Maine’s Experience Utilizing Full Depth Reclamation with Foamed Asphalt

NESMEA 2004
Portsmouth, NH
History of FDR in Maine

- Late ’80s: 2 projects stabilized with emulsion
- 1990s: Numerous projects, most not stabilized
- 2000: Experimental project comparing four methods – Emulsion, Emulsion + Lime, Cement and untreated control section
Results of Study

- Emulsion w/Lime showed greatest strength gain, lowest life-cycle cost
- Follow-up lab study showed similar benefit from Emulsion w/Cement
- Decision made to stabilize majority of FDR projects
Foamed Asphalt

- MDOT was interested in trying foam stabilization
- In spring of 2001, Wirtgen assisted us in advertising a pilot project
- Loudon Associates and WPI performed onsite evaluation and mix design
- Project advertised later that spring
Why the interest in Foam Stabilization?

- Uses PG binder, less expensive than emulsified asphalt
- Emulsion contains 30 percent water, requires curing period (7-10 days)
- Process had been used successfully elsewhere
How does Foamed Asphalt work?

Diagram showing the process:
- Hot bitumen
- WATER
- AIR
Typical candidate
Typical candidate
Typical candidate
Test Pit Evaluation
Collecting Pavement and granular material samples
Crushing Specimens
Samples now obtained with milling attachment
Sieve Analysis

Need > 5%
Minus #200
Moisture-Density Relationship
Lab Foam Plant
Testing the Binder
Foaming Characteristics

- Expansion
- Half-life
Determining Foam Water

Water addition (% by mass of bitumen)

Expansion Ratio (times)

Half-Life (seconds)

Bitumen Temperature 175°C
What if you don’t get good foaming?

- Increase binder temperature
- Change binder source
- Change binder grade
Mix Design specimens

- Blend crushed pavement and granular material at specified ratio
- Add other materials required (cement or lime, crusher dust)
- Add moisture
- Mix specimens at several binder contents
Additives

- Most designs contain portland cement
- Recommendation is 1 to 1-1/2 % max
- Used to prevent moisture damage and aid in dispersion of the foamed asphalt
Compacting specimens

- Wirtgen design method uses Marshall compaction
- New procedure uses gyratory compactor
- 100 mm specimens recommended to reduce material needed
Curing

- 40 degrees C
- 72 hours
Testing of specimens

- Indirect tensile strength (dry)
- Indirect tensile strength (soaked)
Criteria for selecting binder content

- Maximum soaked tensile strength
- Dry tensile strength > 200 kPa
- Wet tensile strength > 100 kPa
- Retained tensile strength > 50%
Typical Mix Design

Foamed Asphalt vs. ITS dry

Foamed Asphalt Content
Typical Mix Design

Foamed Asphalt vs. ITS wet

Foamed Asphalt Content
Typical Mix Design

Foamed Asphalt vs. ITS

Foamed Asphalt Content

1.5% 2.0% 2.5% 3.0% 3.5% 4.0%

ITS WET  ITS DRY
Typical Mix Design

Foamed Asphalt vs. ITS Retained

Foamed Asphalt Content

- 94%
- 95%
- 96%
- 97%
- 98%
- 99%
- 100%
- 101%
- 102%

- 1.5%
- 2.0%
- 2.5%
- 3.0%
- 3.5%
- 4.0%
Construction Issues

- Need proper equipment
- Need trained operator and ground person
- Proper compaction is critical
Foam Recycler
Injection of foamed asphalt and water
Control panel
Foam test nozzle
Manually applying cement
Spreading cement
One type of spreader
Most commonly used now
Note

- Roadway has been pulverized prior to foam stabilization
- Typical treatment depth is 6”
Behind the train
Checking consistency
Compaction
Padfoot roller
Cutting to grade
Smooth drum roller
Sealing the surface
Tight, “well-knit” surface
Compaction testing
Compaction specification

- Based on test strip density
- Roll with padfoot until roller “walks” out of mat
- After grading, make passes with soil compactor until no increase for 4 passes
- Take 5 random compaction tests
- Throw out high, low, average other 3
- Must meet 98% of this for Acceptance
Finished product
With HMA layers applied
Cores
Problems
Potholing
Padfoot marks??
Things to monitor during construction

- Proper recycling depth
- Quantities of asphalt and cement
- Asphalt temperature
- Nozzles working?
- Asphalt foaming at test nozzle?
- Recycler speed
- Compaction
Results

- Lab specimens and FWD data show an estimated layer coefficient of 0.22 – 0.24
- Most projects have been very successful
- Specifications revised to include QC tests and seasonal limitations
- Price: $6.25 - $8.75 /square meter
- MDOT will use foamed asphalt as primary means of FDR stabilization