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NOISE EMISSION OF TYPICAL ROAD SURFACES WITHIN NEW MEMBER STATES USING THE CPX METHOD AND THE NEW ASTM TYRE IN THE EU PROJECT SPENS

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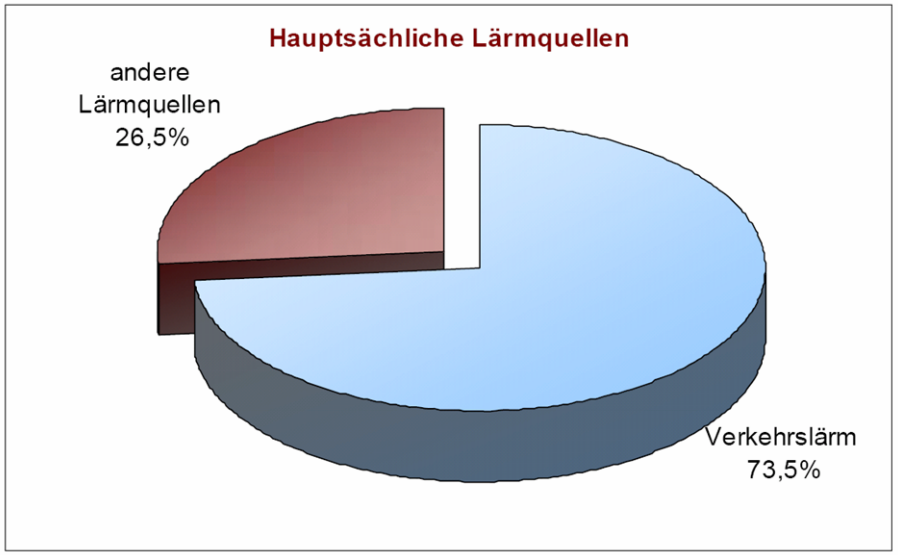
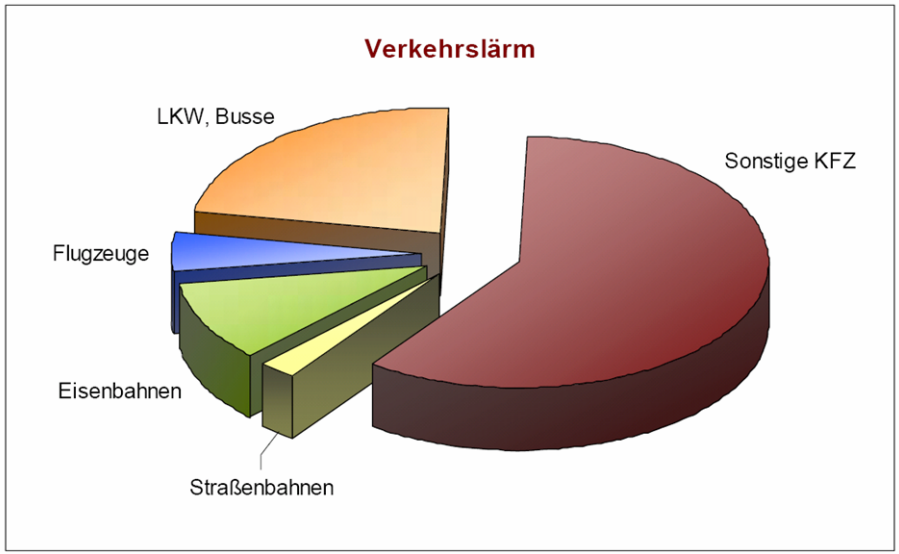
Outline of the Presentation

1. Introduction
    1. Impact of road traffic noise
    2. Generation of tyre/road noise
    3. Context of the study: the SPENS project
2. Measurement method
3. Results
4. Discussion
5. Conclusions

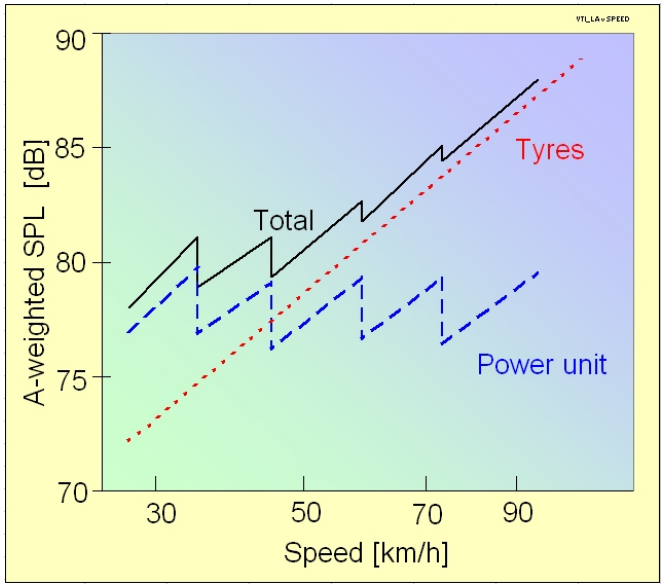
Impact of Road Traffic Noise

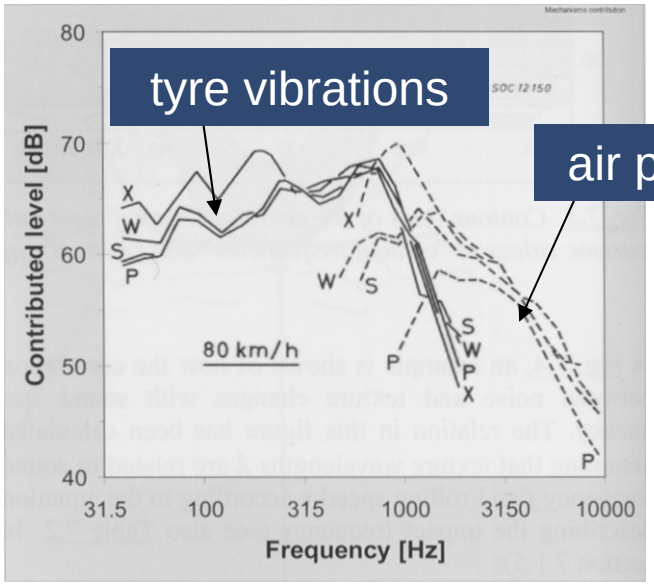




- Traffic noise is a big environmental problem within the EU
- 28% of the Austrian inhabitants are disturbed by noise
- 73,5% are disturbed by traffic noise
- 60% of the traffic noise is caused by road traffic!
- Problem of traffic noise is not only political & economical issue!
  → technical point of view as a first step for solving the problem

