

## **THE INFLUENCE OF THE ROAD SURFACE ON THE TRAFFIC NOISE**

**Tomasz Figlus<sup>1</sup>, Andrzej Wilk<sup>2</sup>, Štefan Liščák<sup>3</sup>, Łukasz Gozdek<sup>4</sup>**

### **1. Introduction**

One of the causes why the car transport is heavy for the environment is the arising traffic noise [1-6]. The source of the noise in the vehicle is the powertrain [7-9], the elements of car body [10, 11], the chassis and the contact of tyres with the surface [12]. There are many researches which aim at reducing the noise in the source of its generation. During the last several years it was possible to reduce the noise caused by the combustion in the engines what is noticeable especially in the Diesel engines [13].

The type of surface and the road localization have a big influence on the traffic noise connected with the vehicle [14]. We can distinguish the following factors which influence the noise: the type of road, the type and structure of the surface, the road grade, the traffic lights and the condition of the road.

The type and the structure of the surface has a big significance as far as the noise emission in case of the dominant source of vehicle noise which is the contact of the tyres and the surface. In case of urban traffic, the noise is not so important however, outside the city after speeding over 60 km/h the noise has a great impact (fig. 1). One of the ways to reduce its emission is to use the tyres with lower rolling resistance which generate lower noise. There are also researches which deal with the influence of the surface on the noise generation.

In the work, there are the research results which aim at comparing in the real traffic, two different types of surface influencing the noise emission. For the research, two road sectors were chosen – made of Stone Mastic Asphalt (SMA) and the concrete of cement.

a)

b)

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<sup>1</sup> Ph.D. (Eng.) Tomasz Figlus, Department of Automotive Vehicle Construction, Faculty of Transport, The Silesian University of Technology, 8 Krasinskiego Street, Katowice 40-019, tel. (+48) 32 603 41 46, e-mail [tomasz.figlus@polsl.pl](mailto:tomasz.figlus@polsl.pl)

<sup>2</sup> Prof. Ph.D. D.Sc. (Eng.) Andrzej Wilk, Department of Automotive Vehicle Construction, Faculty of Transport, The Silesian University of Technology, 8 Krasinskiego Street, Katowice 40-019, tel. (+48) 32 603 41 18, e-mail [andrzej.wilk@polsl.pl](mailto:andrzej.wilk@polsl.pl)

<sup>3</sup> Prof. Ph.D. (Eng.) Štefan Liščák, University of Žilina, Faculty of Operation and Economics of Transport and Communications, Department of Road and Urban Transport, 1 Univerzitná Street, Žilina 010 26, tel. 041 513 3507, E-mail: [stefan.liscak@fpedas.uniza.sk](mailto:stefan.liscak@fpedas.uniza.sk)

<sup>4</sup> M.Sc. (Eng.) Łukasz Gozdek, student, Department of Automotive Vehicle Construction, Faculty of Transport, The Silesian University of Technology, 8 Krasinskiego Street, Katowice 40-019

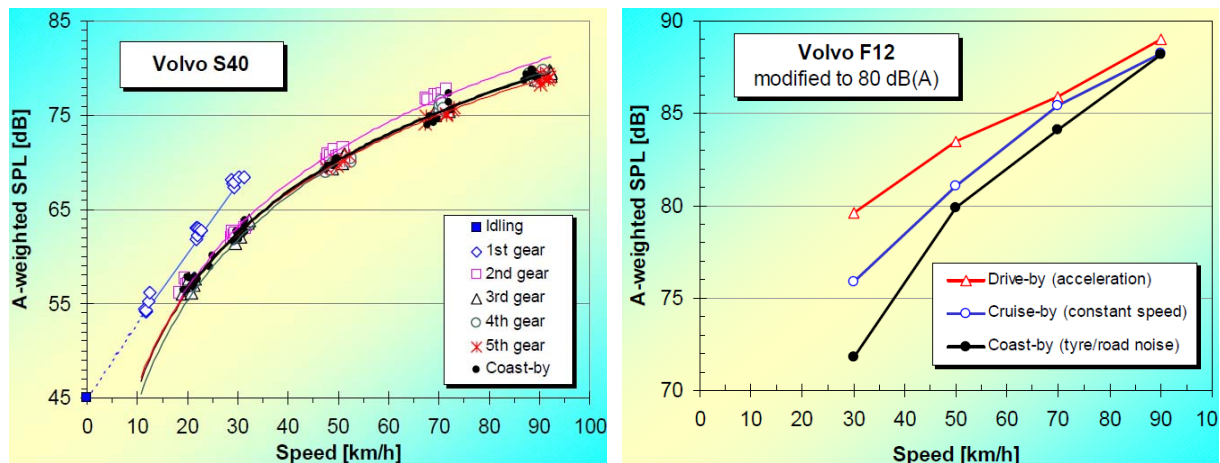


Fig.1. Visual dependence of the noise level change depending on the speed [12]:  
a) Volvo S40, b) Volvo F12

