Figure 5: laying quiet road surface

Developments

Since autumn 2011 the city of Rotterdam started a project with quiet asphalt that is especially designed for heavy good vehicles. A number of test sections is laid and will be monitored the coming years.

Colofon:
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Schiedam, 9 February 2011

Transmitted by the expert
from the Netherlands

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Quiet Road Surfaces

Introduction

Noise pollution is a serious threat for health and the individual well being. This has been proven in many reports published by numerous experts and institutes. Recently the World Health Organization has published a report on Burden of Disease from Environmental Noise (March 2011). A large part of the population of Europe is exposed to high noise levels caused by traffic. This can lead to annoyance, sleep disturbance, health effects, learning difficulties, an amount of lost healthy life years (DALY's) and even mortality. To reduce traffic noise, many measures need to be taken at a local level as well as at the national governmental level. At a local level, noise reducing road surfaces represent the preferred solution for reducing traffic noise, especially in urban context, where it is generally the most cost-effective, compared to other noise abatement measures (noise barriers or façade insulation). Since the end of the last century silent roads have been applied particularly on urban roads and bypasses (near built-up area).

This leaflet gives a short introduction for those who wants to explore the benefits and common pitfalls of silent road surfaces in urban situations.

Policy

The European Commission addressed environmental noise as one of the main environmental problems in Europe. Reduction of traffic noise is an increasing priority in the policy of European countries, not in the least by the European Noise Directive 2002/49/EC. The EU

members states are imposed to produce noise maps and action plans regarding environmental noise.

In many action plans silent road surfaces are the most effective and cost efficient measure in the abatement of environmental noise. However, history has learned that a silent road surface is a type of surface that only can be applied with specific knowledge about design, laying process and maintenance procedures. Therefore it is important to know the relevant aspects of application of these surfaces

Noise reducing road surfaces

The acoustic emission of modern passenger cars is dominated by the noise of the rolling tyres. Only under conditions of strong acceleration or speeds below 30 km/h propulsion noise can dominate. Also for heavy duty vehicles at speeds above 60 km/h, rolling noise starts to become the major source. Rolling noise is influenced by the properties of the road surface like surface texture, acoustical absorption and aero-dynamical processes (air-pumping). Improving the surface properties in such a way that the efficiency of the noise generating and amplifying processes are reduced will result in a lower rolling noise level.

There are several types of silent road surfaces and their application are mainly determined by the featured noise reduction, the allowable traffic speed, the composition of the traffic flow and the possible wrenching of tyres on the surface due to parking movements. For urban situations three surface types are commonly applied:

A. Thin Surface Layers
B. Stone Mastic Asphalt
C. (Double-layered) Porous Asphalt

of damage. There is more torsion and friction movement of the traffic; and lower vehicle speeds mean a reduced self-cleaning of porous road surfaces. It is recommended that a porous surface is cleaned once or twice a year to prevent clogging. Winter maintenance for silent road surfaces is comparable with what is normally done on porous surfaces. Be aware during the maintenance of the silent road surface that small repairs often have a negative influence on noise reduction.

Monitoring the acoustical effect

figure 4 cpx measurement of the surface

To optimise the performance management of silent roads it is advisable to implement a monitoring program to determine the change of acoustic effect in the lifetime. Managers and decision makers get a synoptic overview of the acoustical effects after implementing their silent road policy. It is recommended to compare the findings of the monitoring with the acoustic effect of a conventional road surface. A study like a monitoring programme provides insight into the long-term effects of low noise road surfaces. These insights allow well-founded choices to be made in terms of durable solutions to noise problems.

Economical aspects (costs and benefits)

A silent road surface is more expensive to lay most of the time and also more expensive to maintain than a conventional surface. At the same time the expected life time of a silent road surface is shorter. Its cost efficiency can only be proved by comparing these costs to those of conventional noise measures (noise screens or facade insulation). Although silent road surfaces are expensive they are most of the time the cheapest noise reduction measure.

The following aspects had be taken also in amount with regard to silent road surfaces:

- For porous layers the durability of the sideway drainage is an extra aspect for attention. Periodically cleaning or extra precautions can be expensive;
- The contribution of porous layers to the bearing capacity of the pavement construction is relatively small, so strengthening can be necessary;
- Almost all silent road surfaces are not adequately resistant to wrenching tyres and therefore not a suitable application for crossings, roundabouts etc. The general rule is: more reduction means more voids, and thus a shorter service life.

