Improving the acoustics of laminate floor coverings by means of damping materials

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Introduction

Corresponding to a preliminary norm of the Association of European Producers of Laminate Flooring (EPLF norm 021029-1) the loudness according to Zwicker (DIN 45 631) should be used to evaluate the quality of a laminate floor by walking across it.

Therefore, it is proposed to excite the laminate floor by a tapping machine and to measure the thus emerged loudness in the same room.

In the following, the results of different laminate floors available on the market were compared. Additionally, damping material frequently used in the automotive industry was applied to optimize the acoustics.

Brief description of the preliminary EPLF Norm (EPLF 021029-1, 2002)

An area of 2 meters times 2.4 meters of the respective laminate floor has to be installed in an anechoic chamber. Four microphones have to be positioned around the sample. Each of those microphones is recording thirty seconds of the noise produced by a tapping machine positioned at two different points on the sample (figure 1).

For the thus received eight recordings the one-third-octave spectrum averaged over the full recording period of 30 seconds has to be calculated. Out of those one-third octave levels the loudness according to Zwicker (DIN 45631) is gained. The arithmetic mean of the four lowest values (of all eight recording) has to be built. That value should notify the consumer in future of the quality of a laminate floor.

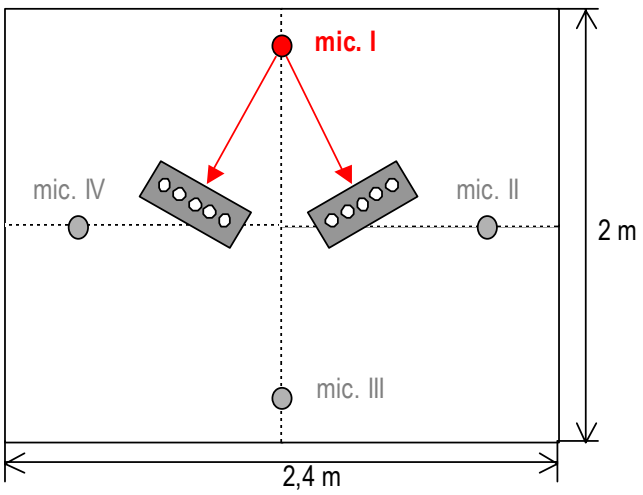

Figure 1: Sample of laminate floor and the proposed positions of the tapping machine on it for the recordings with microphone 1.

Various laminate floors in comparison

The results described in the following paragraph were obtained by the application of the above detailed preliminary EPLF-norm, except of the sample size which differed from the requested size and was only 1 meter times 1.2 meter.

Ten different laminate floors available on the market with varying thickness and mass per unit area of the acoustically efficient material were measured according to this. Figure 2 shows the rankings of the received loudness values of the ten samples.

Altogether, loudness values between 80 and 69 sone are resulting. This means, that the ten studied laminate floors are varying according to their loudness in between by 13 %.

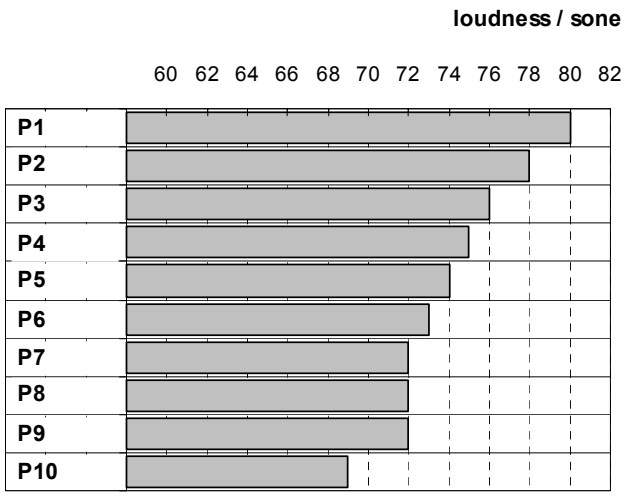

Figure 2: Ten different laminate floors (P1 to P10) available on the market measured according to the preliminary EPLF-norm and listed with regard to the hence received loudness.