Generation of Road Traffic Noise



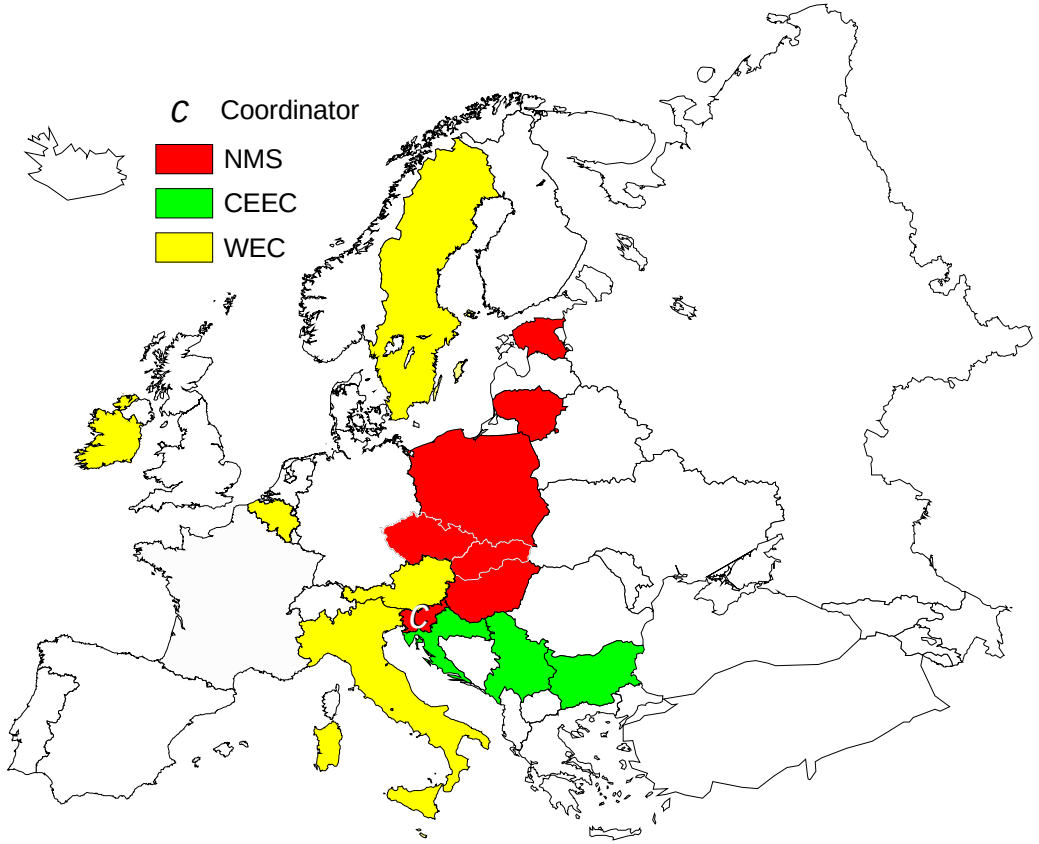


Sandberg/Ejsmont, Tyre/Road Noise Reference Book

- Major part of noise emitted by vehicles on roads in the mid- to high-speed range (v > 30 km/h) is due to tyre/road noise
- Tyre/road noise: the tyre tread pattern interacts with the texture of the road surface, which generates complex tyre vibrations as well as aerodynamic effects and resonances (are called air pumping)
- Tyre/road surface combination must be optimized → noise reductions.

Context of the Study

- EU project SPENS (Sustainable Pavements for European New Member States)
- Objective of this research project: to develop appropriate tools and procedures for the rapid and cost-effective rehabilitation and maintenance of roads in the EU New Member States (NMS)



Context of the Study

SPENS WP5:
Impact assessment of roads on the environment

Partners: arsenal (Austria, leader), ZAG (Slovenia), VTI (Sweden), CDV (Czech Republic), TUZA (Slovakia)

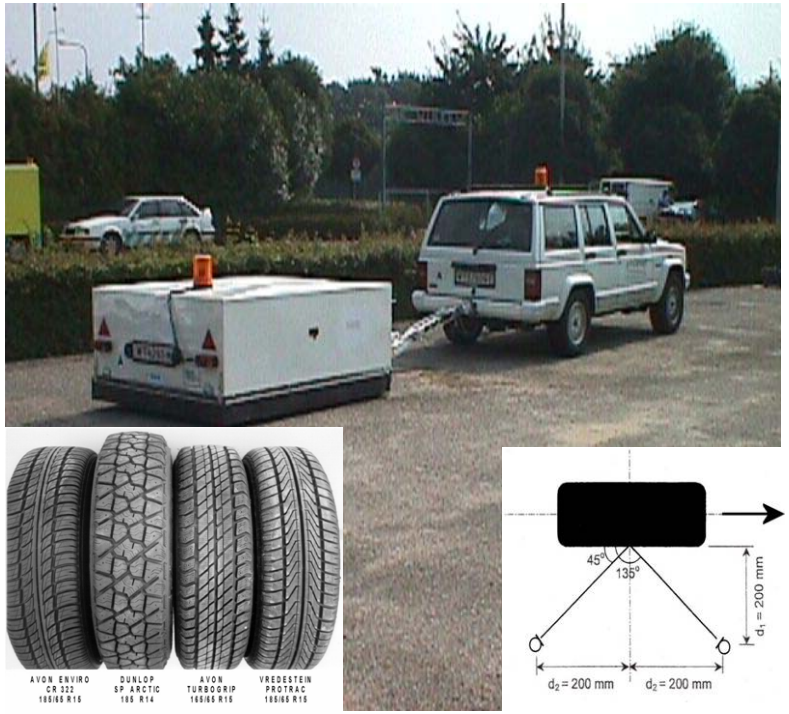
- **Task 5.1: Environmental assessment of pavements**
  - particle generation
  - pollutant emission
- **Task 5.2: Role of the road network as source of noise emissions**
  - analysis of the different pavement types
  - measurements according to EN ISO 11819-1 (SPB method)
  - measurements according to ISO/CD 11819-2 (CPX method)