## 2. The surface characteristics chosen for the research

Stone Mastic Asphalt used as a surface characterizes with the composition with discontinuous granulation with a great content of grit, with a greater content of adhesive and with cellulose fibre absorbing adhesive and preventing its flow. The mixture characterized by great stability, great harshness and the wear resistance.

The concrete surfaces in contrary to the asphalt ones, are much more inflexible which is more profitable of their durability and they do not have deeper ruts. The concrete is of light colour which is profitable for the visibility and enables to reduce the lightning costs. The concrete surfaces have also a good adhesion. And what is important there are less accidents.

Categorizing the above mentioned surfaces according to the possibility of noise generation by the vehicles, we can assume, according to Ejsmond and Gardziejczyk that:

- SMA – is a surface of normal noisiness,
- cement concrete – is a surface of higher noisiness.

Traverse grooves and dilatation, which separates the plates, have an additional influence on the higher level of noisiness generated on the cement concrete surface.

In figure 2 and 3 there are a presentations of a road made of SMA and cellular concrete.

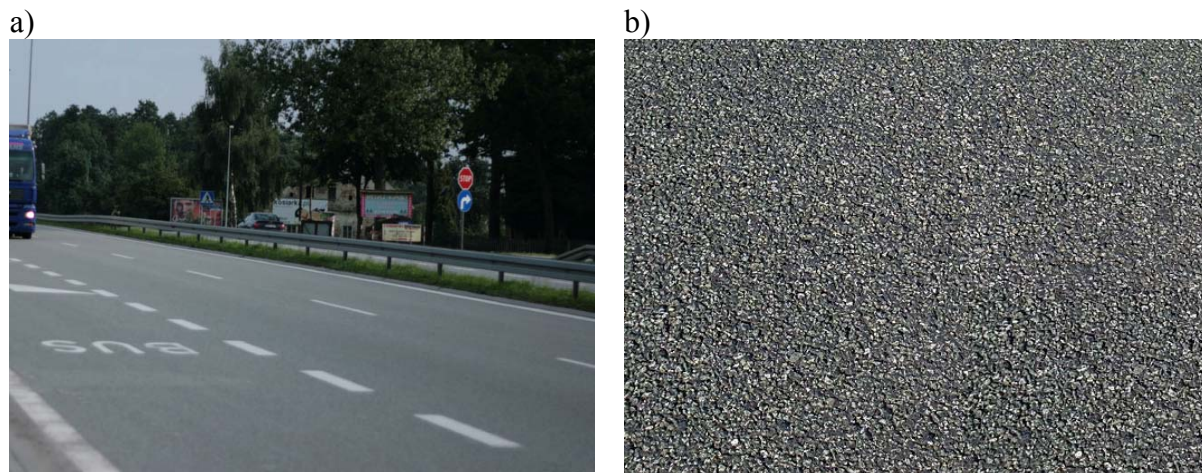


Fig.2. a) SMA road and b) SMA surface view

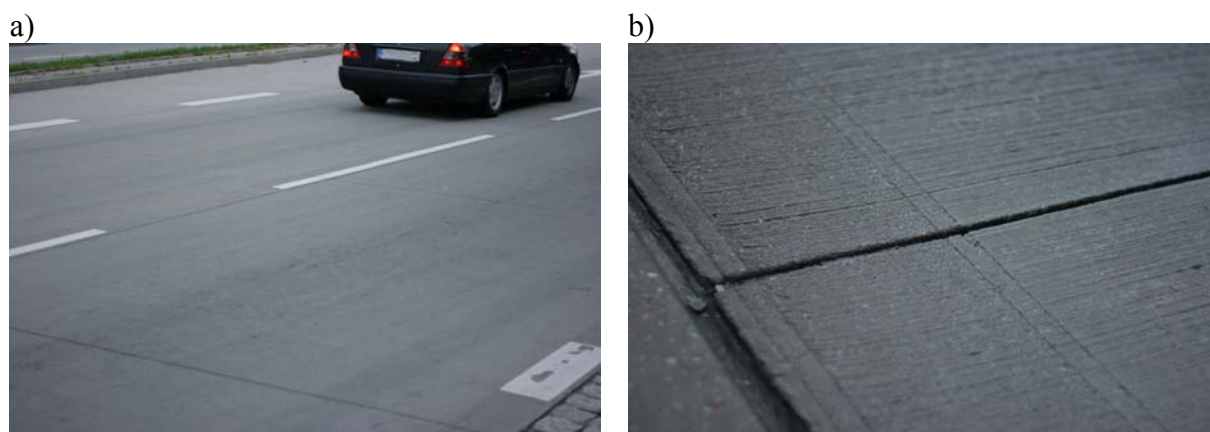


Fig.3. a) cement concrete road and b) traverse grooves and dilatation view

