Tyre/Road Noise Research

Validation of CPX results

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Road Traffic Noise in NZ

- The tyre/road interaction dominates road noise emission
- Chipseal covers 75% of NZ state highway network
- OGPA is our primary tool for mitigating road noise
- NZ OGPA is highly variable in noise emission

NZTA want to optimise the specification of OGPA, and the CPX trailer is an instrument capable of directing that effort
Study Objectives

Primary aim was to validate the measurements of the epoxy OGPA trial surfaces on John’s Road, Christchurch.

General objectives:
— Identify a link between CPX and wayside noise levels
— Does CPX rank OGPA surfaces ‘correctly’?
— Does the CPX standard tyre behave like ‘typical’ car tyre?
— Side study: new vs old ‘typical’ car tyre
CPX

OGPA trial: 5 surfaces
CPX Measurements

5 trial sections, 4 test tyres, 3 runs for each combination

What is a ‘typical’ NZ passenger car tyre?
– The tyre fitted to the most common model
– The most common single tyre size and design
CPX Measurements

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P1 - TigerPaw  H1 - Avon AV4

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CPX Measurements

5 trial sections, 4 test tyres, 3 runs for each combination

P1 - TigerPaw  H1 - Avon AV4  Supercat (new)  Supercat (worn)

What is a ‘typical’ NZ passenger car tyre?
— The tyre fitted to the most common model
— The most common single tyre size and design
Ranking the Surfaces using CPX
Does the P1 respond to OGPA like NZ car tyres do?

P1 minus worn SC
CPX Findings

Typical tyre – New vs. Worn
- Tidy experiment with few confounding variables
- Worn tyre is $(0.3 \pm 0.1)$ dB quieter than new tyre on OGPA

Typical tyre compared to standard test tyre P1
- More variables but still a good experiment
- P1 is $(1.6 \pm 0.1)$ dB louder than worn tyre on OGPA

Comparison between four test tyres
- All tyres maintained a consistent relationship over 5 surfaces
Wayside Noise Measurements

- Statistical Pass-by (SPB) methodology chosen
- 6 sites selected (4 different specifications)
- Captured $L_{A\text{max}}$ from 100 car and 30 truck passes per site
CPX(P1) vs SPB(cars)

SPB_{cars} = 0.99 \times CPX_{P1} - 19.7 \quad r^2 = 0.95
CPX(H1) vs SPB(trucks)

\[ \text{SPB}_{\text{trucks}} = 0.23 \times \text{CPX}_{\text{H1}} + 62.3 \quad r^2 = 0.40 \]
OGPA Study Conclusions

— Strong relationship exists between CPX and wayside levels from passenger cars at 80 km/h on OGPA.
— Weak relationship between CPX using H1 tyre and wayside levels from trucks at 80 km/h on OGPA.
— The relationship between the 4 test tyres remained consistent across the different OGPA test surfaces.
— Sections of nominally the same surface type presented different CPX and wayside levels, as seen previously.
— There was no evidence that ‘high voids’ OGPA provided additional benefit at the wayside compared to CPX.
Chipseal Study

Early Results
Chipseal CPX Study

Objectives:
— Get an indication of range of CPX levels ‘in the wild’
— Test CPX against wayside levels on non-asphaltic surfaces

Survey:
— Minimise: bumps, hills, < 80 km/h
— Maximise: surface types & ages
— SH73 ideal for repeated runs
— SH1 to extend survey distance
— Pick a week with lovely weather
Early Results

- 750 km of CPX measurements
- 5 SPB surveys (focussed on cars)
- Found reasonable agreement between CPX using P1, SC new, and H1 tyres on SH73

- Good agreement between CPX and SPB measurements
- Interesting that slope is higher than unity: P1 insensitive? (but it is a small sample)
CPX emission by surface type

Normalised to AC indirectly via SMA-10 minus 1.5 dB (no suitable AC available)
### All CPX and wayside pairs (OGPA and Chipseal)

The following graph illustrates the relationship between CPX PI Level (dB) and SPB Cars norm. 80 km/h (dB) for various materials and grades. The equation and correlation coefficient for the line of best fit are:

\[ y = 1.2575x - 45.508 \]

\[ R^2 = 0.9409 \]

#### Materials and Grades
- **Random Sawn AC**
- **Grade 3**
- **Two-coat 3/5**
- **Two-coat 2/4 (flushed)**
- **Grade 5**
- **EPA7**
- **EPA7**
- **EPA10**
- **EPA10 HV**
- **EPA14**

#### Graph Details
- **x-axis**: CPX PI Level (dB)
- **y-axis**: SPB Cars norm. 80 km/h (dB)
- The graph shows the data points for each material and grade, with error bars indicating variability.