MEASUREMENTS OF STUDDED TIRES, WINTER TIRES AND SUMMER TIRES

Ólafur Daníelsson

Línuhönnun hf.
Division of Acoustics and noise control
Suðurlandsbraut 4a, 108 Reykjavík, Iceland
od@lh.is

ABSTRACT

This project is in a way an extension of a masters degree project done in 2005, *Hljóðvist í nágrenni stofnbrauta* (e. *Noise level in the vicinity of a highway*). In the masters degree project, the sound pressure level in the Markarholt building site was examined. Markarholt is a grass field located between Suðurlandsbraut and Miklabraut, to the east of Skeiðarvogur in Reykjavík. In the project a comparison between measured sound pressure level and results from software (*Soundplan*) was made. The measurements were made both in winter conditions (use of studded tires) and in summer/fall conditions (no studded tires). However, only a part of the measurements were carried out with a sound level meter that displayed separate frequency bands.

Therefore, the purpose of this project is to measure sound pressure level from three types of tires (winter tires, studded winter tires and summer tires) in two different distances from a straight road (with no other traffic). The outcome will display the difference between the tires and the effect of distance on separate frequency bands.

1. INTRODUCTION

In the year 2005 a project study was conducted regarding noise level in the vicinity of a highway. A part of the project was to measure and compare measured noise level in winter time and in summer time (with and without use of studded tires).

It was in a way surprising that the noise level measured lower when studded tires (and conventional winter tires) were in use. Other parameters could have involved, like different traffic volume between periods. Also, geographical conditions and other roads in the vicinity could have had some impact on the results.

The purpose of this project is to compare different sound level from different tire types. Those types are conventional winter tires, studded winter tires and summer tires. All other factors influencing noise will be minimized as possible. Noise will be measured at two driving speeds and two different distances from the road.

1.1. Former results

In former project, which was made in 2004 - 2005, results showed that environmental noise due to traffic is less in winter time than in summer time. This can be seen in the graph below (figure 1); the noise level in winter time is considerably lower in the near vicinity of the road (25 m) but the noise level gets more similar with more distance. This is partly also explained by the fact that more traffic was measured at 25 m distance in summer time than in winter time.

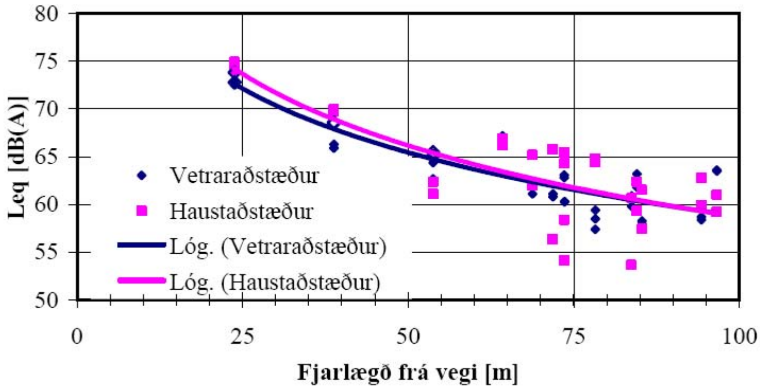

Figure 1. *Equivalent sound pressure level as a function of distance in winter time (blue line) and summer time (pink line)*

Comparison of the two lines (blue and pink) shows that the sound pressure level is quite similar. However it can be seen, that the sound pressure level in summertime is a bit higher close to Miklubraut. A reason for this could be that more traffic was when those measurements were conducted as it was earlier in the morning.

