Traffic noise: can the poro-elastic road surface help?

GRB Geneva
1 September 2015

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Why bother about traffic noise?

Traffic is the main source for environmental noise

- 125 Mio people in the EU affected by $L_{den}$ levels exceeding 55 dB(A)
- 20 Mio feel annoyed
- 8 Mio suffer sleep disturbance
- 900 000 cases of hypertension per year in EU
- 43000 hospital admissions per year in EU
- 10000 cases of premature death per year in EU

Noise screens

- Often high noise reductions:
  - 2 dB/m height (< 4m)
  - 1 dB/m height (> 4 m)
- Expensive, “extra” constructions
- Intrusive
- Vandalism and dirt
- Effect on a limited area
- Effectiveness influenced by meteo
- Reflecting screens can worsen the acoustic situation on the other side
- Generally do not have “the eternal life”...
…and performance is sometimes disappointing…

Predicted (on average): 10,4 dBA  Measured (on average): 7,5 dBA

Source: Buytaert, A; Vanhooreweder, B “Control measurements near houses before and after installation of noise reducing devices”, Proceedings Internoise 2013, Innsbrück, Austria, 15-18 September 2013
Where does traffic noise come from?
Rolling noise vs. engine noise…

Fighting traffic noise ≈ fighting rolling noise!
Parameters influencing “noisiness” of pavement

- Texture
  - Thin asphalt layers
  - Two layer porous asphalt
  - Single layer porous asphalt

- Absorption

- Elasticity
  - Poro-elastic road surface
The champion of “conventional” low noise pavement: two layer porous asphalt

Voids against air pumping

Optimized texture with a minimum of megatexture

7 cm thick absorbing layer, for optimal absorption

Noise reduction of up to 7 dB(A) compared to DAC or SMA 0/11
Test tracks with low noise pavements in Kasterlee (B)

SMA C2 (ref)

Two layer porous asphalt
Low noise pavements

- Cost effective noise reduction
- Generally lower noise reduction than screens
- Shorter technical lifetime
- Acoustic benefit appears to decrease with lifetime
- Present day LNP: the higher the initial noise reduction, the higher the pace you loose it 😞

How to go further? The poro-elastic road surface (PERS)!

- What is it?
  - Mix containing
    - Rubber particles
    - Stone aggregate
    - Polyurethane
    - Additives
  - **NO** bitumen, hence it is NOT an asphalt

- Why PERS?
  - Extreme noise reduction (7 -12 dB)
  - Tyre recycling
The concept PERS is not new…
Main challenges

- Combination of
  - Durability
    - Ravelling resistance
    - Bonding to sub layer
    - Resistance to fuel spills, deicing salts, frost-thaw etc.
  - Good friction
  - High noise reduction
  - Acceptable rolling resistance
  - ...

The PERSUADE project

- PERSUADE = PoroElastic Road SUrface for Avoiding Damage to the Environment
- 12 partners from 8 EU countries
- Duration: 6 years
- 1 September 2009 - 31 August 2015
- Total budget: 4,7 M€
- Funding EC: 3,4 M€ (72 %)
The mission of the project

- ... the development of a cost effective PERS type with an acceptable durability

- ...moving from a promising but yet experimental concept to a usable noise abatement measure
Project plan

- Completeness
  - Technical aspect
  - Safety: environment – working environment – traffic safety
  - Economical aspect
- Stepwise approach
  - Lab testing
  - Small scale test tracks
  - Full scale test tracks
  - Monitoring
- Dissemination
What we have done…

- Found in lab two mixes with good...
  - Ravelling resistance
  - Polishing resistance
  - Bonding to sub layer
  - Resistance to hydro-carbons
  - Fire resistance
  - ...

Aachener Ravelling Tester
Testing PERS mixes with the ARTe

Loss of thickness after ARTe treatment [cm]

Sample/mixture number
What we have done…

- Small scale “pilot” test tracks (10-30 m²), with little or no traffic
Full scale fire tests
Full scale fire test
Full scale test tracks
Full scale test track in Belgium
Full scale test track in Belgium
Mixing PERS in mobile cement concrete plant in Zaventem (two batches)
Full scale test track in Belgium
Full scale test track in Belgium
Compaction
Full scale test track in Belgium

Herzele, September 2014

Herzele, June 2015
Full scale test track in Denmark

Kalvehave, July 2014
Full scale test tracks in Sweden

September 2014
Full scale test tracks in Sweden
Full scale test track in Poland

September 2014

One week later...
Full scale test track in Slovenia

- Spreading glue on cement concrete blocks
- Manual mounting of PERS pieces on concrete blocks
Full scale test track in Slovenia

- Laying blocks...
- When finished, joints were filled with sand 0/1 mm
- The excess sand was broomed away
What we have done...

- Monitoring
  - Noise reduction
  - Durability
  - Elasticity
  - Winter behaviour...
SPB noise reduction at 80 km/h
Development of PERS mixes which

- can be quite ravelling resistant
- can yield a sufficient skid resistance
- yield a good to an excellent noise reduction...
- and the noise reduction seems to be quite stable in the time (alternative for noise screen of 4 to 6 m high !!!)
PERSUADE achievements - status (II)

- do not pose problems concerning toxicity
- are more fire safe than a DAC
- are resistant to fuel spills
- of which the winter behaviour can be handled
- reduce moderately traffic vibrations
- are already beneficial at a short lifetime (stand. CBA calculation)
PERSUADE achievements - status (II)

- Development of lab tests for PERS
- Development of techniques for full scale application yielding reasonable to good surface characteristics
Remaining problems

- PERS + PU tack layer + bituminous underlayer + heavy vehicles → debonding
- But:
  - short term bonding quality is OK
  - long lifetime (> 4 y) feasible when exposed to moderate car traffic volume (hence without HV)
  - (Strong) indications that tack layer is more durable and does resist HV if bitumen on underlayer is removed or absent
Remaining problems

- Construction of a PERS pavement is still a delicate issue. Mistakes committed during any phase of the construction process are paid cash!
- Reproducibility of full scale results are still an issue

more practicing is needed
What to do now?

- Further testing of present PERS with PU tack layer on a bituminous sublayer on a road with negligible HV
- Further testing of present PERS with PU or epoxy tack layer on a bitumen-free sublayer on a road with some HV
- ...then larger scale test tracks (500 m and longer)
Short term project

- Construction of a new test track on a street (with low HV column) in the city of Antwerp (local "SToLA" project)
More information

www.persuadeeproject.eu

of

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