→ Goal: help road authorities to select durable and environment-friendly pavement types which will minimise environmental impact

Measurement Method

Close ProXimity Method: draft standard ISO/CD 11819-2

- Trailer method → check homogeneity of noise emission properties of road surfaces over long distances → used for approval testing
- Four specified reference tyres: A, B, C and D → survey method: A for passenger cars and D for trucks
- Microphones: measure the energetic average of the A-weighted sound pressure level every 20 m
- Reference speeds: 50, 80, 110 km/h



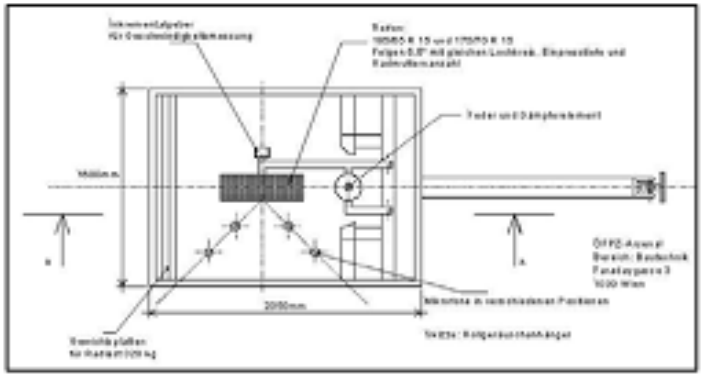
Advantages of the CPX Method

Advantages:

- long road sections can be measured
- background noise and reflecting objects do not affect the results
- measurements in the normal traffic flow

Disadvantages:

- engine noise is not included in the results
- propagation effects cannot be covered (microphone close to the test tyre)
- methods depends on the representativeness of the test tyres



CPX Method in the Project

- Survey method→ tyre A (passenger cars) and D (heavy vehicles)
- Additional test with tyre ASTM SRTT (American Society for Testing and Materials Standard Reference Test Tyre) → 3 used tyres
- Compare the behavior of the ASTM tyre (proposed for replace A tyre)
- 11 measurement sites in 3 European NMS: Czech Republic, Slovenia and Slovakia

Reference tyre A

Tyre ASTM SRTT

Reference tyre D

The Measurement Campaign

- Pavement material: CC, SMA, AC (8&11mm)
- Pavement age: 2 months to 15 years
- Reference speed: 50 and 80 km/h

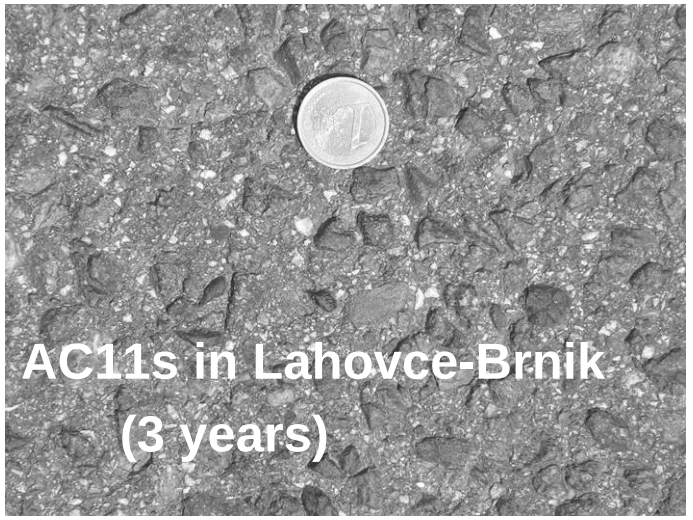
Measurement in summer 2008 in:

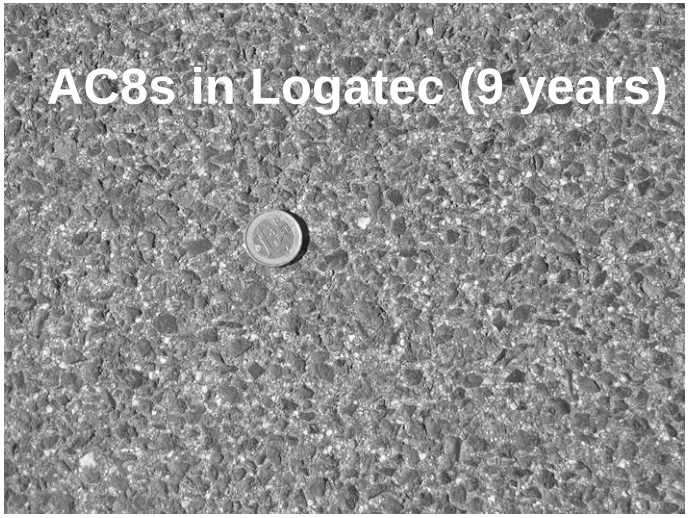
- Czech Republic
- Slovenia
- Slovakia

Test Sites

Country	Location	Pavement type	Age of the pavement	Reference speed used for CPX tests
Slovenia	Domzale	SMA8s	8 years	50 km/h
Slovenia	Lahovce - Brnik	AC11s	3 years	50 km/h
Slovenia	Logatec	AC8s	9 years	50 km/h
Slovakia	Bratislava D1	SMA11	2 years	80 km/h
Slovakia	Dolny Hricov east	AC11	2 months	50 km/h
Slovakia	Dolny Hricov west	AC11	15 years	50 km/h
Slovakia	Bytca	SMA11	4 years	50 km/h
Czech Republic	D3 to Prague	SMA11	4 years	80 km/h
Czech Republic	D3 to Ceske Budejovice	SMA11	4 years	80 km/h
Czech Republic	D2 to Brno	SMA11	12 years	80 km/h
Czech Republic	D2 to Brno	Cement concrete	31 years	80 km/h

