Slurry/Microsurfacing Mix Design Pooled Fund Study

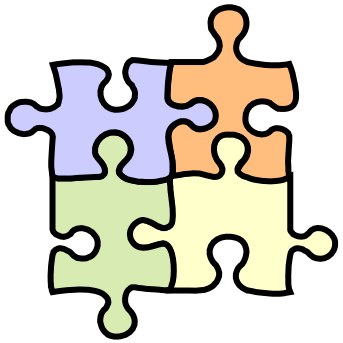
Midwestern Pavement Preservation Partnership

Missoula, Montana
October 23-25, 2007

Caltrans Contract No. 65A0151

Pooled Fund Study Team

- DOT's: Caltrans, Delaware, Georgia, Illinois, Kansas, Maine, Michigan, Minnesota, Missouri, New Hampshire, New York, North Dakota, Texas, Vermont
- FHWA
- ISSA
- Consultants
  - Fugro Consultants
  - MACTEC Engineering and Consulting
  - Consolidated Engineering Laboratories
  - Applied Pavement Technology



Project Objectives

Improve the Performance of Slurry Surfacing Systems through the Development of:

- Rational Mix Design Procedures
- Guidelines for Proper Use and Application of These Systems
- Improved Specifications

Work Plan and Study Approach

- Phase I
  - Review Literature
  - Survey Industry and Agencies
  - Develop Detailed Plans for Phases II and III
- Phase II
  - Develop and Evaluate Mix Design Procedures
- Phase III
  - Conduct Field Validation
  - Develop Guidelines & Specs
  - Develop Training Materials

Phase I – Literature Review

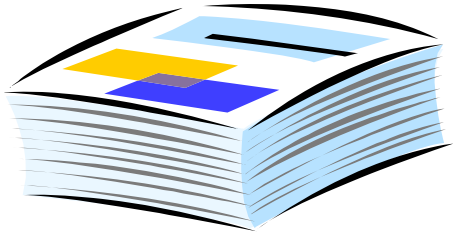
- Extent of Use Worldwide
- Mix Design Procedures and Laboratory Tests
  - ISSA, ASTM, TTI
- Performance of Existing Projects
  - 9 Projects in US and Canada
- Guidelines and Specifications
  - ISSA, Caltrans, TTI, CSIR, Austroads

Phase I - Surveys

- Mix Design Method
- Extent of Use
- Benefits
- Problems
- Life Expectancy
- Tests that Relate to Performance
- Quality Assurance Testing

Phase I - Surveys

- Agencies – 21 Respondents
- Industry – 21 Respondents
- Advisory Panel – 4 Respondents



Findings

- All methods derived from the ISSA Guidelines A 105 and A143
- Extensive experience with the product is needed to ensure the success of a project
- There are concerns with the repeatability of the laboratory tests used in design

Findings (Cont'd)

- Slurry seal and microsurfacing performance data is limited to the first few years after construction
- Failures are generally a result of poor project selection – there is a need to educate users on the proper use of slurry and microsurfacing

Phase I Deliverables

- Phase I Report
- Detailed Work Plan for Phase II
- Detailed Work Plan for Phase III

- Phase I Completed
- Panel Meeting in February 2004

Phase II Activities

- Develop framework for rational mix design procedure
- Evaluate existing and proposed test methods
- Perform ruggedness testing of proposed test methods
- Finalize mix design and develop AASHTO style test protocols
- Make recommendations for a “field test” for slurry and microsurfacing

Philosophy – Mix Properties

- Mixable – components can be mixed, coated and applied through the machine in a continuous fashion
- Workable – the applied mixture sets to a rain-safe condition quickly and cures within a reasonable time to allow return of traffic without causing damage
- Performing – the mixture maintains good friction resistance, does not ravel, de-bond, bleed, exhibit moisture damage, or lose cohesiveness over the life of the treatment

Philosophy – Laboratory Tests

- Repeatable
- Relate to field performance
- Cover the range of temperature and humidity conditions that may occur in the field
- Easy to implement
- Low Cost

Slurry Vs. Micro | S3

- Should there be a distinction?

  In terms of performance, the mix design method should simply show the benefit of one system over the other, e.g.: rut filling capabilities, rapid vs. slow set, etc.

