MADRID
inter.noise 2019
June 16 - 19
NOISE CONTROL FOR A BETTER ENVIRONMENT

The Comparison Analysis among Noise Reduction of Different Pavement Types through the Sound Absorption Measurement

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ABSTRACT

In order to evaluate noise reduction effectiveness of different types of pavements, these two method, CPX method and SPB method, could usually be used in common. CPX method is based on tire rolling on the pavement surface with measuring microphones located close to a rear tire on the test vehicle. CPX method can evaluate the influence of pavement surface on traffic noise. Also SPB method is for sampling noise from traffic flows on a given pavement surface with to assessing the influence of the pavement surface on traffic noise. However these two method could be influenced by adjacent environmental conditions, for example community noise, atmospheric environment, weather condition etc. Therefor this study analysed noise reduction impacts of different types of pavement such as normal asphalt pavement, single layer low noise pavement and two-layer low noise pavement using the sound absorption measurement method. This method can measure noise levels in various frequency ranges with asphalt specimens. From the results of this study with the sound absorption measurement method, characteristics of noise levels in various types of low noise pavement and characteristics of noise levels in various frequency ranges for different types of pavement could be found.

Keywords: Noise, Environment, Annoyance
I-INCE Classification of Subject Number: 72

1. INTRODUCTION

There are several methods to evaluate noise levels from fricative between surface of pavement and tire. In order to analyse noise characteristics of different types of pavements, 2 type methods such as Close-Proximity method (CPX method) and Statistical Pass-By method (SPB method) could usually be used in common.

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CPX method is based on tire rolling on the pavement surface with measuring microphones located close to a rear tire on the test vehicle. CPX method can evaluate the influence of pavement surface on traffic noise. Also PBS method is for sampling noise from traffic flows on a given pavement surface with to assessing the influence of the pavement surface on traffic noise, atmospheric environment, weather condition etc.

Even though these two methods, CPX method and SPB method, are appropriate methodology to measure noise levels in pavements which providing by ISO (International Standardization for Organization), there are some limitations to apply in normal measurement of noise levels of road environment. When it measures noise levels in specific segments of roads by CPX or SPB method, it could be easily contaminated with noise in living environments, weather conditions, traffic condition etc. So it could be hard to estimate noise levels of fricative between surfaces of pavement and tire.

In order to get over this limitation, this study uses the sound absorption measurement for comparing noise reduction impacts of different types of pavements such as normal asphalt pavement, single layer low noise pavement and two-layer low noise pavement. This method can measure noise levels in various frequency ranges with asphalt specimens. From the results of this study with the sound absorption measurement method, we could define characteristics of noise levels in various types of low noise pavement and characteristics of noise levels in various frequency ranges for different types of pavement.

2. METHODOLOGY

2.1 The Sound Absorption Measurement Equipment

The sound absorption measurement equipment should be built according to ISO standards such as ISO 13472-2 and ISO 10534-2. The sound absorption measurement had a couple of benefits for example, it enables evaluation of the sound absorption characteristics of pavement surfaces without any damaging the surface of pavements. This method specified in especially ISO 13472 is based on propagation of the test signal from the source to the pavement surface and back to the receiver through an impedance tube (ISO 13472-2, 2010). According to the sound absorption measurement equipment specifications in ISO 10534-2, the layout of the equipment should be assembled as shown in the figure below.

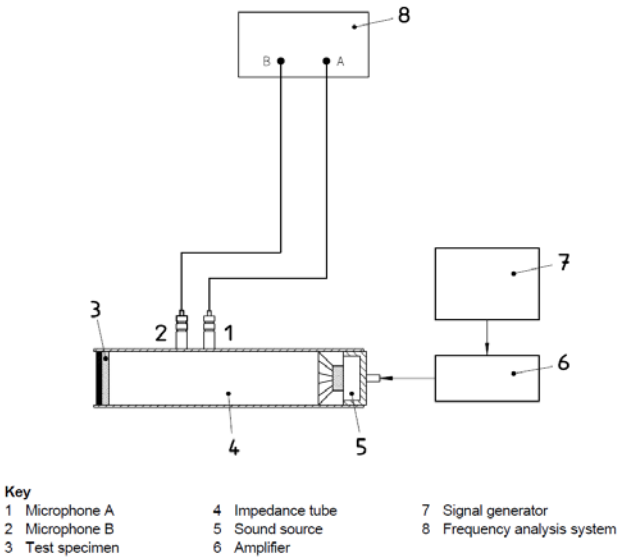

Fig. 1 – Example of layout for the sound absorption measurement equipment (ISO 10534-2)

Therefore, this study constructed the sound absorption measurement equipment as system in accordance with ISO 13472-2 and ISO 10534-2. This system consisted of a tube, microphones, a sample holder, a data acquisition system, speakers, and a computer. Also this system needs analysis tool like a software such as absorption recorder and absorption inspector as well.

