Foamed-Asphalt Base Stabilization: A Review of Alaska's Experience

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Asphalt Pavement Summit
Anchorage, 03-Dec-07

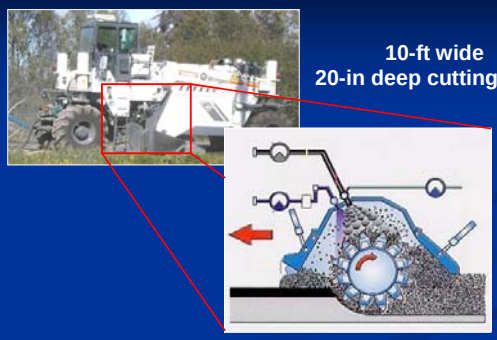
Stabilized Base Course Policy

- Bound stabilized bases, containing:
  - Asphalt cement (ATB)
  - Emulsion asphalt (EATB)
  - Lime (LTB)
  - Portland cement (CTB)
  - Mixture of RAP & base course material
  - Foamed-asphalt cement (FASB) using *Full Depth Reclamation* (FDR)

The Reclaimer

WIRTGEN (WR2500), CMI, Caterpillar Paving

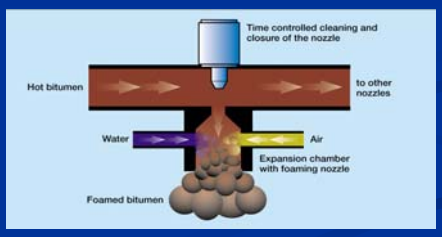
The Drum



10-ft wide
20-in deep cutting rotor

Expansion Chamber

- Cold water & air are injected simultaneously into the hot asphalt
- Hot asphalt foams explosively & shoots down into the mixing chamber



Foaming process

- The asphalt expands up to 15 times its original volume

- Foaming increases the asphalt surface area:
  - reduces asphalt viscosity
  - mixes well and binds fine aggregates

- Asphalt: 2.5% - 3.5% (> 160C = 320F)

- Water: 2.0% - 2.5% by weight of asphalt

- 6% - 20% Fines (P200):
  proper dispersion of the foamed asphalt

One Pass Operation

In one pass of the reclaimer, the following is achieved:

- Pulverizes the old asphalt wearing course and part of the base course (typical depth 5” to 10”)

- Injects foamed asphalt (asphalt & water) : 2% - 4%

- Lays down the product ready to be spread, shaped, graded and compacted; wearing course added

- Portland Cement spreading on the existing wearing course before starting the pulverization

Some AK Foamed-Asphalt Projects

- East and West Hill Roads – Homer (AK Road Builders, 2002)
- St. Paul Airport (QAP, 2002)
- Red Dog Zinc Mine (Knik Const. Co., 2002)
- Parks Hwy MP 325-351 (Wilder, 2005)
- St. George Airport (QAP, 2005)
- Kalinfornsky Beach Rd MP 4.3-11 (QAP, 2006)
- Seward Hwy MP 0-8 (QAP, 2006)
- Seward Hwy MP 37-43 (QAP, 2007)

Homer
East Hill & West Hill Roads

West Hill & East Hill Roads - Homer

- Central Region, Alaska RoadBuilders, 2002
- Extensive moisture damage in the sub layers

East Hill & West Hill Roads - Homer

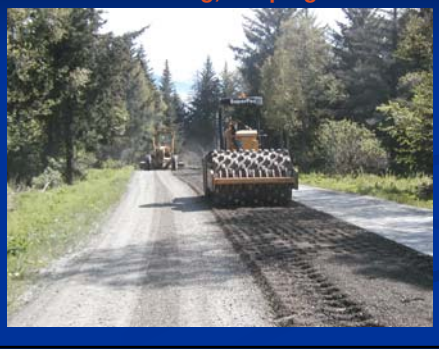
- Existing 2” HMA + 4” base course
- P_{200} = 5%
- Cement = 1%
- Mix Design
- West Hill Road: 3.0% ± 0.3% foamed asphalt
- East Hill Road: 2.5% ± 0.3%