  Constructability issues are the same for both

- Team's recommendation:

  Slurry = Micro = Slurry Surfacing Systems (S3)

Strawman Specification

Set Time	Test or field Condition	Units	Traffic Hi	Traffic Med	Traffic Low	Temperature Hi 35 C	Temperature Med 25 C	Temperature Low 10 C	Humidity Hi 90%	Humidity Normal 50%
Rapid	***PFS-1 (Mixing)***									
	Mixing Torque - maximum	*kg-cm*	9	9	9	9	9	9	9	9
	Mixing time - minimum	*sec.*	120	120	120	120	120	120	120	120
	Spread index - maximum @ 120 sec.	*kg-cm*	12	12	12	12	12	12	12	12
	Blot test - 30 sec.	-	clear water	clear water	N/A	clear water	clear water	clear water	clear water	clear water
	Coating	-	100%	100%	95%	95%	95%	100%	100%	95%
	PFS-2 (Wet Cohesion)									
	30 min. cohesion - minimum	*kg-cm*	12	12	12	12	12	12	12	12
	60 min. cohesion - minimum	*kg-cm*	23	20	20	20	20	20	20	20
	90 min. cohesion - minimum	*kg-cm*	25	25	25	25	25	25	25	25
	12 hr. cohesion - minimum	*kg-cm*	28	28	28	28	28	28	28	28
	PFS-3 (Abrasion Loss)									
	30 min. loss - maximum	g/m^2	200	200	400	300	300	300	300	300
	1hr. loss - maximum	g/m^2	100	100	300	100	200	100	100	200
	3 hr. loss - maximum	g/m^2	100	100	200	100	100	100	100	100
Slow	***PFS-1 (Mixing)***									
	Mixing Torque - maximum	*kg-cm*	9	9	9	9	9	9	9	9
	Mixing time - minimum	*sec.*	120	120	120	120	120	120	120	120
	Spread index - maximum @ 120 sec.	*kg-cm*	12	12	12	12	12	12	12	12
	Blot test - 30 sec.	-	clear water	clear water	N/A	clear water	clear water	clear water	clear water	clear water
	Coating	-	100%	100%	95%	95%	95%	100%	100%	95%
	PFS-2 (Wet Cohesion)									
	30 min. cohesion - minimum	*kg-cm*	12	12	12	12	12	12	12	12
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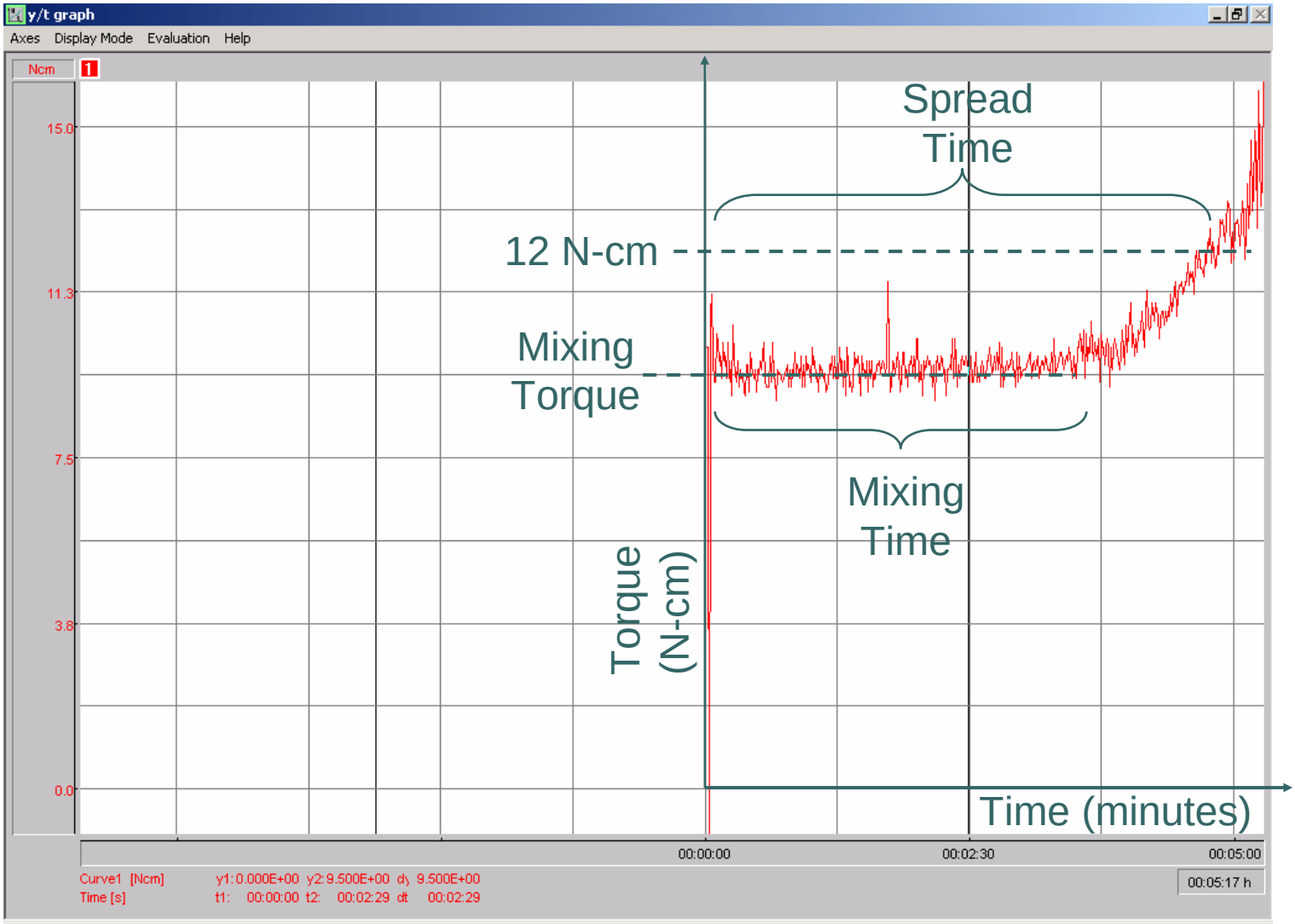
	3 hr. loss - maximum	g/m^2	100	100	200	100	100	100	100	100