Slovenian Road Surfaces

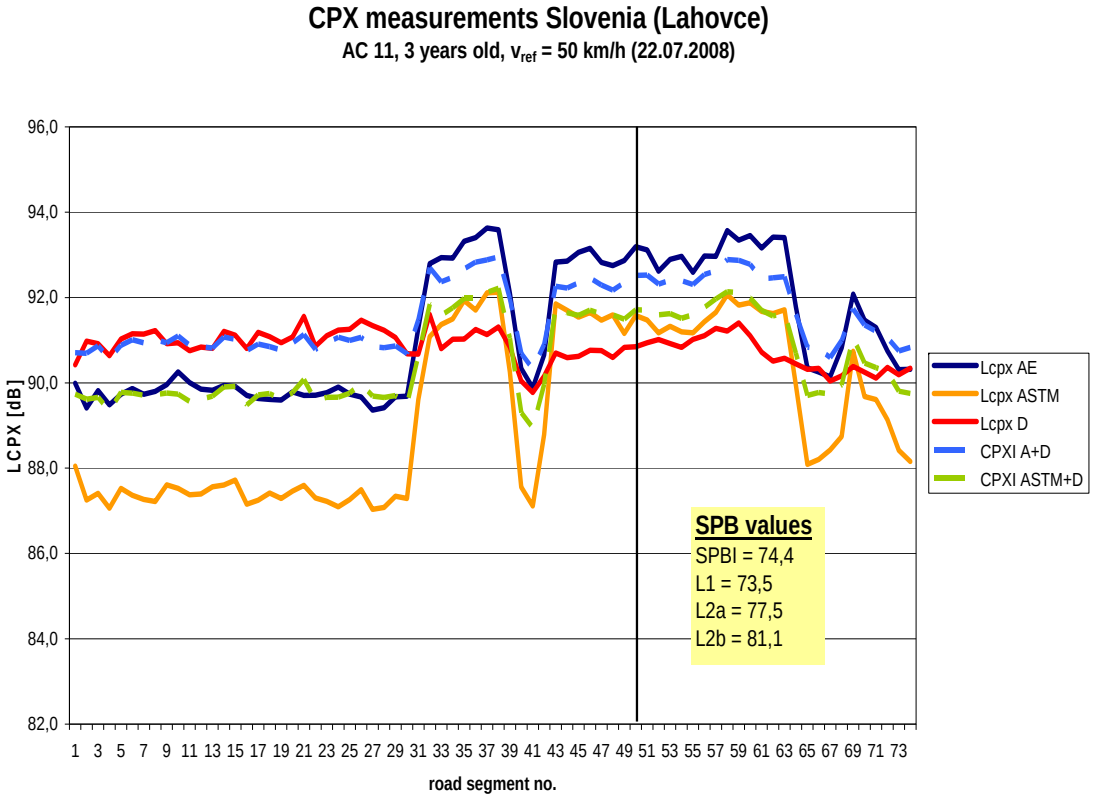




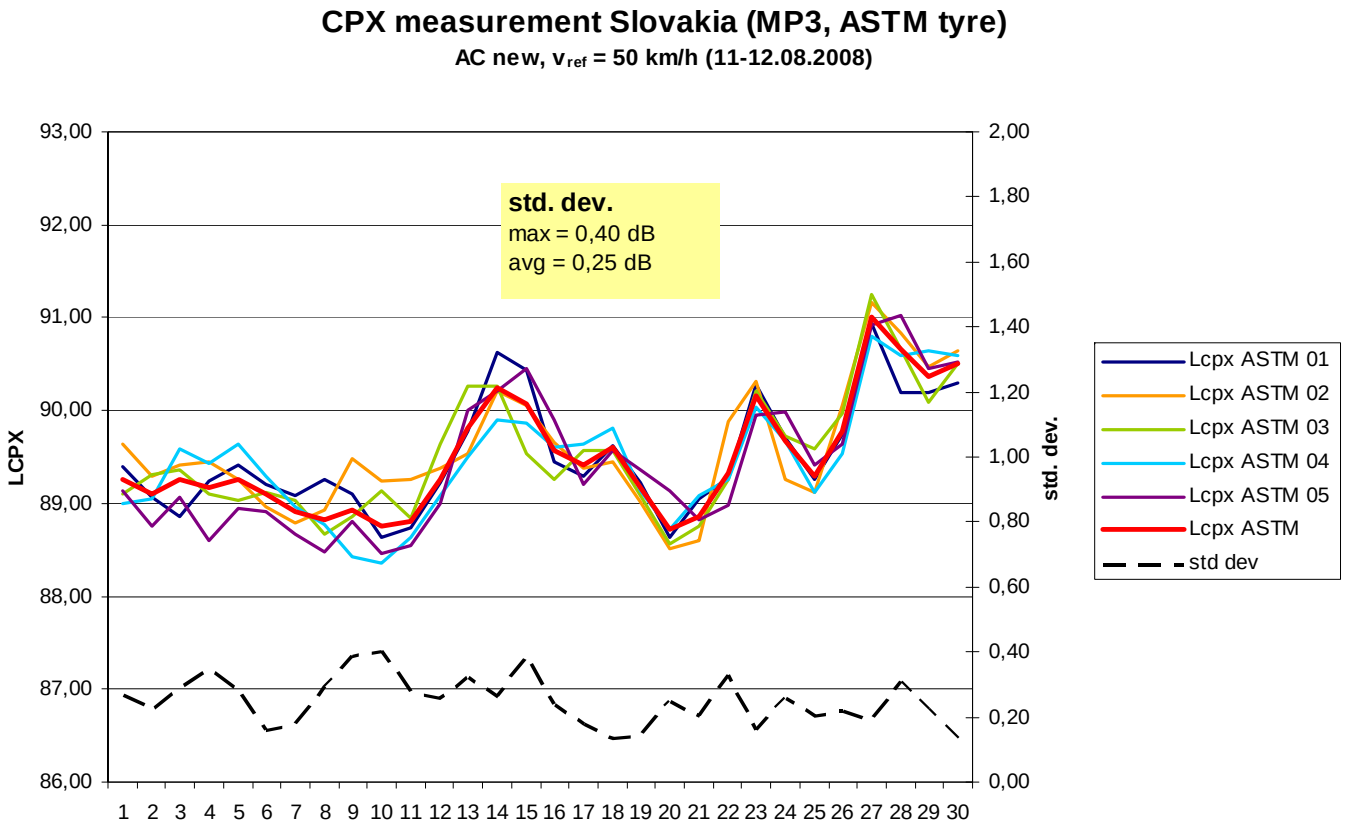
Represents 70% of the Slovenian road surfaces