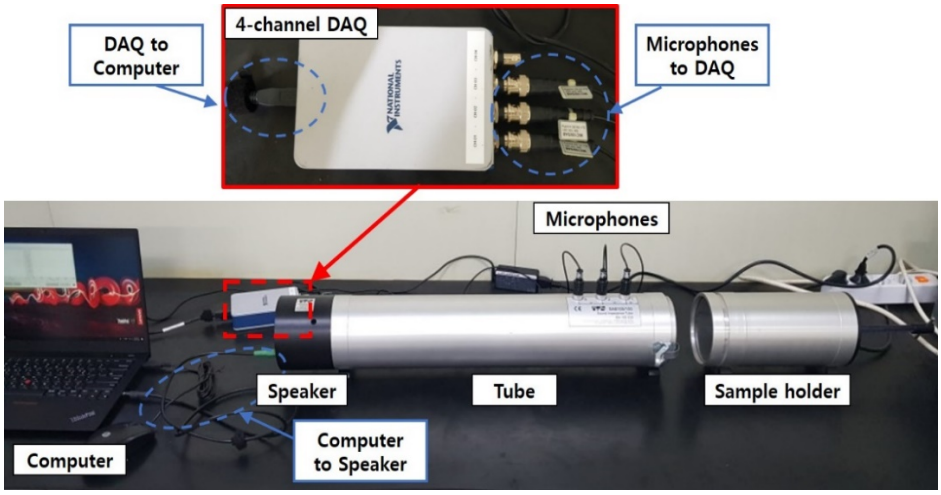

Fig. 2 – Composition of the sound absorption measurement equipment

2.2 Process of the sound absorption measurement

To compare and analysis the noise reduction effects through the sound absorption measurement, specimens of different types of pavements such as normal asphalt pavement, single layer low noise pavement and two-layer low noise pavement were produced in a laboratory. Typically, pavement specimens are produced in 101.6㎜ according to Korean Industrial Standards. However, the sample holder in the sound absorption measurement equipment allows only 99.0㎜ of specimens to measure a sound absorption level in a certain range of frequencies. So this study made specific dimensions, 99.0㎜, of pavement specimen mould in custom orders for the test.

Fig. 3 – Procedures of the sound absorption measurement

The sound absorption measurement for different types of pavements were conducted according to the procedures such as ISO 13472-2 and ISO 10534-2. Each specimen was measured 3 times as it was rotated then the sound absorption rates of each frequency range were obtained.

3. COMPARISON NOISE REDUCTION CHARACTERISTICS

In order to evaluate noise reduction effects in different types of pavement such as normal asphalt pavement, single layer low noise pavement and two-layer low noise pavement, in this study, the sound absorption measurement method was carried out using pavement specimens tests. The sound absorption rates were measured in specific frequency bands between 200 Hz and 1,600 Hz aimed at each type of pavement specimen. Measured sound absorption rates for different types of pavements are as shown in Table 1 and Figure 4.

Table 1 – Comparison of sound absorption rates in different types of pavements

Frequency	200	250	315	400	500	630	800	1000	1250	1600
Normal Asphalt	0.07	0.08	0.06	0.04	0.07	0.06	0.07	0.09	0.09	0.10
Single Layer Low Noise	0.00	0.03	0.05	0.08	0.21	0.63	0.67	0.24	0.13	0.23
Two-Layer Low Noise	-	0.05	0.08	0.19	0.48	0.57	0.33	0.17	0.13	0.17

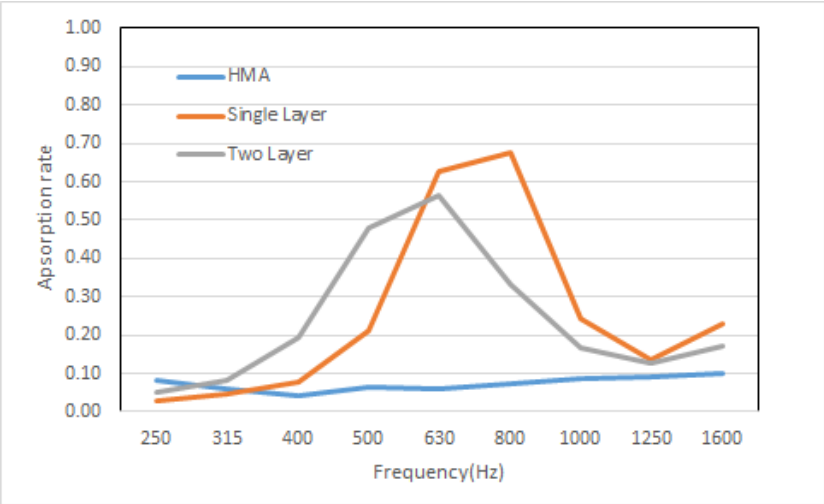

Fig. 4 – The sound absorption rates in different types of pavements

Figure 4 represents the sound absorption rates in different types of pavements in specific frequency bands. It is observed that single layer low noise pavement and two-layer low noise pavement have a better absorption rate than normal asphalt pavement. Also the sound absorption rates of single layer low noise pavement in higher frequencies (over 630 Hz) are bigger than two-layer low noise pavement. However in lower frequency (below 630 Hz), the sound absorption rates of single layer low noise pavement are smaller. It means that noise reduction effects of different types of low noise pavements could be determined by frequency bands.

Therefore in order to evaluate noise reduction effects of different types of pavements, frequency bands should be considered in characteristics of lower frequency band or higher frequency band.

Also this study analysed noise reduction coefficient (NRC) with 250, 500, 1000, 1600 Hz. NRC is an average rating of how much sound an acoustic product can absorb. From the results of NRC analysis, two-layer low noise pavement could be better absorbing sound comparing with normal asphalt pavement and single layer low noise pavement, as shown in Table 2.

Type of pavement	NRC rates
Normal Asphalt Pavement	8.3 %
Single Layer Low Noise Pavement	17.8%
Two-Layer Low Noise Pavement	21.8 %

4. ACKNOWLEDGEMENTS

This research was supported by Seoul R&DB program (PS 160001).

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