Summary of Proposed Major Changes

CURRENT	PROPOSED
ISSA TB 113 – Trial Mix Procedure for Slurry Seal Design	Automated Mixing Test (AMT)
ISSA TB 100 – Test Method for Wet Track Abrasion of Slurry Surfaces (WTAT)	Cohesion-Abrasion Test (CAT)
ISSA TB 139 – The Modified Cohesion Tester	Automated Cohesion Test (ACT)
Tests run at standard laboratory temperature and humidity conditions	Tests run over a range of temperature and humidity conditions

Automated Mixing Test (AMT)

AMT Results

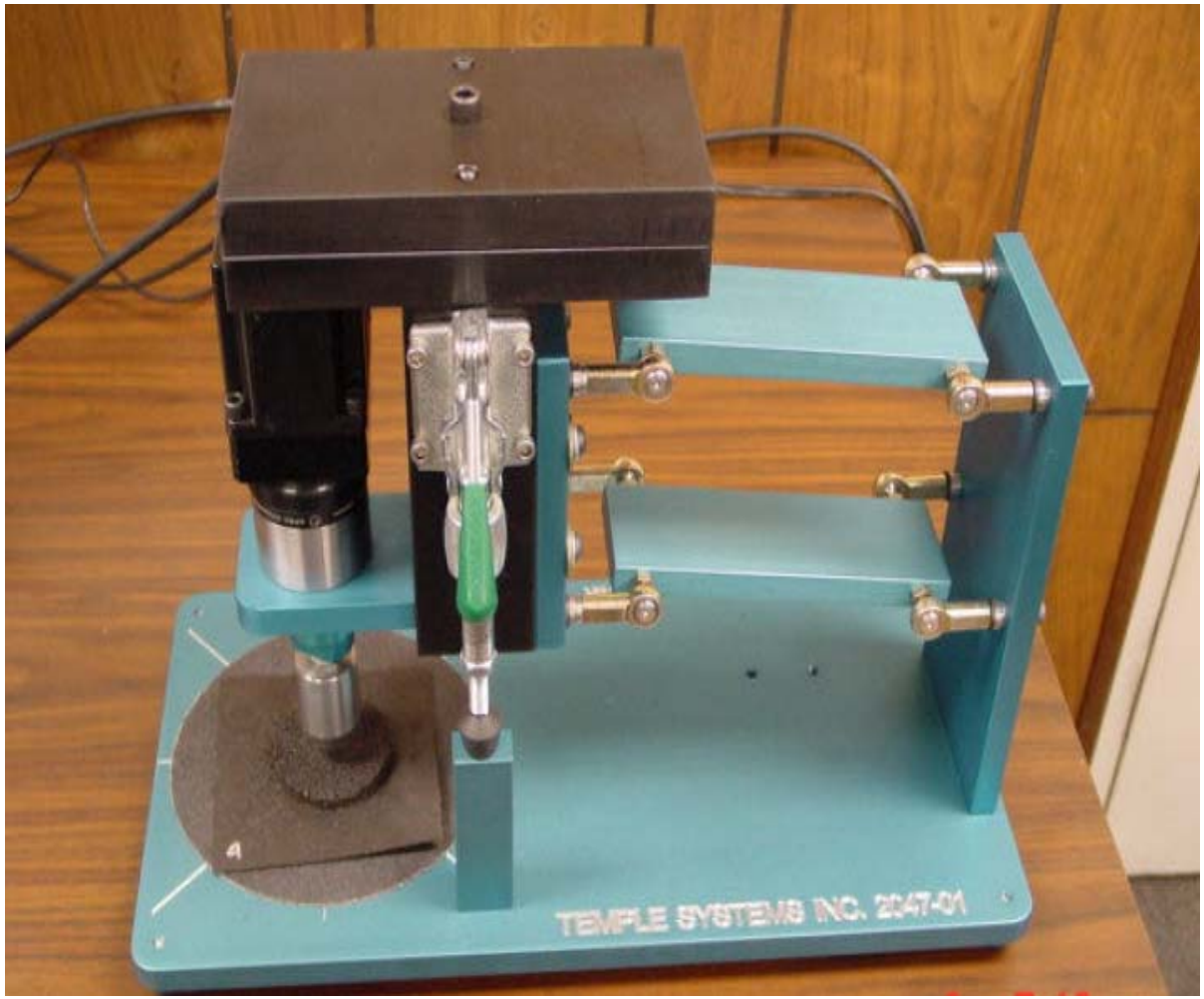

y/t graph
Axes
Display Mode
Evaluation
Help
Ncm
15.0
11.3
7.5
3.8
0.0
Spread Time
12 N-cm
Mixing Torque
Mixing Time
Torque (N-cm)
Time (minutes)
00:00:00
00:02:30
00:05:00
Curve1 [Ncm]
Time [s]
y1: 0.000E+00 y2: 9.500E+00 dy 9.500E+00
t1: 00:00:00 t2: 00:02:29 dt 00:02:29
00:05:17 h

Cohesion-Abrasion Test (CAT)

