Tire/Pavement Noise Results from California PCCP and HMA Pavements

Erwin Kohler, Dynatest Consulting Inc
Linus Motumah, California Department of Transportation
Bruce Rymer, California Department of Transportation
John Harvey, UCPRC
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The OBSI method

AASHTO TP 76-08 - Standard Method of Test for Measurement of Tire/Pavement Noise Using the On-Board Sound Intensity (OBSI) Method
Quiet Concrete Pavements

• From early AZ and CA database:
  – “at least in the US, the absolute level of quiet PCC does not approach that of quiet AC”

• The concrete industry responded with testing and building test sections in Iowa through the National Concrete Pavement Technology Center

• CP Tech Center has published results in terms of OBSI levels on 4 “families” of concrete pavements
  - Diamond Grinding
  - Drag
  - Longitudinal Tining
  - Transverse Tining
CP Tech Center data

The image shows a graph with four distinct probability density functions. Each function is labeled as follows:
- **Orange line with solid line pattern**: Diamond Grinding
- **Dark green line with solid line pattern**: Drag
- **Blue line with solid line pattern**: Longitudinal Tinning
- **Red line with dashed line pattern**: Transverse Tinning

The x-axis represents the A-weighted Overall OBSI Level at 60 mph, with the units in SRTT (dB ref 1 pW/m²). The y-axis represents the probability density, ranging from 0.00 to 0.35.
Tire noise work at UCPRC

- Caltrans’ Quiet Pavement Research (QPR) Program
- Concrete pavement field testing in 2008. Second year testing to start in September 2009
- Lab work on characterizing HMA pavements (materials, sound absorption, friction) in 2006/07
- Lab work on optimized HMA mixes in 2009/10

→ Dedicated vehicle with OBSI and profilometer
State-wide AC & PCC OBSI studies

- Range of climates, traffic levels, pavement types
Asphalt Pavements Sections

Total number of sections

2006 → 76
2007 → 71
2008 → 65

By mix type

OGAC: 18 (Open Graded Asphalt Concrete)
RAC-O: 20 (Rubberized AC Open Graded)
RAC-G: 13 (Rubberized AC Gap Graded)
DGAC: 18 (Dense Graded AC)
Other: 7 (BWC, F-mixes, Euro gap graded, MB)

→ Represent entire population of AC pavements
Asphalt Pavements 3-year Results

Overall OBSI (dBA)

Phase ID: 1 2 3 1 2 3 1 2 3 1 2 3 1 2 3 1 2 3 1 2 3 1 2 3 1 2 3 1 2 3 1 2 3
Age Category: <1 1-4 >4 <1 1-4 >4 <1 1-4 >4 <1 1-4 >4 <1 1-4 >4

01-N114
06-N466
QP-17
Asphalt Pavements 3-year Results

- OBSI results on all sections by year of testing

![Graph showing OBSI results for all asphalt sections by year of testing. The graph displays data for the years 2006, 2007, and 2008, with OBSI values ranging from 94 to 110.](image-url)
Overall OBSI, dB(A)

Cumulative Percent

96 98 100 102 104 106

0 2 0 4 0 6 0 1 0 0

DGAC (34)
OGAC (39)
RAC-G (35)
RAC-O (46)

DGAC Average OBSI = 102.8 dB(A)

OBSI noise with SRTT tire at 60 mph

Increased noise

Overall OBSI, dB(A)

Cumulative Percent

0 10 20 30 40 50 60 70 80 90 100

96 98 100 102 104 106

OGAC
RAC-O

DGAC
RAC-G

Increased noise
OBSI vs Pavement Age & by Mix Type

- no AC section older than 8 years has OBSI <100 dB(A)
PCC Sites have 3 sections

- Location: 03-Yol-113-N-3.0

  District – County – Route – Direction – Postmile

- A site is $\frac{1}{4}$ mile long - or 1,320 ft
- A section is 440ft (5-seconds at 60mph)
### Pavement and Bridge Sections

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OBSI Testing

• Pavement
  – 3 passes collecting 5 sec (typical OBSI as in AASHTO TP76)
  – 1 pass collecting 0.015 sec (for approximate joint effect)

• Bridges
  – 3 passes collecting at 1 sec intervals
  – 1 pass collecting 0.015 sec (for approximate joint effect)
Longitudinal Tines
Errors of +/- 0.2 dB are common, needs correction
UCPRC results include speed correction
QP-166 Mojave 58
Effect of faulting on OBSI
Texture testing Mojave 58

- LTS – Laser Texture Scanner
Partial Results of PCC OBSI Levels

- Burlap Drag
- Diamond Grind
- Diamond Groove
- Longit Tining

OBSI level (dBA)
Comparison of PCC and AC

- WSDOT study (1992) indicated that asphalt pavements start quieter than Portland cement concrete pavements, but noise level increases with age.
- After about six to eight years the noise levels from asphalt pavements become greater than those of concrete pavements.
- The results of the UCPRC PCC study will allow comparison of AC and PPC noise levels.
- For now the CP Tech Center data on PCC noise levels is used to compare to AC.
- Preliminary PCC OBSI levels by UCPRC are not as low as those reported by CP Tech Center.
Rough Comparison of PCC and AC

- Cumulative distributions of OBSI levels
- PCC: CP Tech Center, from several states, custom equipment, shorter interval
- AC: UCPRC, only California, AASHTO TP-76
Preliminary Observations

• Diamond ground surfaces are the quietest

• It is important to establish goals for tire/pavement noise. A noise level of 100.0 dB(A) measured at 60 mph seems reasonable

• The UCPRC study shows that after two years, the average noise from about 70 AC sections has increased from 100.8 dB(A) to 102.1 dB(A). This is an increase of 1.3 dB(A) over a two-year period.

• It must be noted that many RAC-O sections that are less than 8 years old are still between 98 and 100 dB(A).
Preliminary Observations

• None of the asphalt sections in the UCPRC study after 8 years in service offers OBSI levels lower than 100 dB(A)

• Reduction on joint slap noise (from wide and/or faulted joints) will reduce concrete pavement noise

• Further analysis of data being collected will answer questions about durability of acoustic properties of different types of concrete pavements.
Thanks