Reducing Traffic Noise with Quieter AC Pavements

By
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Reducing Traffic Noise with Quieter AC Pavements

- What’s the interest in quieter pavements?
- What examples are there of quieter pavement applications?
- What makes pavement quieter?
- How long does pavement stay quieter?
- How does performance vary?
Drivers of Quiet Pavement Interest

• Public concern over noise from freeways

• Extensive use of sound walls for noise abatement – 1800 km in US
- $2+ million per mile
- Can not be used everywhere
- Limits future highway expansion
- Not necessarily effective
- Blocks views
ADOT Application of Quieter Pavement

Original Uniform Transverse Tine

1” Rubberized AC Overlay

79 dBA

70 dBA
Interest in Quiet Pavement

Questions:
• Does it Last?
• Does it work for a traffic mix?
I-80 Pavement Project

Location: I-80 just east of Davis and west of Sacramento, CA

Traffic: 140,000 ADT (*almost 10% trucks*)

- **Existing** - Aged DGAC surfacing
- **Quiet Overlay** - Applied OGAC in July 1998
Measurements & Environment

Distant Microphone Locations at 140m

Reference Microphone Locations at 20m
Old Asphalt Surface

78.6 dB

New Quieter Overlay

Initial Reduction

6.4 dB

72.2 dB
On-Board Sound Intensity Measurement

- Measure of propagating energy from tire
- Rejects flow noise
- Directional
- Isolates tire/road noise
- Vehicle adaptability
- AASHTO, SAE, ASTM Standards

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OBSI Measurements

Windscreen
ADOT/FHWA

Arizona Quiet Pavement Pilot Project

- 185 km of freeway overlaid with ARFC
- FHWA allowed 4 dB “credit” for pavement
- Long term research project to measure performance over 10 years

Measurements
1. On-board measurements at each milepost
2. Wayside time average measurements
Pre & Post Overlay – Site 3D

ARFC Overlay (25mm Thick)

Random Transverse Tined PCC
I-280 in San Mateo County, CA
New & Existing Pavements on I-280
I-280 in San Mateo County, California

1 to 2 dB Quieter
(Ground)

6 dB Quieter
RAC(O)
Las Vegas I-515 ROGFC Overlay
Las Vegas I-515 Pre & Post Levels

Original PCC | New ROGFC

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Overall OBSI Level, dBA

11.7 dB Reduction
Pre & Post Rehabilitation Project
6½ dB
Reduction
(OBSI)
5½ dB Reduction In Backyards
On the Road in Europe

Noise Intensity Testing in Europe:
The NITE Study
The NITE Project

Scope
- First definitive comparison of European & US pavement
- 4 countries, 68 pavements
- Compliment to the AASHTO/FHWA Scan

Objectives
- Measure the quietest pavement of all types
- Measure the range of pavements in use
European Pavements at 97 km/h

Sound Intensity Level, dBA

- PA
- PCC
- DGA
- DLPA
- SMA
Comparison of Quietest Pavements

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- DLPA 2/6
- DLPA 4/8
- PA 4/8
- PCC (P/G)
- LA 138 OGAC
- LA 138 RAC
- ARFC

- Europe: various Pavements
- California: various Pavements
- Arizona: various Pavements
What Makes AC Pavements Quieter?

- Smaller aggregate size
  - Less displacement input to the tire
  - Other surface characteristics also important
Coarse & Fine SMA Surfaces

8/10mm – 105.7 dBA

0.8/1.5mm – 99.7 dBA
Extreme Surfaces – Chip Seals

Replica of California Pavement

104.8 dB

California SR 84

105.0 dB
Extreme Surfaces – Fine Texture

“Ultra-Smooth” Test Track Pavement

94.6 dB

95.7 dB

Caltrans Test Track
What Makes AC Pavements Quieter?

- Smaller aggregate size
  - Less displacement input to the tire
  - Other surface characteristics also important

- Porosity
  - Sound absorption in the pavement
  - Reduction of some tire noise mechanisms
Porous & Non-Porous AC Surfaces

0/10mm Dense Grade – 101.3 dBA

0/10mm Porous – 98.5 dBA
Propagation of Tire Noise over Absorptive Pavement

Potential: ~3 dB Reduction
Typical 2-Layer Porous Asphalt
the Netherlands

Small Aggregate Size

Coarse Aggregate Size
Double Porous Layer Asphalt Surfaces of Varying Aggregate Size

![Graph showing sound intensity levels for different DLPA aggregate sizes.](image-url)
What Makes AC Pavements Quieter?

- Smaller aggregate size
  - Less displacement input to the tire
  - Other surface characteristics also important

- Porosity
  - Sound absorption in the pavement
  - Reduction of some tire noise mechanisms

- Added rubber content
Rubber & Non-Rubber OGAC of Similar Aggregate Size/Gradation

OGAC – 98.0 dBA

Rubberized OGAC – 97.1 dBA
What Makes AC Pavements Quieter?

- Smaller aggregate size
  - Less displacement input to the tire
  - Other surface characteristics also important
- Porosity
  - Sound absorption in the pavement
  - Reduction of some tire noise mechanisms
- Added rubber content
- Surface compliance?
Issues

➢ Acoustic Longevity
➢ Variation in pavement performance
Caltrans LA 138 AC Research Sites

2½ to 3 dB in 6 Years
Sacramento I-5 RAC(O) Overlay
I-5 Sac RAC(O) Performance over Time

Overall Sound Intensity Level, dBA

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I-80 Davis Long-Term Performance

Traffic Noise Level, dBA

~ 2 dB in 10 years
San Mateo I-280 Performance

Overall Sound Intensity Level, dBA

- SB OGAC Shoulder
- SB RAC(0) Travel Lane
- NB RAC(0) Travel Lane

Comparison between 2002 and 2005.
Performance of AZ ARFC over Time

Site 3D

Traffic Noise Level, dBA

Pre-Overlay 1 Year 1.5 Years 2 Years 2.5 Years 3 Years 3.5 Years 4 Years
Levels for “Zebra” Sections in the Netherlands

Double Layer Porous
4/8mm

Sound Intensity Level, dBA

~ 2 dB
Variation of ARFC Tire/Pavement Noise Source Levels at Arizona Site 3’s

Sound Intensity Level, dBA

Site 3A WB
Site 3A EB
Site 3C-1
Site 3C-2
Site 3C-3 WB
Site 3C-3 EB
Site 3D WB
Site 3D EB
Site 3E SB
Site 3E NB

~ 2 dB
Variation of RAC(O) Tire/Pavement Noise on I-5 in Sacramento

Sound Intensity Level, dBA

Southbound

Northbound

3+ dB

Segment 2  Segment 3  Segment 1
Summary

- Reductions of 5 to 12 dB possible
- Quietest pavements between US and Europe
  Perform almost equally
- Aggregate size & porosity patter
- Quieter AC performance can degrade at 0.2 to 0.5 dB/Yr
- Performance varies up to 2 to 3 dB