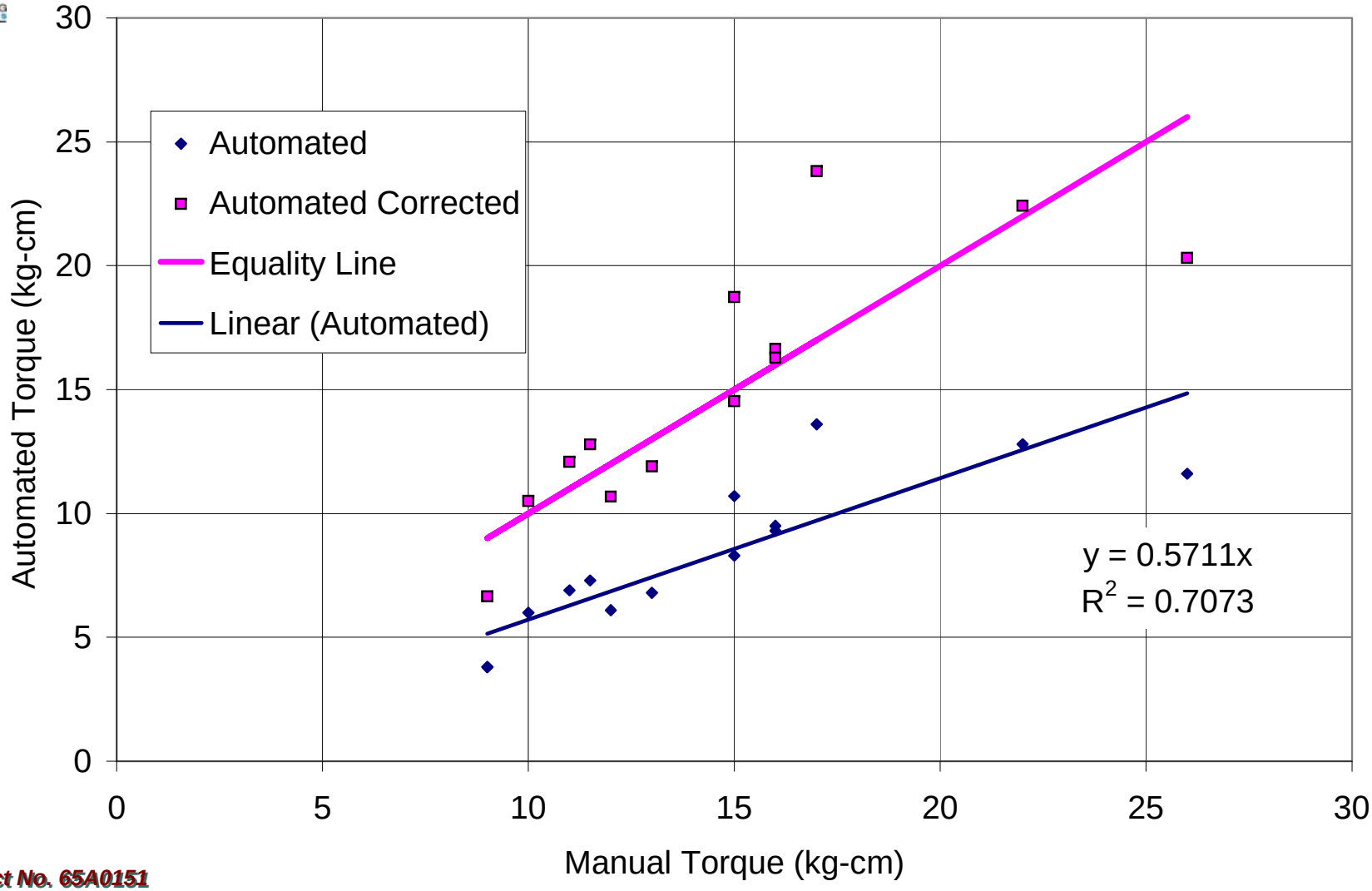
CAT Evaluation

- 300 tests on 5 slurry surfacing systems at 3 temperatures and 2 humidity levels; with and without compaction; with and without conditioning (soaking + oven cure)
- Major findings:
  - Compaction does not influence the results
  - Temperature, Humidity and Curing Time are affecting the abrasion resistance of non-soaked specimens and predictive models can be developed to estimate these effects

Automated Cohesion Tester (ACT)



ACT Comparison with Modified Cohesion Tester



Field Test for Micro/Slurry

- Purpose:
  - Correlate with long term performance
  - Evaluate uniformity and conformance with mix design
  - Evaluate readiness for opening to traffic
- Approach
  - Literature Review / Select Candidate Test Methods
  - Limited Experimental Study
  - Recommendations for Future

Candidate Field Tests

- Field Cohesion Test (traffic time)
- Field Abrasion Test (performance)
- GeoGauge (traffic time)
- Infrared Camera (traffic time, uniformity)
- In Situ Shear Tester (performance)

Phase II Deliverables/Progress

- Recommended Mix Design / Strawman V.3 available
- Evaluation of promising test methods / AMT, CAT completed, ACT in progress
- Ruggedness testing / in progress
- New and Revised test methods in AASHTO format / AMT, CAT completed, ACT in progress
- Recommended Field Tests for QA purposes / in progress

Phase III – Pilot Projects

- Identify Test Sections
  - Develop Site Selection Guidelines
  - Develop Test Section Layout
    - Control / Preferred / New (S3)
- Develop Construction Guidelines
  - Pre-construction
  - Construction
  - Post-Construction

Phase III – Training

- 1.5-Day Training Course
  - Reference Manual
  - Visual Aids
  - Instructors Guide
  - Hands-On Workshops:
    - Use of laboratory test equipment
    - Test learning using game-style Q&A
- Pre-Job Training Module
  - Pocket Guide
  - “Tailgate” Session

Phase III - Deliverables

- Training – 95% Completed
- Guidelines – 90% Completed
- Pilot Projects/Field Validation – Will be completed by Fall of 2008

Thank you

- For more info:

  www.dot.ca.gov/newtech/maintenance/slurry_micro-surface/slurry_micro-surface.htm