UDOT's Experience with Cold In Place Recycle







Why Cold in Place Recycle?

- 1) Cost: can yield significant savings.
- Environmental: Reuse of existing materials, less impact on pit and oil sources. Less impact from hot plant emissions.

What is Cold in Place Recyling







Crushing and Processing



Paving



Compaction



Utah's History

There were four projects done with the medium set solvent based emulsions all of which were in Region 4.

In 2007 we made the change to engineered solventless emulsions.

Why the Change to Solventless Emulsions

- Curing times, reduced from Days to Hours. Allows for faster restoration of traffic. On average we've seen a 3 to 4 hour timeframe.
- 2) Environmental, less VOC. Sooner then later this will impact the solvent based emulsions.

Projects Done with Solventless Cold in Place Recycle

No projects in Region 1

Two projects in Region 2

Five projects in Region 3

Fourteen projects in Region 4

Projects



Monticello US-491, Seven Years after Paving 3 inches HMA over CIR



Bluff SR-191 One Year after Paving Chip Seal over CIR

Projects



SR 32 Marion

US 40 Strawberry

Projects



I-15 Blackridge

Issues with Solventless Specification

1) Proprietary aspects of Specification

- a) Defining emulsion difficult as it was a proprietary product.
- b) Mix Design also had proprietary issues.

This led to some projects that did not work as well as most we had experienced.

How to Solve the Specification Problem

In 2010 UDOT petitioned for and received permission from FHWA to utilize a sole source specification approach.

Region 4 developed a special provision that targeted a medium set solventless emulsion and was not sole source.

How to Solve Continued

Research Projects were funded to determine:

Phase I: Measureable Lab Properties of Mix.

Phase II: Performance based tests to gauge field stability and release to traffic.

Phase III: Mix Design.

What We've Learned: Phase I

Determining Measurable Properties of a Mix on Samples from the field:

Compaction of samples 2 to 3 hours after sampling results in consistent and maximum stability values.

Marshall stability run 8 hours after compaction.

4.5% Moisture content yields best stability.

There is an acceptable compactive effort of 30 gyrations with the Superpave Gyratory.

What We've Learned: Phase II

The goal for this phase was to evaluate different field test methods to determine if we could find a way to test when the finished product would be able to accept traffic without rutting or ravelling.



Modified Shear Vane Test Worked Well. Predicted stability for traffic at 15 ft-lbs.



DCP also proved reliable for establishing opening to traffic conditions; 12 mm/blow.

Field Ravelling test did not work as expected in providing useful guidance.



What We've Learned: Phase III

The goal of Phase III was to evaluate the mix design process and try to find established AASHTO and ASTM tests that would contribute towards developing a mix design that correlates with what actually happens during construction. Creating a mix that meets the project needs for traffic release as well as long term durability. The Questions/Goals:

- Evaluate time and temperature impacts on the mix reaching desired stability yet preserving acceptable durability characteristics.
- 2) Evaluate impacts of gradation on density and optimum emulsion content.
- Evaluate Density and its effects on emulsion content, stability, cracking potential, and permeability.
- 4) Evaluation of appropriate adjustment rates of emulsion in the field.

Tests Evaluated:

- Modified Proctor: Used to evaluate moisture content impact. Assumption that material is unbound prior to emulsion setting.
- 2) Modified Marshall Stability: Evaluate Strength.
- 3) Superpave Gyratory: Evaluate compactibility at different temperatures.
- 4) Semi-circular Bending Test: Cracking susceptibility.
- 5) Cone Penetration: Measure emulsion cure rate.



Semi-Circular Bending Configuration

Forced Cone Penetration







Completed Sample

Cone

Test Underway

Conclusions

- Superpave Gyratory samples can be used to measure temperature and gradation sensitivity. Can use that information to set target densities and emulsions at varying temperatures. Field testing can then be used to adjust emulsion percent.
- 2) The Cone test can be used to determine demulsification rates in advance.

- 3) Modified proctor can help determine desirable moisture contents.
- 4) Semi-circular Bending Test: More evaluation needed.

A draft specification has been written based on what the research has yielded. We hope to try it on a project as one becomes available. Evaluate how well it works and define further needs.

Will propose additional funding for more research to further address issues that weren't completed with previous research and come up in trial of the new special.