### **3. The method of measuring traffic noise**

The researches were conducted along the DK 86 road near Żory, Poland. The measures were conducted in different times:

- during the day at about 1pm. The approximate intensity of the traffic was 31 vehicles (including 3 trucks) per minute. The measures were conducted in the following weather conditions: the temperature 23°C, the humidity 80%, the pressure 740 mmHg and the speed and direction of wind SW 1-3 m/s, partly cloudy without falls,
- at night at about 3am, there were almost no vehicles. The measures were conducted in the following weather conditions: the temperature 9°C, the humidity 72%, the pressure 756 mmHg and the speed and direction of wind SW 2-4 m/s, partly cloudy without falls.

The speed of the vehicles on the road during the noise research, conducted by the road was 70 km/h (SPB method), whereas during measuring the noise inside the vehicle 100km/h (CPX method) – the tested car Nissan Primera Wagon 1,8 dm<sup>3</sup> MPI.

The measures were made by digital sound analyser Sonopan DSA 50 (fig. 4a). Every time the measures were conducted with the following sets of the meter: octave filter and the frequency correction A. During measures, the microphone was installed on the tripod of 1,2 m and in the distance of 2m from the edge of the traffic lane (fig. 3b).

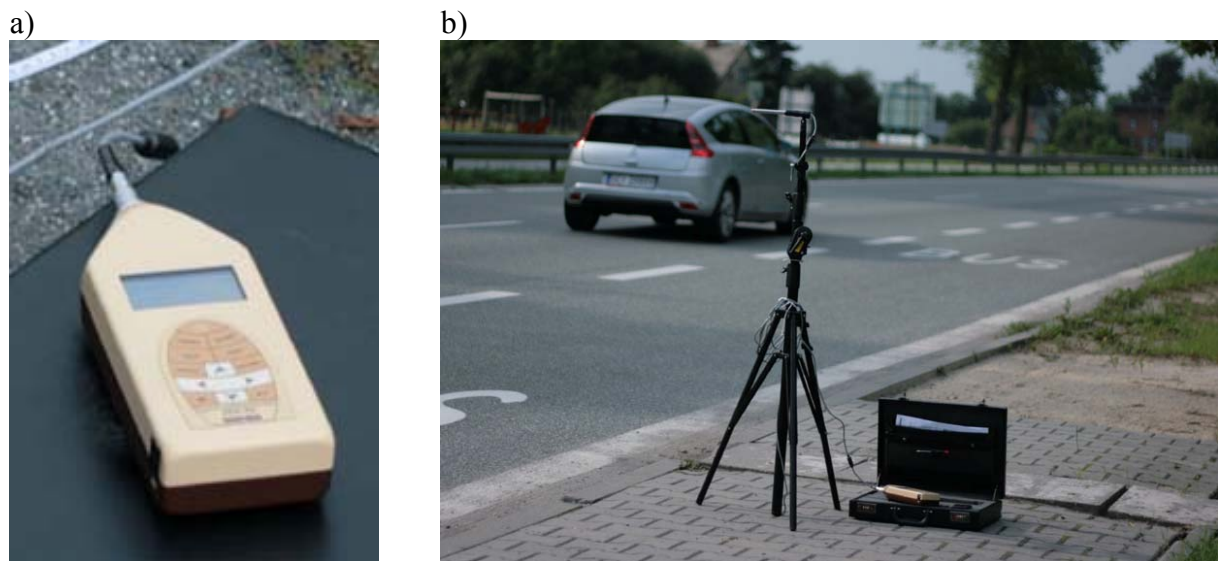


Fig.4. a) analyser Sonopan DSA 50 – view and b) the exemplary measure point (the SMA surface)