Management and maintenance

The laying of a silent road surface is a critical process. Extra restrictions considering lay out, weather conditions and skill of the asphalt laying team have to be taken into account. The dry and wet skid resistance will vary in the first period after laying and low values can be measured, so warning of the road users is essential.

Processes that can negatively influence the acoustic degradation of low noise road surfaces are loss of stones, ravelling and the reduction of absorption (for open-graded mixes). Particularly in urban environments road surfaces are very sensitive to these types

figure 1: double layered asphalt

A. Thin asphalt layers:
These thin layered bitumen surfaces exhibit moderate porosity and acoustic absorption, but, due to the fine grading, optimal surface texture. This result in a surface with an acceptable durability, moderate costs and quite positive noise reducing properties. This asphalt reduces noise relative to DAC 0/16 by 2 to 5 dB in urban situations.

B. Stone Mastic Asphalt:
Stone mastic asphalt is popular because of its durability and its resistance against rutting. Stone Mastic Asphalt with an aggregate size of 5 to 6 mm has an optimal texture of the surface. The noise reduction for this type of SMA is a maximum of 2 dB in urban situations relative to DAC 0/16. Although considered noise reducing road surfaces, the versions with larger stone sizes can be quite noisy. The effect of a 40 % increase in aggregate size is 1,5 dB for passenger cars.
C. (Double-layered) porous asphalt:

Drainage or porous asphalt shares its stone skeleton with SMA, but due to the lower amount of mortar, holes are not closed, but form open channels through the material. The porosity gives the road surface good absorptive properties. The noise suppressing effect is maximal when the surface is smooth (by use of a fine fraction in the top layer) and the thickness is optimized so the acoustical absorption is maximal for reducing traffic noise. With this road surface, noise reductions of more than 4 dB can be achieved. But, this type of asphalt needs regular maintenance. Without maintenance the noise reduction performance drops rapidly. The durability of this asphalt is low, especially in urban circumstances. In suburban areas (ring roads for example) porous asphalt appears to be more suitable.

Durability of the acoustical effect

It is known that the surface properties which cause the acoustic reduction change in time. In almost all situations this lead to a decline of the noise suppressing capabilities. By lack of monitoring programmes, there is insufficient general knowledge of the material's long-term behaviour with regard to civil engineering and acoustic properties. Most relevant processes are the roughening of surface texture due to stone loss in the surface and increasing of flow resistance due to clogging of the pores.

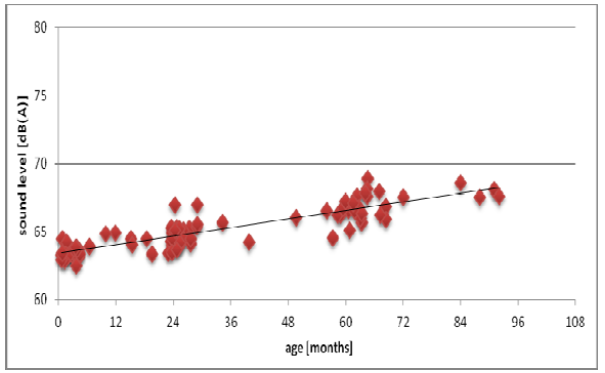

figure 2: sound reduction over lifetime

When conducting a study into acoustic properties over time, it is important to evaluate the road surface depending on the expected life. A conventional road surface such as dense asphalt concrete (DAC) or stone mastic asphalt (SMA), will show less acoustic degradation, but these surfaces have a significantly longer life. A quick decline in noise reduction for conventional road surfaces thus has a greater effect over the long term than for low noise road surfaces. The blue line is silent road surface and the red one conventional road surface. The dashed lines are the averaged life times.

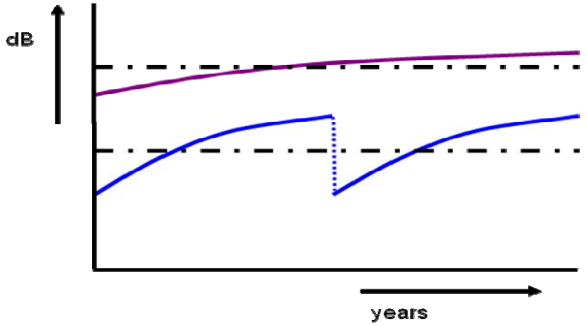

figure 3: comparison quiet asphalt and normal asphalt