Results: Overall values

- CPX results over time at Lahovce (Slovenia) for tyre (A, ASTM and D) and SPB results at the road segment no. 50
- Discontinuity in the pavements easy to identify (for tyre A and ASTM)
- A and ASTM different information than tyre D (different profile → average of noise emission?)
- Level difference between A and ASTM tyre about 2 dB



Repeatability of the Results

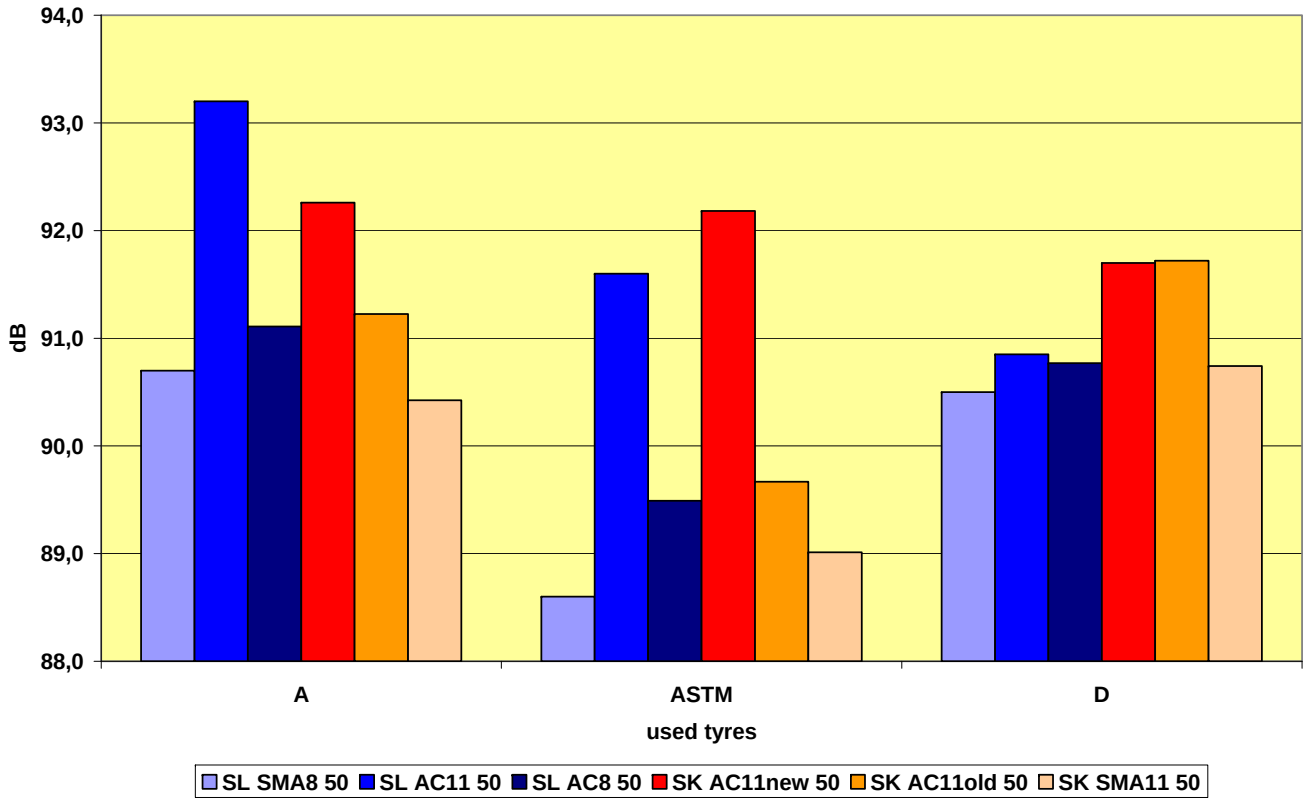


- 5 measurements at the same place for each tyre
- Good repeatability of the measurements: std. deviation 0,15 to 0,40 dB

CPX Levels

Pavement tested @ 50 km/h

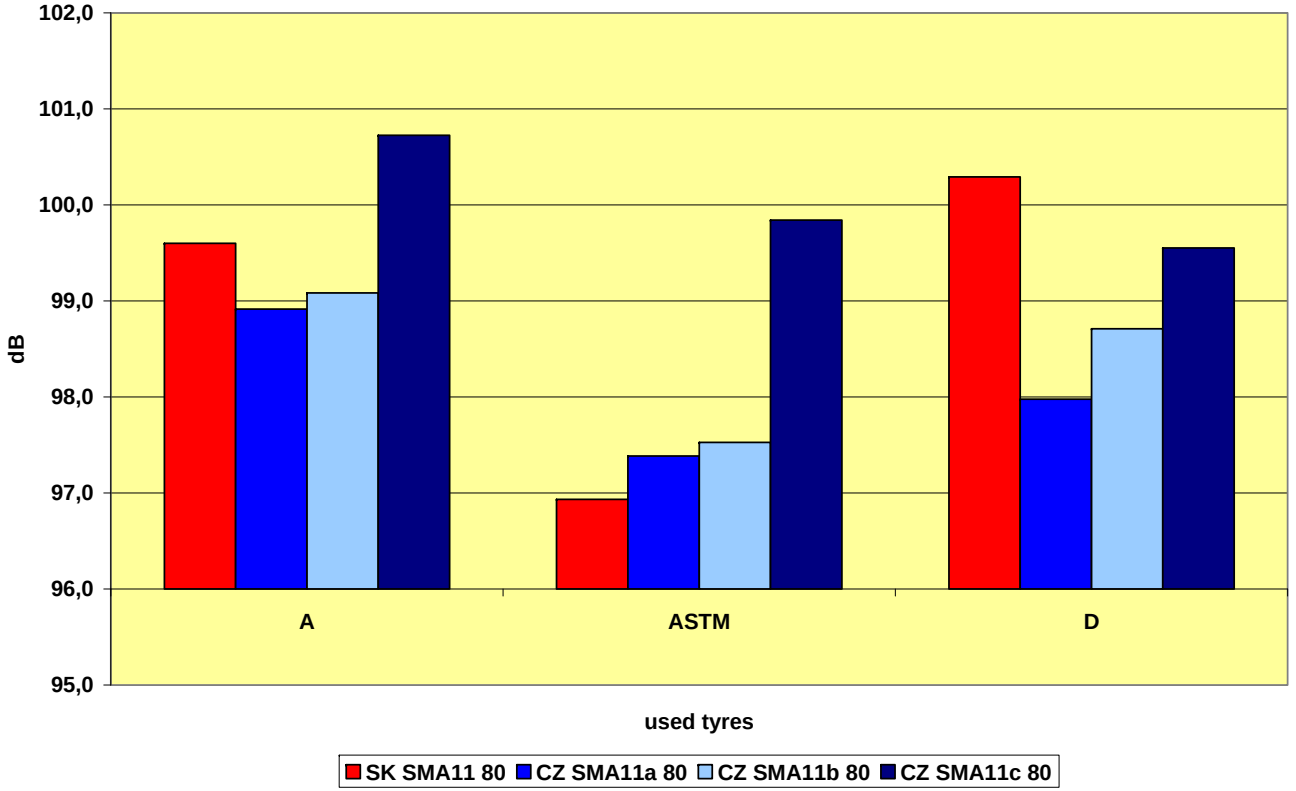
- CPX levels between 88,5 and 93,2 dB
- Span from 1.5 (tyre D) to 4 dB (for A and ASTM) → D averages surfaces because of the more gross profile
- Ranking between the pavements similar for each used tyre