The Train

Pad-foot compaction

Foamed-Asphalt Base Material

Pad-foot Compaction
Then
Grading, Shaping

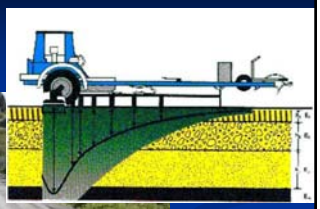


Watering
and
Steel Drum Compaction

FASBC covered with HMA

Before & After

FWD Evaluation



FASBC Modulus = E = 110 ksi

Red Dog Zinc Mine - Tech Cominco
Knik Construction Co. , 2002

- Haul truck: 240 ton ~ 480k lbs, 11 axles
- 33 trucks/day; 105 psi tire pressure
- Traffic volume: 27M ESALs over a 10-year design period

Red Dog Mine – Existing Embankment

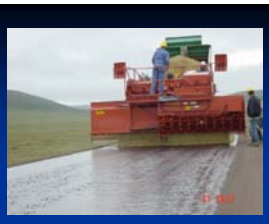
12” (1/2 – 2” size rock) ; 7” left

12” (4 – 6” size rock)

24” (12 – 15” size rock)

36” (20 – 24” size rock)

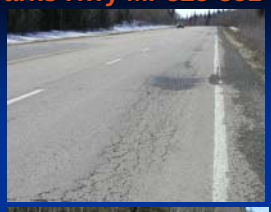

- 5-in crushed rock added
- Stabilization depth: 10”
- 3.0% ± 0.3% foamed asphalt
- AC-2.5 at 330ºF
- 2.5% water


Parks Hwy MP325-351 Rehab

- Northern Region, Wilder, 2005
- FASBC (318) = 6”
- Wearing course = 4” HMA in 2 lifts
- FASBC Mix design:
  - Asphalt (PG52-28) = 3%
  - Water = 2.5%
  - Cement = 1%

Prior to Rehab - Parks Hwy MP325-351

Cement Spreading - Parks MP325-351

The Train - Parks Hwy MP325-351 Rehab

Initial Compaction – Parks MP325-351

Watering, Grading & Shaping
Parks Hwy MP325-351

Intermediate Roller – Parks MP325-351

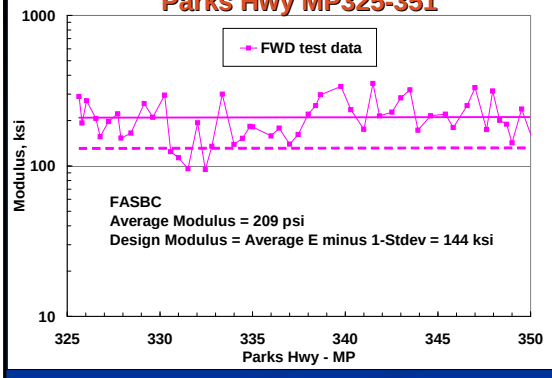
Finish Roller – Parks MP325-351

Parks Hwy MP325-351 Rehab

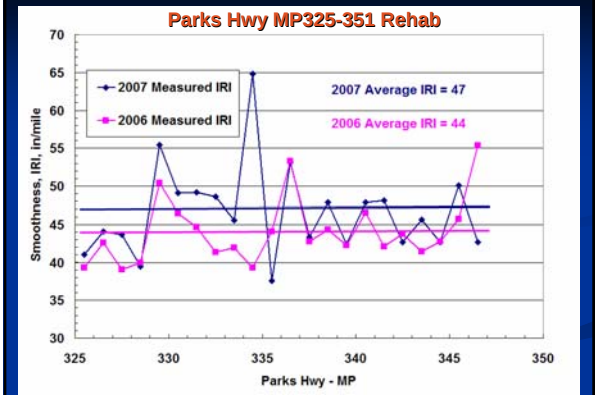
Finished FASBC:

- Sat for > 3-days before paving
- Performed well under traffic & rain: no potholes
- Generated low dust
- Cost: ~$4.3M for 25 miles >>> $170k/mile