#### **4. The measure results and their analysis**

1. The measurement results of equivalent sound level recorded during the day (fig. 5) show that in case of cement concrete roads there is traffic noise increase by the road by over 1dB(A) in comparison to the normal noisiness of SMA surface. The greater differences are more visible in case of the noise inside the vehicle where the differences are almost 2 dB(A). The conducted measurement of noise spectrum with the use of octave filter show (fig.6), that the noise generated by the cement concrete surfaces is higher in the range of octave 250 Hz and can be over 5 dB(A). The smallest difference of sound level was recorded in the frequency 125 Hz and 1 kHz, and the generated noise on the SMA surface has a lower level in other frequency bands.

2. The measures conducted at night enabled to isolate from the whole range of vehicles, a single car drive or a single truck drive (fig.7).



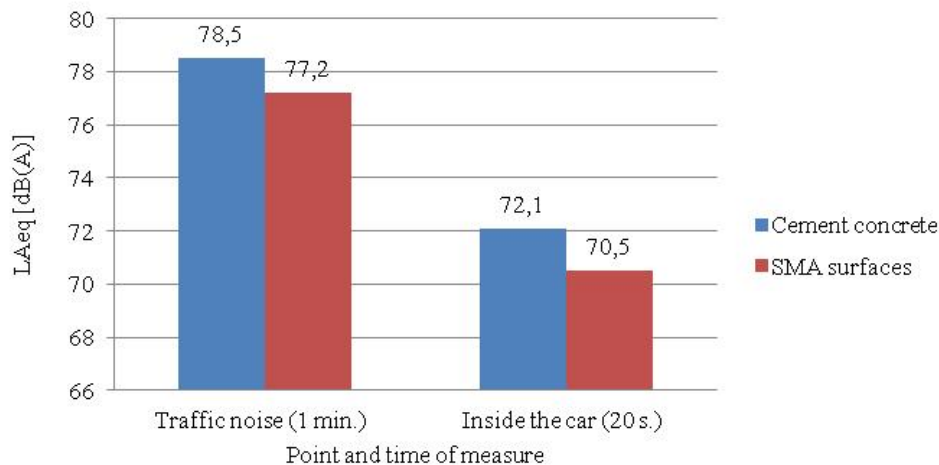


Fig.5. The noise of cement concrete and SMA surfaces in the measure point – during the day

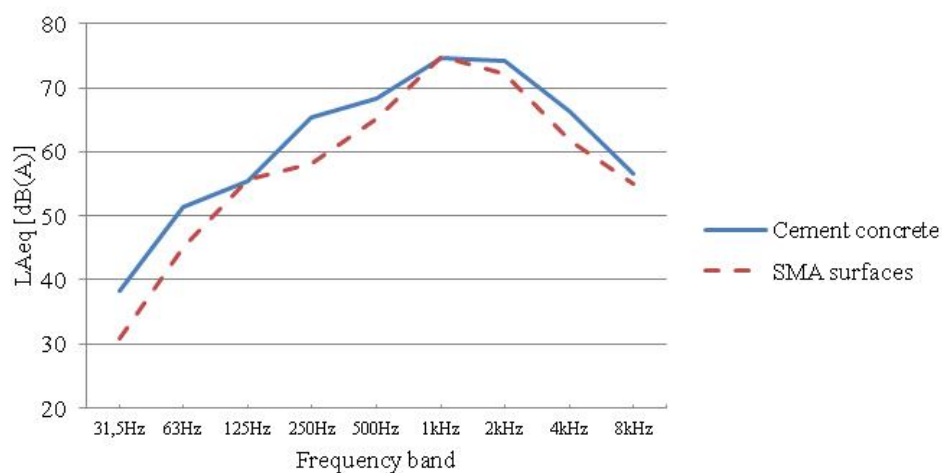


Fig.6. Spectral distribution of surface noise during the drive of many vehicles – during the day, the time of measurement 1 minute