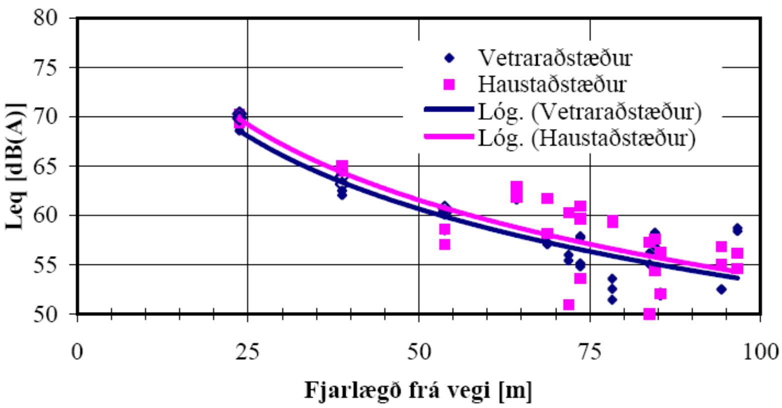

Figure 2. *Equivalent sound pressure level, recalculated with Nordtest method, as a function of distance in winter time (blue line) and summer time (pink line)*

After recalculating the results with the Nordtest method the different between the two paths stays the same (see figure 2), but is virtually constant through all distances from the road.

1.2. Equipment and tools – measurements 2008

When measurements were carried out, the Nordtest measuring method *NT ACOU 056 - Road traffic: Measurements of noise immission - survey method (2002)*, was used as a reference. The method demands that roads are dry and the vicinity not frozen or wet, except that is the purpose of the measurements.

Measuring devices was as follows:

Table 1: Measurements devices used in the measurements

Nor-121,	Sound level meter from Norsonic.
2 stk. ½” microphone	Norsonic 1225.
2 stk. ½”microphone pre-amplifier	Norsonic 1201/SLM, Norsonic 1282
Calibrator	Norsonic 1251
Cables and software to calculate results and present them	

In the measurements, all factors influencing the noise level are minimized, for example other traffic or industrial noise.
The vehicle used for the measurements is a mid-size station wagon, Toyota Corolla, year 2004, with front wheel drive and manual transmission and 1,4 L 95 hp engine – see figure 4. The vehicle weighs 1655 kg.

All tires used were of same size, 195/65 R15 – see figure 3. The tires were borrowed for the experiment from Sólning (in Kópavogur). All tires used can be descried as “typical” and commonly used for each type of tires.

Figure 3. *Conventional winter tires, summer tires and studded winter tires*

Figure 4. *The vehicle used, Toyota Corolla, and the driver.*

1.3. Conditions when measurements were conducted

Sound level measurements were made at Krýsuvíkurvegur near Hafnarfjörður. The sound level meter was placed to the side of the road in 25 m and 75 m distance from the road-edge. Previously mentioned vehicle was driven past the sound level meter and the noise measured while driving in both directions. Each measurement was made while the vehicle drove certain section of the road, marked in and out. The driver maintained constant driving speed the whole time.
Eight drive-byes were measured for each tire type, each for two driving speeds, 50 km/h and 80 km/h.

Measurements were carried out three separate days. However, the weather was excellent all three days (8. July, 16. July and 19 July), no wind, temperature averaged 11,3°C, 11,1°C and 9,9°C respectively. Background noise was measured all three days (see chapter 1.4).

The road was recently repaved (see figure 5) and therefore the road can be descried as a "silent" road

Figure 5. *Road surface and alignment*

The ground between road and measurement points can be assumed to be very diffusing and highly absorbing, whereas it is lava covered by moss – see figure 6 below.

Figure 6. *The diffusing and absorbing vicinity of the road.*

1.4. Measurement results

Here below are few graphs that show the preliminary measurements results. The first graph (figure 7) shows measured background noise for all days (all tire types) and both microphones, whereas each tire type was measured on separate days. Winter tires (8. July) and studded tires (16. July) were measured late in the evening, but summer tires (19. July) were measured early in the morning. The difference between measured values between days is in a way explained with the aluminum factory nearby, which could be heard. Since all values are less than 30 dB it is assumed to have little influence on tire noise measurements, although this should be kept in mind.

