AUSTRIAN INSTITUTE OF TECHNOLOGY
TOMORROW TODAY

LOW NOISE SOLUTIONS FOR ROAD SURFACES

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Standardization of the acoustic assessment of low-noise pavements

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OVERVIEW

1) Background information
2) Tyre/road noise
3) Low-noise pavements
4) Assessment methods
5) Standardization
6) Link to noise mapping
7) Conclusion
8) Challenges

BACKGROUND INFORMATION

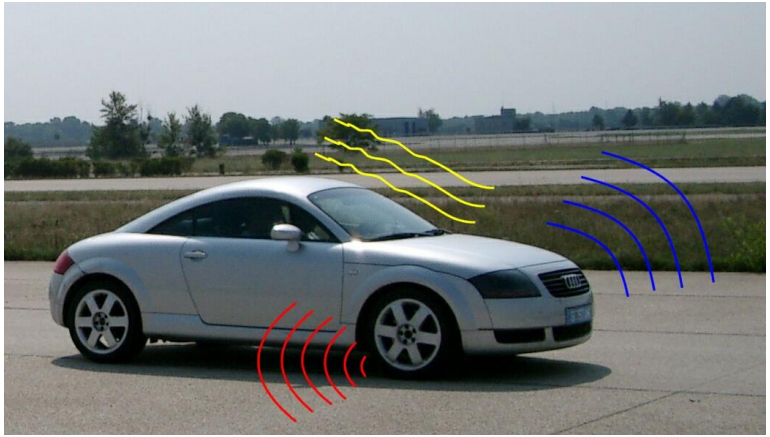
- WHO has classified traffic noise (road, rail and air traffic) as the second most important environmental cause of ill health in Western Europe after air pollution
- Road transport is the most significant contributor to environmental noise pollution in the EU (source: EEA)
- At least one in five people in the EU are exposed to long-term noise levels considered harmful to their health (source: EEA)
- Long-term exposure to environmental noise causes high annoyance, heart disease, sleep disturbance and learning impairment
- EU's zero pollution action plan aims to reduce the number of people chronically disturbed by noise from transport by 30% by 2030 (compared with 2017)
- The European Environmental Noise Directive (END, 2002) has harmonized noise mapping and action planning
- With the implementation of the CNOSSOS-EU results also the noise calculation methods have been harmonized

SOURCES OF EXTERIOR ROAD TRAFFIC NOISE

Aerodynamic noise

only relevant at high speeds (v >130 km/)

or for trucks with noisy superstructures



Tyre/road noise

ICEs: dominant from v = 30 - 130 km/h

EVs: main noise source v < 130 km/h

Engine and powertrain noise

ICEs: dominant for v < 30 km/h

EVs: only some powertrain effects

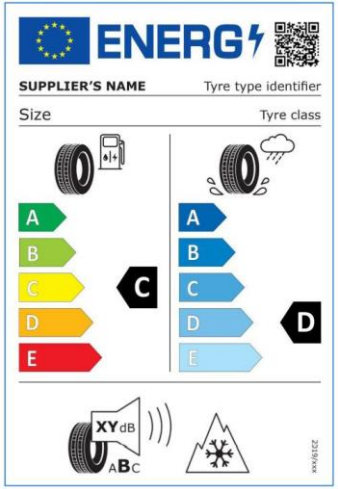
Still dominant for 2-wheelers

LOW-NOISE TYRES

Key influencing factors:

- Tread pattern
- Tyre width/dimensions
- Rubber hardness
- Number of tyres
- Inner tyre structure
- Temperature, load and pressure
- Wear and ageing

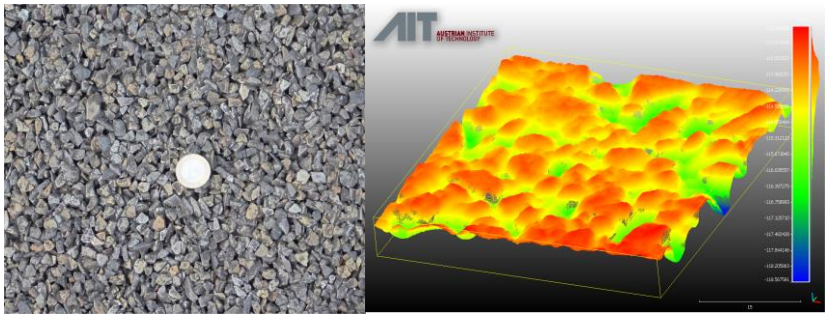
- Regulations:
  - Tyre noise measurement and limits in UNECE Regulation No 117
  - Tyre labelling in 2020/740/EC

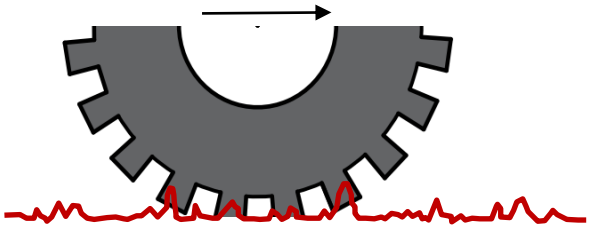


LOW-NOISE PAVEMENTS

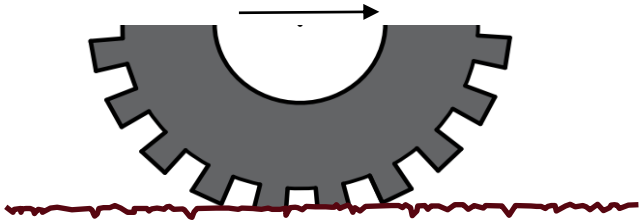
Key parameters for low-noise pavements:

- Small maximum aggregate size
- Sufficient texture depth
- Concave shape („Plateau with valleys“)
- Increased void content
- Sound absorption through connected voids





Noisy texture



Low-noise texture

LOW-NOISE PAVEMENTS

Examples:

- Porous asphalt (1 or 2 layers)
- Low-noise Stone Mastic Asphalt (SMA)
- Asphalt types with low aggregate sizes (< 8 mm)
- Exposed Aggregate Cement Concrete (EACC)
- Longitudinally grooved/grinded concrete
- Poroelastic pavements (experimental)
- …

STANDARDIZED ACOUSTIC ASSESSMENT

- Pass-By-Methods:
  - ISO 11819-1: Statistical Pass-By Method (SPB)
  - Controlled Pass-By Method (CPB)
  - SPB/CPB with Backing Board
- Procedure:
  - Measurement of the sound pressure during individual vehicle pass-bys with a microphone at 7.5 m from the center of the lane at 1.2 or 3.0 m height + speed and temperature measurement
  - Regression analysis to determine noise level for a reference speed
- Requirements:
  - Suitable traffic flow, no large reflecting surfaces, dry, level and uniform pavement, ideally no guard rail, no noise barrier
- Variants:
  - SPB: normal traffic, CPB: dedicated test vehicles

STANDARDIZED ACOUSTIC ASSESSMENT

Trailer/Vehicle-based methods:

- Trailer/Vehicle-based methods:
  - ISO 11819-2: Close-ProXimity Method (CPX)
- Procedure:
  - Measurement of sound pressure level with 2 microphones very close to the tyre/road contact at traffic speed, speed + temperature measurement
  - Trailer or special vehicle with representative reference test tyre (for passenger cars and heavy vehicles), enclosure possible
- Requirements:
  - Dry and uniform pavement, constant measurement speed possible, control of tyre load, tyre pressure
- Variants: SPB, On-Board Sound Intensity method (OBSI) used in the US

COMPARISON OF METHODS

Key features	ISO 11819-2	ISO 11819-1
Measurement equipment	Trailer with 1 or 2 wheels, open or closed, or specially equipped passenger car, 2 representative tyres	Microphone at the roadside, 7.5 m from the centre of the lane at 1.2 m height, speed measurement
Measured property	Tyre/road noise levels very close to the tyre/pavement contact	Overall vehicle noise from all sources during vehicle pass-by
Measured vehicles	Only measurement vehicle	Vehicle collective from actual traffic
Representation of heavy vehicles	Via a proxy tyre representing truck tyres	Yes
Measurement length	Not limited	Ca. 100 m around measurement position
Duration of measurement	Quick, measurement in the traffic flow	Several hours to collect enough isolated pass-bys
Contains influence of propagation path	No	Yes
Requirements regarding measurement site	Low	High (e.g. no reflecting objects, suitable traffic flow)
Speed range	Can be chosen freely	Determined by vehicle collective, road category and speed limits
Frequency range	315 Hz – 5000 Hz	50 Hz – 10000 Hz
Reference speeds	50, 80, 110 km/h	50, 80, 110 km/h

ROSANNE PROJECT

ROSANNE: ROlling resistance, Skid resistance, ANd Noise Emission measurement standards for road surfaces, FP7 project 2013 - 2016

Objective:

- Prenormative research creating the technical basis for draft standards for harmonized assessment methods for key pavement properties

Outcome for noise emission:

- Improvements in ISO 11819-2 (CPX method): e.g. for temperature and tyre hardness corrections
- Draft document as basis for a possible future standard for the acoustic characterization of pavement based on CPX – handed over to standardization working groups CEN TC 227/WG 5 and ISO/TC 43/SC 1/WG 33

The ROSANNE project was funded in the European Community's Seventh Framework Programme (FP7/2007-2013) under grant agreement n°605368

STANDARDIZATION ACTIVITIES

ISO Working groups:

- ISO/TC 43/SC 1/WG 33: Further development of SPB and CPX measurement methods, definition of CPX reference tyres in ISO/TS 11819-3
- ISO/TC 43/SC 1/WG 27: Temperature corrections for SPB and CPX methods
- ISO/TC 43/SC 1/WG 39: Characterization of pavement texture (key influence on noise emission)

CEN Working groups:

- CEN TC 227/WG 5: Pavement surface characteristics
  - Technical Group 3 (TG3): Development of a European Technical Specification for the characterization of the noise emission properties of pavements
  - Using measurement methods developed in ISO

APPLICATION

Application areas of assessment methods for pavement noise emission:

- Comparison of the acoustic performance of different pavement types
- Acceptance/Conformity of Production testing of low-noise pavements
- Long-term and/or network level acoustic pavement monitoring
- Derivation of noise emission parameters for noise mapping

HARMONIZED NOISE MAPPING IN THE EU

- Common noise calculation methods for noise mapping for reporting according to the Environmental noise directive (2002/49/EC) were established with directive 2015/996/EU
- The calculation method for road traffic noise includes a table of speed-dependent pavement-specific emission parameters for a range of example pavements
- For pavements not contained in the table emission parameters are allowed to be derived if suitable data are available
- Ideally the pavement – specific emission parameters should be derived from a standardized procedure

CONCLUSION AND OUTLOOK

- Low-noise pavements are a key tool for road traffic noise abatement
- Tyre/road noise will be even more important for electric vehicles
- Current standardized assessment methods allow acoustic characterization of pavements
- Different methods cover different aspects of road traffic noise and different application areas
- Information about pavement influence is necessary for noise mapping
- Objective: Standardized derivation of emission parameters for noise mapping from measurements

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THANK YOU!

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