Loudness versus sound quality

The aim of the preliminary norm is to make, by means of the resulting loudness values, a statement about the suggested quality of the respective laminate floor (Plinke et al. 2002). As described several times in literature (Widmann 1998, Patsouras 2003), loudness is in many cases an important factor for the perceived quality of the sound. However, if the loudness produced by the tapping machine on the floor can be used as an indicator for the assumed quality of the respective laminate floor, it should be verified in psychoacoustic experiments.

Therefore, the sound of the falling hammers was also recorded by an artificial head system and presented to ten subjects via the adequate play-back system. The subjects' task was to assign the sounds to one of the following categories of the thereby assumed quality of the laminate floor: "first-class", "rather good", "medium", "rather bad" and "cheap". Figure 3 shows the results of the experiments

(median and interquartile ranges) versus the respective loudness values received by the measurements according to the preliminary EPLF-norm. Thus, a rank-correlation of 94 % results between loudness and the suggested floor quality.

Figure 3: Suggested quality estimated in psychoacoustic experiments (red bars) versus the loudness measured according to the preliminary EPLF-norm (gray bars).

Impact of mass per unit area of a specific material of the automotive industry

For a specific material the mass per unit area was varied step wise. In addition to 2 kg/m^2 also 2.5 kg/m^2, 3 kg/m^2 and 4 kg/m^2 were measured. Also in this case the measures were realized with a sample size of 1 meter times 1.2 meter. Figure 4 shows the resulting loudness values.

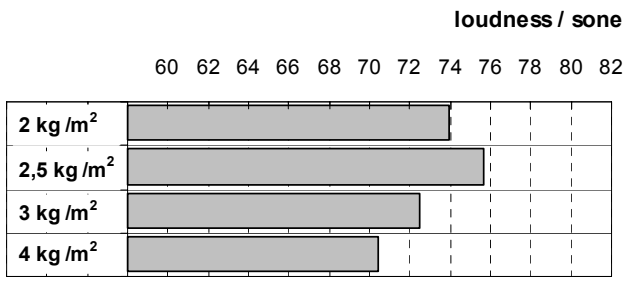

Figure 4: Loudness values measured according to the preliminary EPLF-norm for a damping material with varying mass per unit area.

Except for the sample with 2 kg/m^2, which is slightly better than the sample with 2.5 kg/m^2, an increase of mass per unit area tends to result in lower values in loudness. Between the heaviest sample and that one with 2.5 kg/m2, a difference of 6 sone is received which corresponds to a loudness increase of almost 10 %.

A material of the automotive industry by comparison

In the following, that material which received the best values in the pre-investigations (figure 1, P10) will be compared with a damping material which is frequently used in the automotive industry.

Therefore, the measurements were finally done with the instructed sample size of 2 meters times 2.4 meters on the one hand with the original laminate floor P10 ("original") available on the market. On the other hand the damping material of the automotive industry was added by means of the identical glue on the identical surface as sample P10 ("optimized"). Additionally, the surface was also measured without any acoustically efficient material on the bottom side ("bare"). The results are displayed in figure 5. While between the bare surface and the original laminate floor a loudness difference of 11 % arises, a difference in loudness of 16 % can be achieved between the bare and the optimized version.

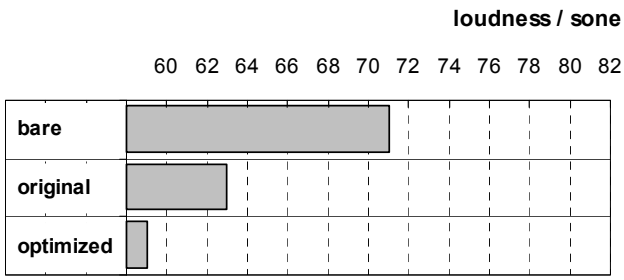

Figure 5: "Bare" surface versus the "original" laminate floor available on the market versus the "optimized" version by means of a damping material frequently used in the automotive industry.

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