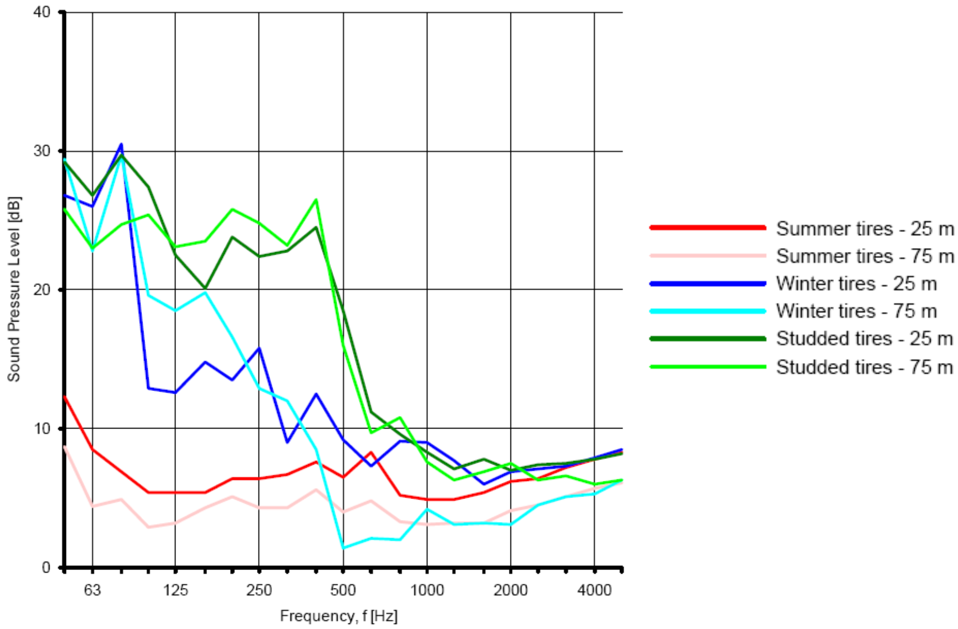

Figure 7. *Background noise, all measurement days (both microphone positions).*

When we look at measurement results in figure 8, it is obvious that tire type differs. It is a common fact that speed also matters. Studded tires measures the noisiest, but summer and winter tires are somewhat alike.

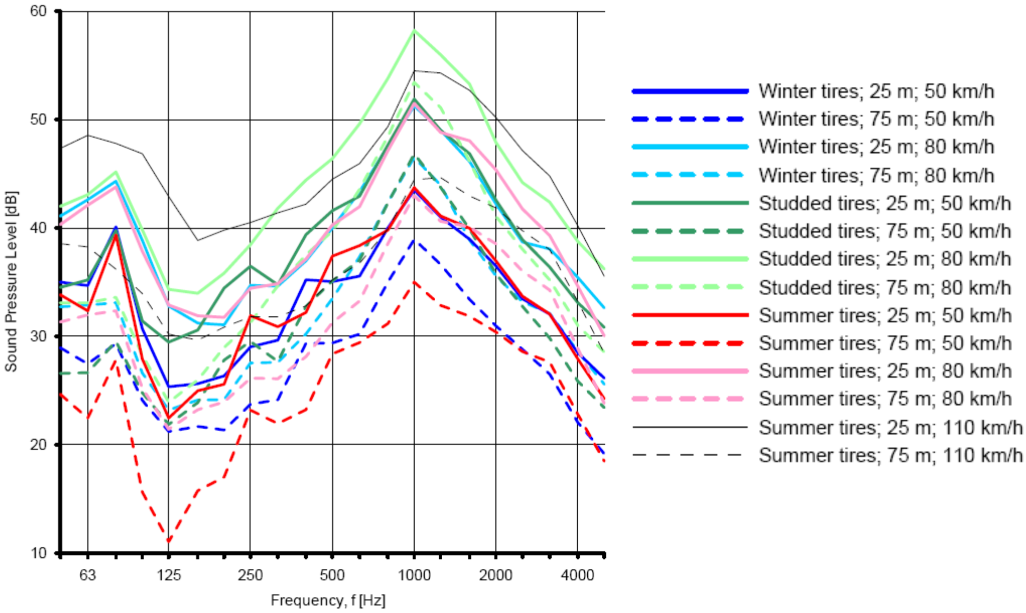

Figure 8. *Sound pressure level, equivalent over each pass-by (time) and averaged for all bass-by´s.*

Yet many questions remain unanswered. In search for answers, some calculations were made and the results are displayed in following graphs.