CPX Levels

Pavement tested @ 80 km/h

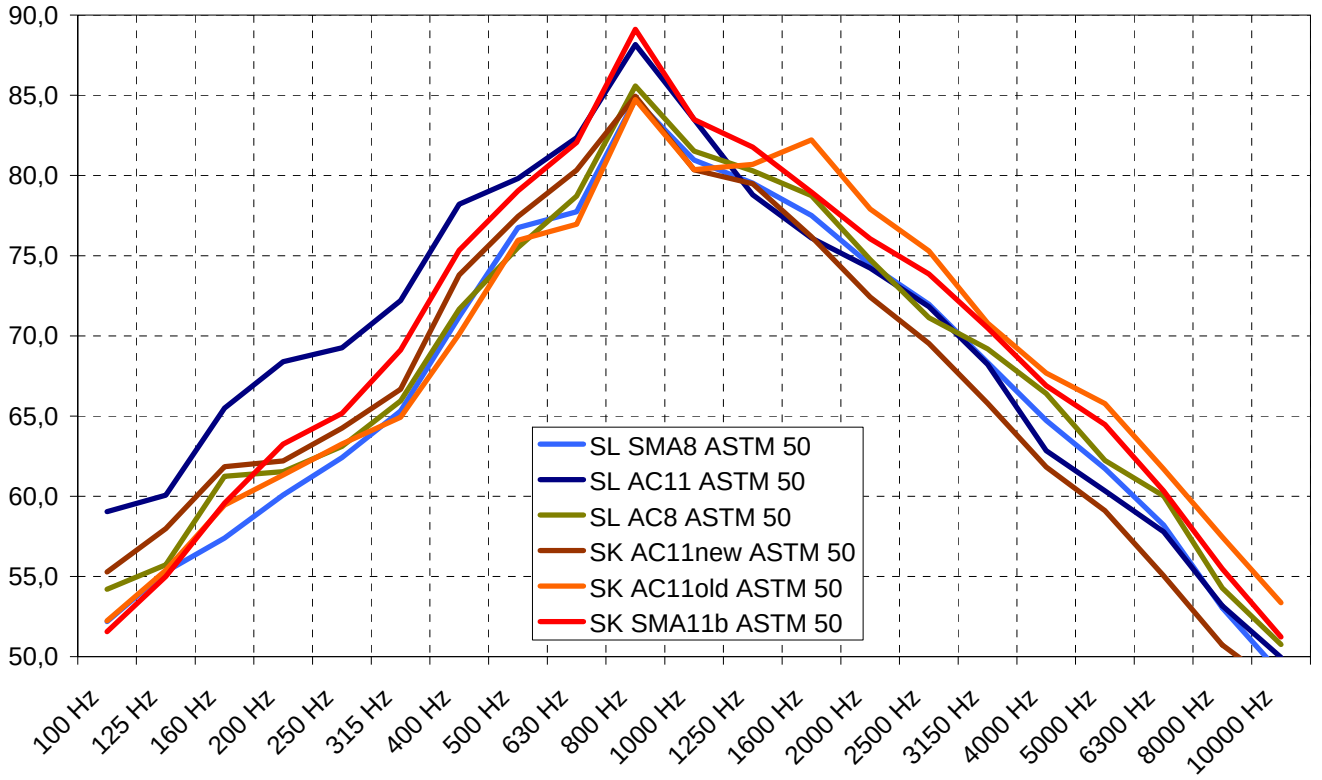
- CPX levels between 96,8 and 100,7 dB
- Ranking of the three SMA11 measured in Czech Republic maintains the same ranking for each tyre (same material!)
- Span between most and less noisy pavement is 2 to 3 dB for all the three tyres



Spectral Analysis of different Surfaces

Differences within the pavement types:

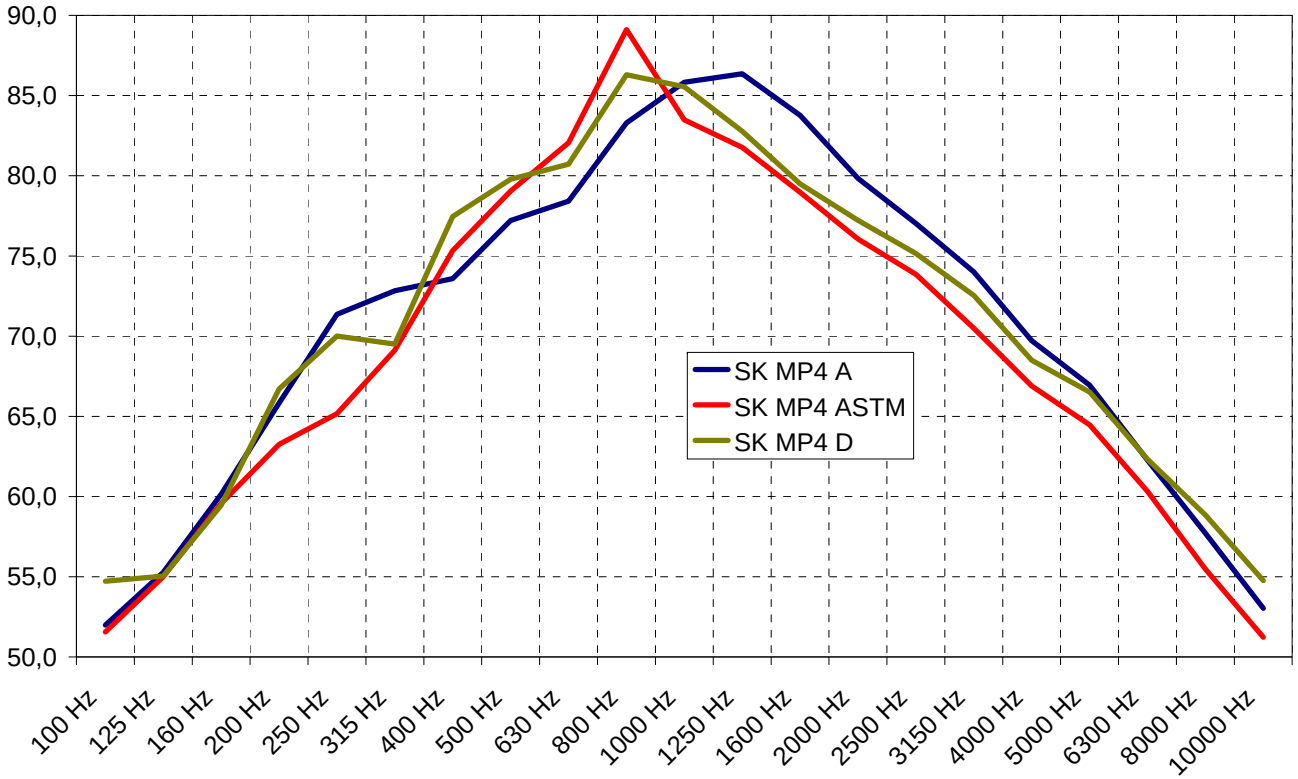
- e. g. 6 measurement sites tested at 50 km/h using ASTM SRTT
- similar energy content for each tested pavement
- shapes very similar for all the pavements (SMA8, SMA11, AC8, AC11new and AC11old)
- peak of the spectra is for all the pavements around 800 Hz.



Spectral Analysis of different Tyres

Comparison of the three used tyres on the same pavement:

- e.g. SMA11 measured with 50 km/h reference speed in Slovakia
- similar shapes of the spectra
- peak for tyre ASTM and D at 800 Hz, peak for A tyre at 1000 Hz
- ASTM tyre: peak at 800 Hz is more acute but less energy content between 200 and 400 Hz



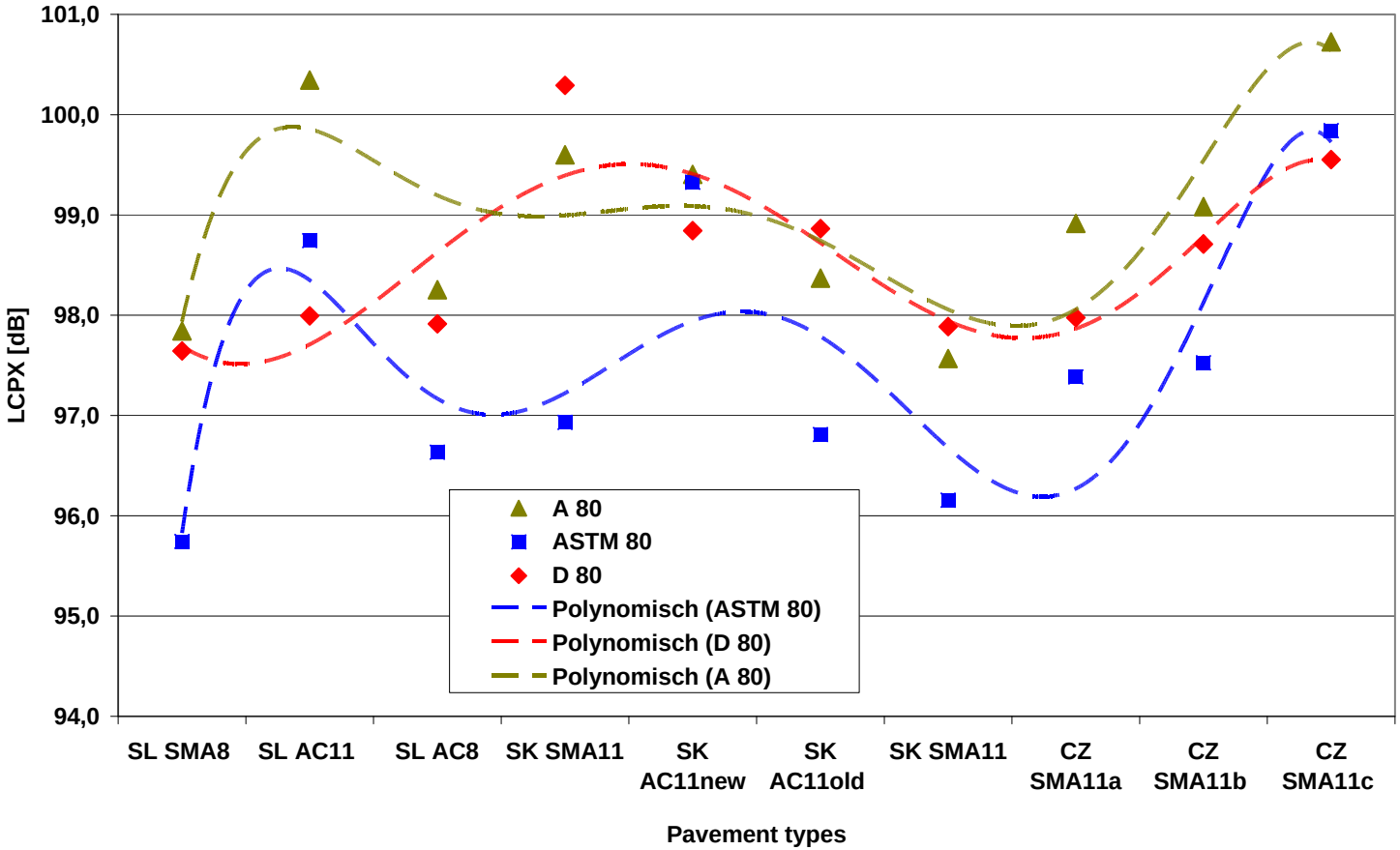
Pavements Ranking

- Noise emission values of the tested pavements for each tyre at the same speed
- Results listed from the most silent to the less silent (different colours indicate to which pavements the results are referred to)
- Similar trends for the pavements ranking using different tyre