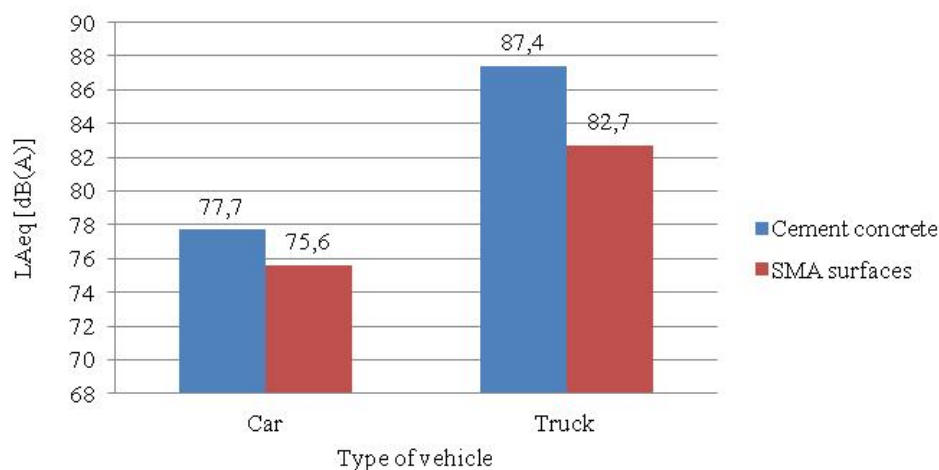


Fig.7. The results of measuring the noise in case of one vehicle – at night, the time of measurement 10 seconds

As the results present, the noise level, during the measures when car drive, is close to this obtained during the day. The sound level differences, depending on the surface type, confirm its higher level when the surface is made of concrete (approx. 2,1 dB(A)).

The differences are greater in case of trucks. In such a situation the sound level differences are almost 5 dB(A), which shows a significant change influence on the generated noise. The traffic intensity of trucks during the day had a little influence on the noise level as the number of these vehicles was small.

The recorded results of spectral noise arrangement by the road and inside a car are presented in figure 8 and 9.



Fig.8. Spectral distribution of surface noise in case of a single car drive – at night, the measurement time 10 seconds

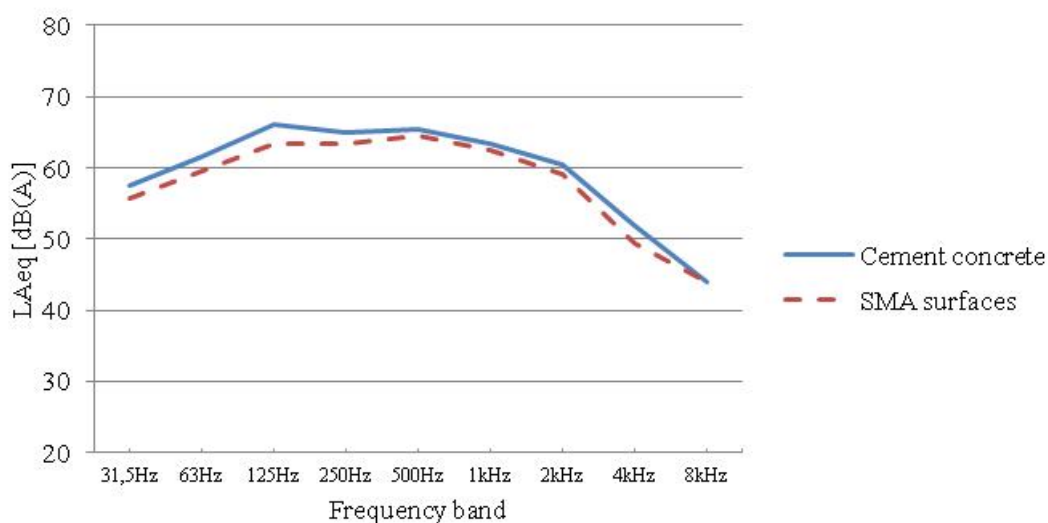


Fig.9. Spectral distribution of noise inside of the car, in case of a single car drive – at night, the measurement time 20 seconds

The measurements results show an influence of type of surface on the noise level in the particular frequency bands, especially in case of measures inside a vehicle (differences of a few dB(A)). It proves a significant and disadvantageous change of vibroacoustic climate for the passengers of the vehicles moving along the cement concrete.

### **5. Conclusion**

The type of surface has a significant influence on the generated traffic noise. The conducted environmental measures have showed that the use of cement concrete cause the increase of sound level near the road in comparison to Stone Mastic Asphalt. This phenomenon is not profitable in comparison to the basic quality of the cement surfaces, which is greater durability. The increase of the noise, shown in this work, equals (in case of a car drive) over 1 dB(A), and in case of trucks 5 dB(A). The conducted measures of the noise inside a vehicle show that the increase of level noise in cars is close to 2 dB(A).

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