First in figure 9, the influence on distance is to be examined. Beforehand it was expected that the studs in the studded tires would develop more high frequency noise than other tire types, which would attenuate more with distance than other tire noise.

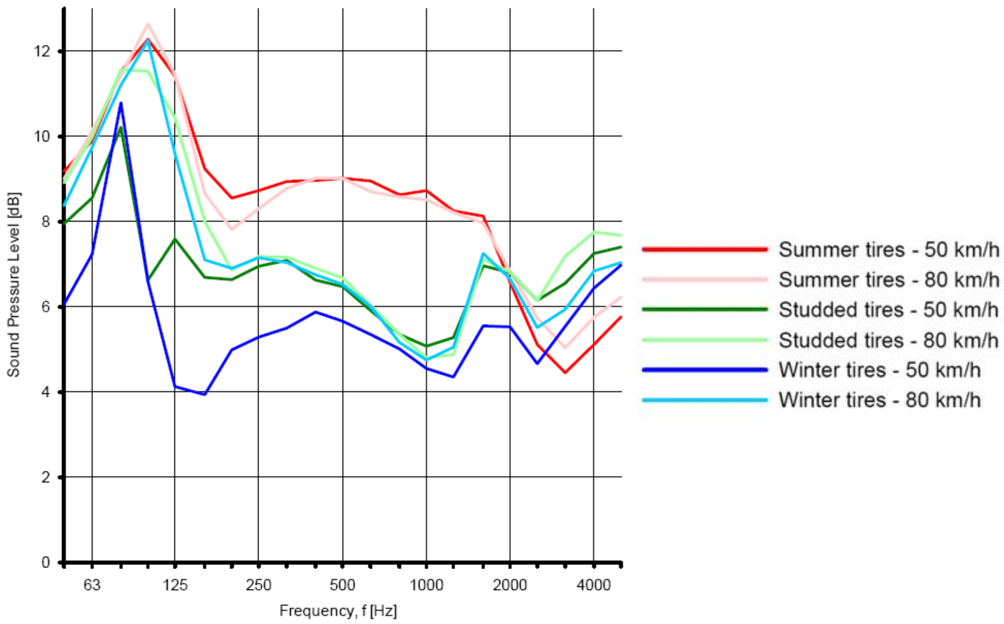

Figure 9. *Difference in sound pressure level due to distance, for all tire types and vehicle speeds, respectively.*

The difference in sound pressure level with distance is most for summer tires, but is similar for both speeds. However, a difference can be seen in the behavior of sound attenuation with distance between studded tires and winter tires for 50 km/h for 1250 – 2500 Hz. This is only seen for 50 km/h which can lead to the conclusion that for higher speed levels, the noise from studs is masked by other tire noise. This is in agreement with people's perception when a car on studded tires drives by at very low speed - each stud can be heard! The difference is also appreciable for 630 Hz and below to 100 Hz. Only winter tires show some difference in sound attenuations with respect to speed.

Figure 9 showed the difference of sound attenuation with distance for each tire type. But is that change different between tire types? When the sound attenuation with distance of one tire type is subtracted from another tire type, we can see if there is a difference. This is shown in figure 10 below.