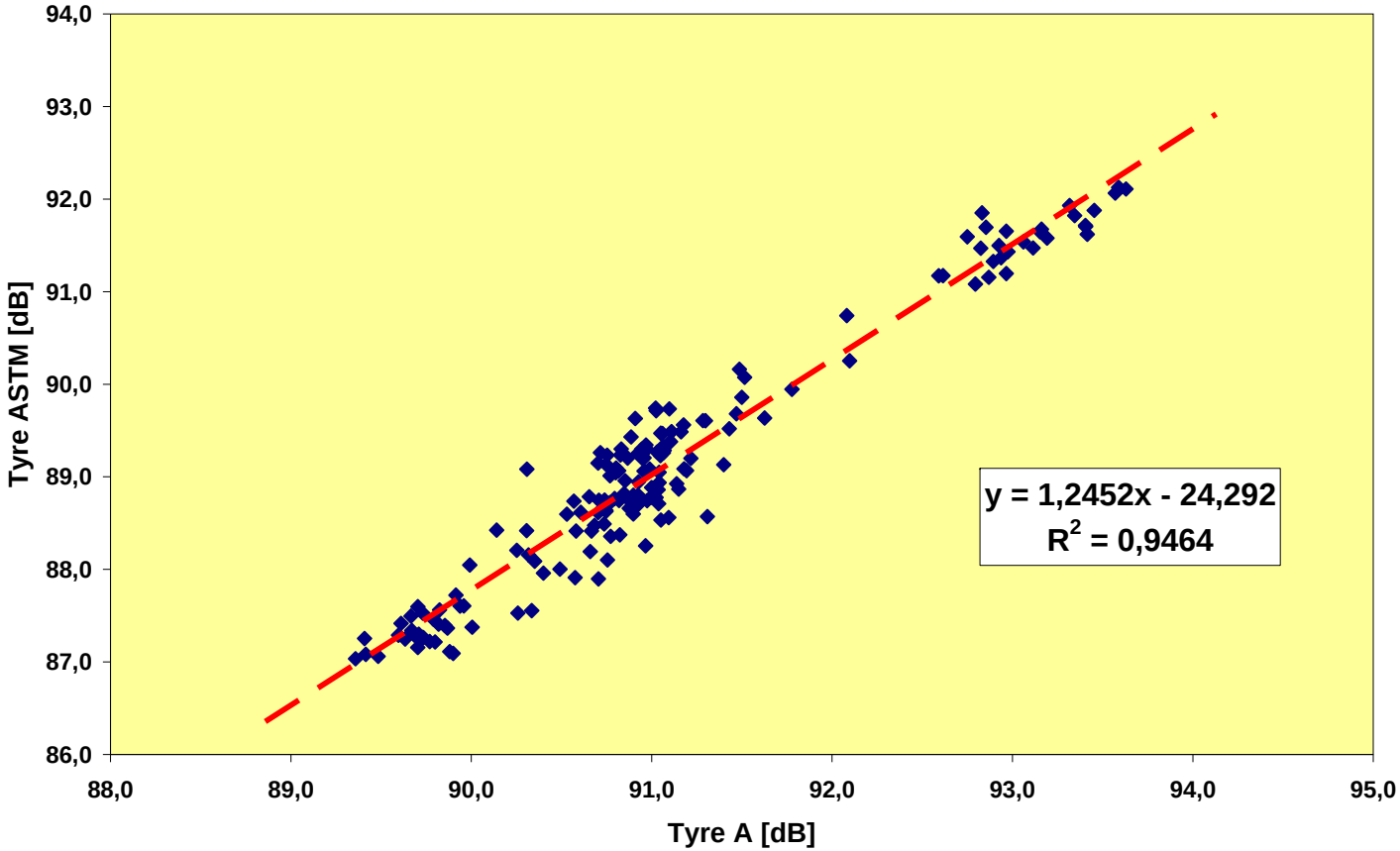
		L_{cpx}		
Site	**Road surface**	**A @ 80 km/h**	**ASTM @ 80 km/h**	**D @ 80 km/h**
1	SL SMA8	97,8	95,7	97,6
2	SL AC11	97,6	96,2	97,9
3	SL AC8	98,3	96,6	97,9
4	SK SMA11	98,4	96,8	98,0
5	SK AC11new	98,9	96,9	98,0
6	SK AC11old	99,1	97,4	98,7
7	SK SMA11	99,4	97,5	98,8
8	CZ SMA11a	99,6	98,7	98,9
9	CZ SMA11b	100,3	99,3	99,6
10	CZ SMA11c	100,7	99,8	100,3

Pavements Ranking

- Pavements ranking for each used tyre
- Trends of A (green line) and ASTM tyre are very similar
- Trend of tyre D (red line) is similar to the other two only for some road surfaces



Correlation Tyre A/ASTM



Correlation over the three pavement types: SMA8s, AC8s and AC11s (166 road sections of 20 meter each)

Conclusions

- Measurements: according to CPX method (reference tyre A, D and ASTM SRTT) used for testing 11 different road surfaces in three European NMS (Slovenia, Slovakia and Czech Republic)
- Tested materials: SMA and AC with 8&11s @ 50 or 80 km/h

- Overall value LCPX: span of 4 dB → difference between noisy and quite pavements is rather small
- Frequency spectra: similar shapes for the same tyre over different surfaces, different shapes for each tyres
- Global ranking of pavements for each tyre and for both reference speeds → similar trend especially for tyres A & ASTM (SMA8 most silent pavement)
- ASTM tyre: good comparability to the reference tyre A → good correlation over different road section (offset -2 dB) → ASTM can replace A tyre.

Thank you very much for your attention!

Noise Emission of Road Surfaces in NMS

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