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Noise emission of structured road markings

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Abstract

Road markings with a structured surface like regular patterns or a random texture have an increased nighttime visibility under wet conditions. In contrast to this advantage structured road markings show an increased noise emission when they are overrun by vehicle wheels. On a test field a choice of different structured road markings as well as a flat road marking were analyzed regarding the noise emission at different velocities of a passenger car. In a speed range from 30 to 120 km/h the controlled pass-by noise of the car was measured. Beside the A-weighted sound pressure level the third octave spectrum was calculated and the vertical directivity was analyzed. Against the background of these results the application area of the different structured road markings can be concretized in order that the positive photometric effects or the intended rumble can be used furthermore without annoying residents.

Keywords: road markings; noise emission; agglomerates; tonal components; increased nighttime visibility

1. Introduction

Road markings are used to guide road users optically and to regulate the traffic. For this purpose road markings have to be visible at day and night and have to withstand the wheel passages of vehicles. In addition road markings have to be sufficiently rough, this is especially important for cyclists.

In principal they consist of a base road marking material and drop-on materials (glass beads and antiskid aggregates), see Fig. 1. Base road marking materials are paints, cold plastics, thermoplastics and preformed road markings like tapes.

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Fig. 1. Glass beads and antiskid aggregates embedded in a base road marking material.

At the surface of the base road marking material embedded glass beads are arranged. Because of the retroreflection of the light of vehicle head lamps at these glass beads the road marking is visible at night. Rain can form a water film at the road marking and this induces, that at darkness the light of the vehicle head lamps cannot be reflected. This can occur in the case of road markings with a flat surface which are equipped with small glass beads (so-called type I road markings). Road markings with an increased nighttime visibility during wetness (so-called type II road markings) are constructed in a way that parts of the road markings jut out of the surface. That can be achieved with big glass beads or a special structure of the road markings (such as agglomerates, rough surfaces or profiles). In this case not the whole road marking is covered with a water film during rain and the parts jutting out can reflect the light of the vehicle head lamps and hence the road marking is visible at darkness.

In Germany there is a widespread range of application for type II road markings. A considerable part of them are carried out as so called agglomerates, a structure with regular or irregular patterns, see Fig. 2 (3)-(6). Due to the agglomerate structure these road markings can show an increased noise emission when they are overrun by vehicle wheels and this can lead to an annoyance due to noise for residents. Complaints of residents about noise emission of agglomerate road markings brought the authors to initiate this study.

2. Determination of the noise emission of road markings

The noise emission of road markings has been already an issue of previous studies. Tiefenthaler et al. (2002) studied structured and profiled road markings with regard to their suitability as acoustic warning line as well as their noise emission during the overrun by passenger cars and trucks. These tests were performed with seven structured road markings and a flat type I road markings as reference. Test drives on the road markings were performed on a highway with velocities of 80 km/h, 100 km/h and 130 km/h for cars and 60 km/h and 80 km/h for trucks.

Beside the pass-by measurements the noise emission of road markings can be analyzed with the Close Proximity (CPX) - survey method determining the near-field rolling noise with a trailer. Alber and Döhmen (2009) determined the A-weighted sound level of different road markings on distinct road surfaces with the CPX method using a test velocity of 80 km/h and a test tire that is based on a truck tire.