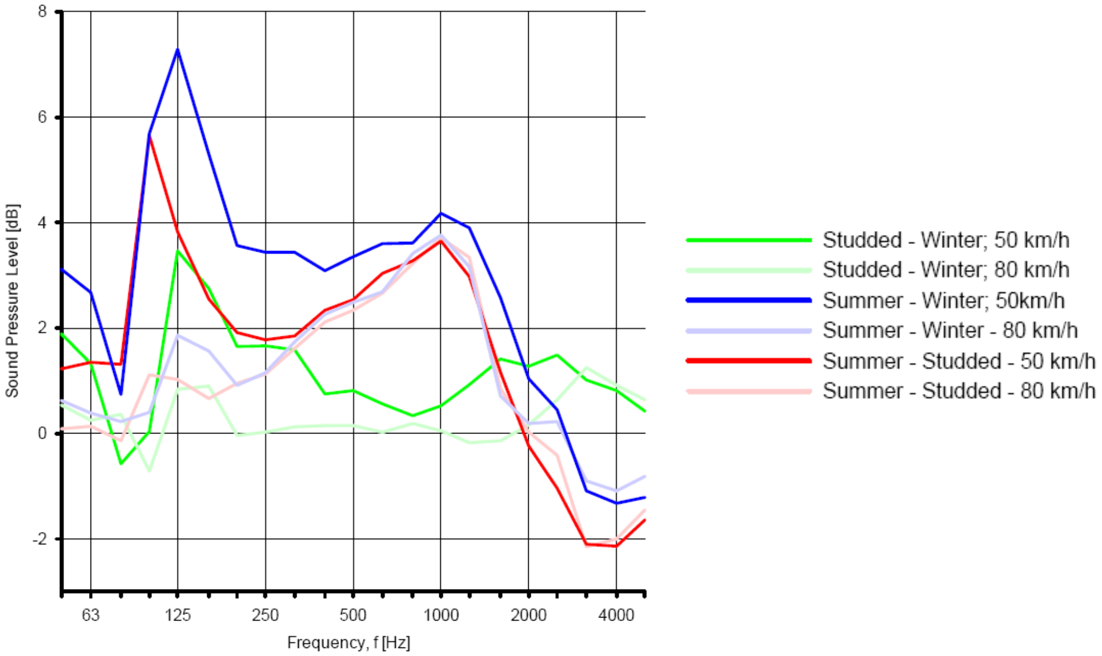

Figure 10. *Difference in sound pressure level between tire types.*

The difference is the most between summer tires and winter tires, but is quite less between summer tires and studded tires. At last, it seems like studded tire noise attenuates a bit faster than winter tire noise for low speed. For 80 km/h the difference is very small. However, when vehicle noise below 50 km/h is examined, the engine noise will influence the measurement results greatly.

2. CONCLUSIONS

Previous results showed that environmental noise due to traffic is less in winter time than in summer time. Here, the preliminary results show that studded tires measured the noisiest, but summer and winter tires are somewhat alike. Beforehand it was expected that the studs in studded tires would develop more high frequency noise than other tire types, which would attenuate more with distance than other tire noise. However, the difference in sound pressure level with distance is most for summer tires (similar attenuation for both speeds). A difference can though be seen in the behavior of sound attenuation with distance between studded tires and winter tires for 50 km/h for the frequency 1250 – 2500 Hz. This is only seen for 50 km/h which can lead to the conclusion that for higher speed levels, the noise from studs is masked by other tire noise. When noise from one tire type is subtracted from the noise level of another tire type, the difference is the most between summer tires and winter tires, but is quite less between summer tires and studded tires. At last, studded tire noise attenuates a bit faster than winter tire noise for little speed. For 80 km/h the difference is very small. However, when vehicle noise below 50 km/h is examined, the engine noise will influence the measurement results greatly.

3. REFERENCES

[1] Nordtest Method, NT ACOU 039, Nordtest, Espoo, 2002
[2] Nordtest Method, NT ACOU 056, Nordtest, Espoo, 2002
[3] Ólafur Daníelsson, *Hljóðvist í nágrenni stofnbrauta*, Háskóli Íslands, Reykjavík, 2005