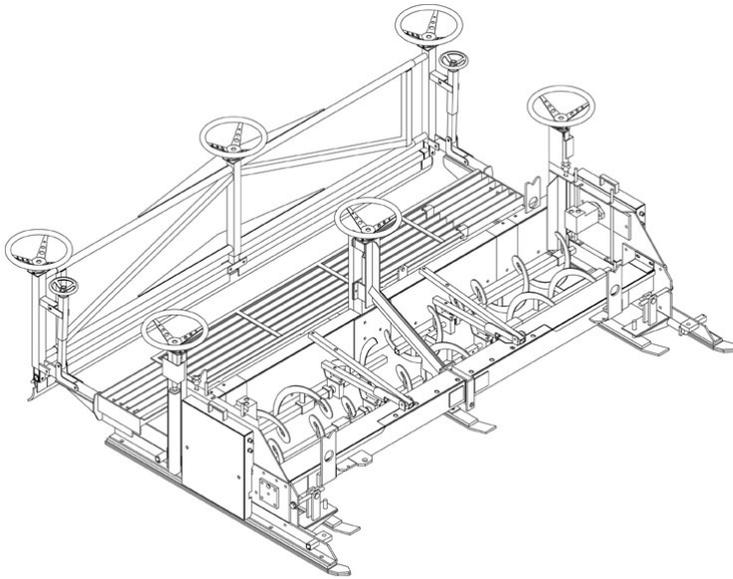


- Requirements similar to those for slurry seal, covered in Caltrans Standard Specification Section 37
- Types:
 - Continuous, self propelled unit
 - Truck-mounted unit
- All equipment should be properly calibrated as per CT 109

Typical Setup

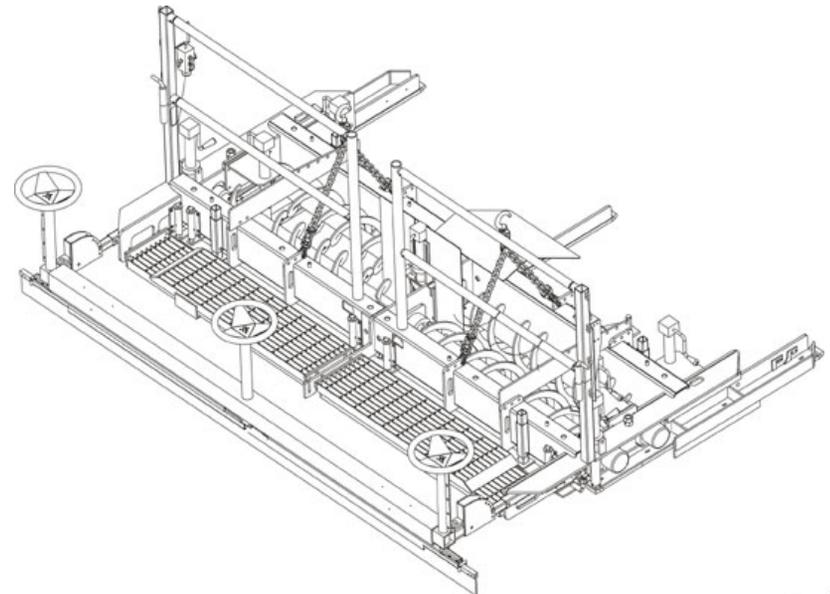


Spreader Boxes for Microsurfacing



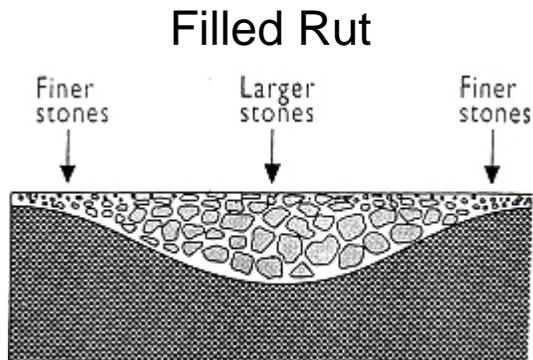
Microsurfacing spreader box with
augers and secondary strike-off

Variable width spreader box for
shoulders and longitudinal joints

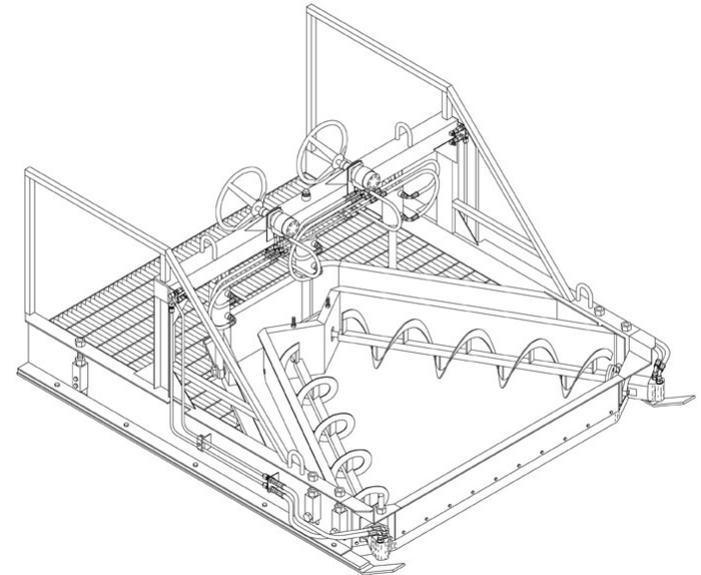


Spreader Boxes for Microsurfacing (Cont'd)

- 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



AFTER

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?