Parks Hwy MP325-351



Parks Hwy MP325-351 Rehab



Seward Hwy MP 37-43
Pavement Refurbishment

- Central Region, QAP, 2007
- FASBC (318) = 5" ; 140k sq.yd.
- Wearing course = 3.5" HMA in 2 lifts
- FASBC Mix design:
  - 50/50 mix, existing HMA/Base course
  - Asphalt (PG52-28) = 2%
  - Water = 3%
  - Cement = 1%

The Train

Loose Foamed-Asphalt Base Material
Seward Hwy MP 37-43

Seward Hwy MP 37-43

Seward Hwy MP 37-43

HMA paving - Seward Hwy MP 37-43

3.5” HMA
over
5” FASBC

Common Features to Foamed-asphalt Projects

1- Mix Design:

WLB 10 Foamed Asphalt Plant

Laboratory-scale foamed asphalt production unit to simulate the foamed asphalt produced in the field

Indirect Tension Test

1- Mix Design:

Common Features to Foamed-asphalt Projects

2- Technical Representative

3- Test Strip: to validate the mix design, equip't performance, compaction pattern

3- Weather Limitation: Temp. > 40F

4- Compactors:
- Vibratory Pad-foot roller
- Vibratory Steel drum roller
- Pneumatic roller

Conclusions - Lessons Learned

- Foamed-Asphalt technology is a cost-effective stabilizing method
- Increases the strength of base course and pavement
- Reduces water infiltration into subbase
- Reduces freeze-thaw cycling effects
- Cost of foaming:
  Initially ~ $10/sq.yd.
  Lately ~ $7.5/sq.yd.

Useful References & Websites

- Foamed-Asphalt related:
https://www.wirtgenamerica.com/fa/index.html

- Recycling related:
http://www.arra.org/content/view/40/25/
http://www.martec.ca/

- ADOT&PF Newsletter – Summer 2002
http://www.dot.state.ak.us/stwddes/research/assets/pdf/02v27n2.pdf

- Wirtgen Cold Recycling Manual
2004, 2nd Edition, isbn: 3-936215-05-7

Parks Hwy MP 325-351
After foaming - Oct.2005 Blisters

Parks Hwy MP 325-351
After foaming - Oct.2005 Blisters
Cross-sectional view of affected area

Parks Hwy MP 325-351
After foaming - Oct.2005 Blisters

Field-cut samples at the office, Nov.2005

Parks Hwy MP 325-351

Traces of Salt on the roadway surface

Parks Hwy MP 325-351

Marking the affected areas, Jun. '06

Parks Hwy MP 325-351

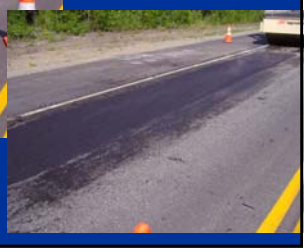
Milling the affected areas

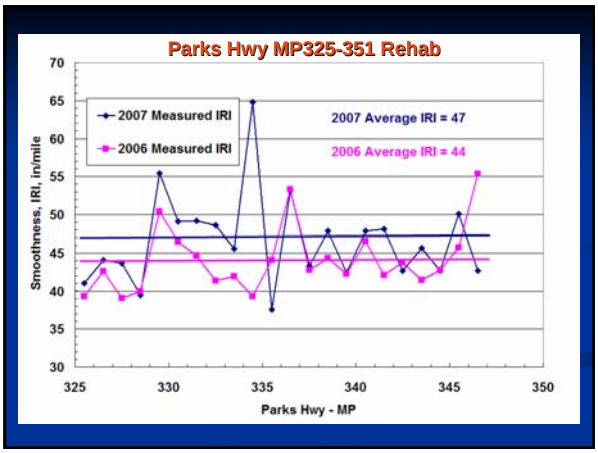
Parks Hwy MP 325-351

Filling milled areas with HMA

Parks Hwy MP 325-351

HMA Compaction




Parks Hwy MP325-351 Rehab
2007 Measured IRI
2006 Measured IRI
2007 Average IRI = 47
2006 Average IRI = 44
Smoothness, IRI, in/mile
Parks Hwy - MP
70
65
60
55
50
45
40
35
30
325
330
335
340
345
350