MONITORING 20 SILENT ROADS OVER 10 YEARS IN THE MUNICIPALITY OF GRONINGEN

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Abstract

The municipality of Groningen in the northern part of the Netherlands has a wide experience with the application of silent roads. This experience covers a period of about 20 tracks with 2-layered porous asphalt and various types of thin layers. These tracks have been and are monitored regularly. The obtained data from 10 years monitoring offer a vast amount of valuable information on noise reduction, durability, maintenance, costs, contracts and policy.

INTRODUCTION

A busy city like Groningen has to be reachable optimally by various means of transport. Especially by road traffic, however, this has a negative side in the form of traffic noise and air pollution. Traffic noise is a major source of annoyance. In the biannual liveability research, about 22% of the population of Groningen states to be annoyed by traffic noise. Also questionnaires for local plans give similar results. It becomes clear that long-term exposure to high noise levels influences health of citizens negatively. Therefore, in Groningen alternatives for transport by car is being developed like simulation of bicycles, better and faster public transport. Also these alternatives have a positive effect on air quality and safety. An additional measure is the application of silent roads. Cars on these kinds of roads produce less noise than on standard road types. In the beginning of the nineties, 2-layered porous asphalt was introduced as the ultimate solution for traffic noise. Now, there is about 10 years of experience with the construction and maintenance of noise reducing asphalt. In the early years the choice was rather limited; nowadays many new silent road types have

been developed. After these ten years it is time to evaluate our experiences. This evaluation will take place every 5 years because the development of new products has not ended yet.

NOISE ASPECTS

Legal Framework

The legal framework for traffic noise is in the Dutch Noise Legislation. This law is meant to:

1. Prevent new situations in which citizens are exposed to traffic noise.
2. Reduce the number of citizens that are already exposed to traffic noise.

Research has shown that an average noise level at the façade of 50 dB(A) is experienced by 10% of the population as annoying. At levels of 65 and 75 dB(A) these percentages are 55% and 85%, respectively. Therefore, the law includes preferable noise levels. For new situations the preferable noise level is 50 dB(A). If in existing situations noise levels are 60 dB(A) or more than sanitation is necessary. This sanitation comprises (possibly in combination):

- Source related measures (reduce emission of noise)
- Transmission related measures (reduce spreading of noise)
- Receiver related measures (reduce noise form entering)

Source related measured are preferred since they improve liveability of other areas too. Any measure must assure that noise levels inside houses do not exceed 45 dB(A). The autonomous growth of traffic leads to slowly increasing noise levels near major routes. This could lead to new sanitation situations along roads, also along those that belong to state and province. Cooperation between various authorities (state, province, and city) is, therefore, essential to abate traffic noise effectively. It is clear that there is more to silent roads than only road construction. According to the earlier mentioned law no house is to be built if there are no source related measures. This implies that for each situation, based on civil engineering as well as legislation arguments, it has to be decided whether to apply noise reducing asphalt or not. Also changing (growing) traffic intensity can force the application of noise reducing asphalt. With conventional asphalt the noise levels at the adjacent houses could be too high.

Present policy against traffic noise

Groningen follows a concentration policy. This means that traffic is concentrated on main routes and, therefore, living areas stay traffic calm. The negative aspect of this is that the main routes cause high noise levels. During many years sanitation measures have been taken to limit traffic noise. This was performed mainly by applying façade isolation and noise barriers. In Groningen, noise barriers have been

put along all roads in suburban areas and façade isolation in areas were noise barriers are unwanted due to architectonic or visual reasons. At this moment, the most urgent cases have been sanitised and, therefore, attention is paid now to less urgent situations. Because financial means are limited no more façade isolation or noise barriers will be used. The stress has been laid on applying noise reducing asphalt in order to limit traffic noise. The practical execution is coupled to programmes for road changes en maintenance. If maintenance of a certain road is up hand there is a built-in checkpoint. If noise reducing asphalt has to be applied the extra corresponding costs are included in the total project.

Contract conditions to durability of noise reduction

VANKEULEN consulting has expertise on the field of developing, application, and labelling of noise reducing road types. They analysed the applied contracts with respect to noise. Especially whether or not these conditions were feasible and correct. Also new demands have been formulated for future applications in which durability plays a role. In general it holds that durability is inversely related to noise reduction. In other words: the higher the noise reduction, the lower its life time. Normally, a loss of 2 dB(A) of noise reduction over 5 years is accepted in our contracts combined with an initial noise reduction of 4 dB(A). If this demand is not met, the contractor has to perform measures to restore the noise reduction. Before putting the road, the contractor has to make it likely on bases of laboratory test, calculations, and/or noise measurements that the demanded noise reduction and its life time can be met. The noise measurement is to be performed according the procedure from the European project Silvia [1].

CIVIEL ENGINEERING ASPECTS

Different types of noise reducing asphalt

Noise reducing asphalt is still under development. Asphalt producers keep searching for mixtures that are cheaper, quieter, and more durable. At this moment the following types are in use:

- *Standard Porous Asphalt* – This road type has been developed for preventing splash and spray and aquaplaning on air fields. A problem with porous asphalt is pollution of the pores.
- *2-layered Porous Asphalt* – The search to combine water drainage and noise reduction this road type emerged. The self cleaning effect is improved, therefore, pollution slows down. The noise reduction is about 4 dB(A) for light vehicles at 50 km/h. The road has to have an advanced drainage system in urban areas.
- *Thin layers* (*microlayers*) – An alternative to 2-layered porous asphalt are thin noise reducing layers. These products have only one layer of about 25 mm thick. The advantaged of these layers are low costs (no drainage) and high durability (good resistance against wear). The noise reduction is a little higher than that of 2-

layered porous asphalt. The expected life time is about 10 years. However, this has still to be proven in practice. Nevertheless, our first experiences are hopeful.

Noise reducing asphalt in Groningen

2-layered porous asphalt

From 1996 to 2000 five roads of the city network have been covered with 2-layered porous asphalt in order to reduce traffic noise. In all cases strict legislation demands had to be met. Traffic had intensified significantly and façade isolation and noise reducing asphalt were the only options in these cases. Noise reducing asphalt, however, is much more attractive, financially. In these cases the Ministry of Environment funded the application of porous asphalt. With this an accompanying long-lasting contract incorporated a long-term warranty with respect to noise reduction. Also a long-term contract with the contractor was made because there was no clue about the long term behaviour of the asphalt. In this contract posts had been included concerning small and major maintenance. Costs of possible repairing were split among municipality and contractor.

Soon after their construction, all surfaces showed damage (ravelling) especially near joints. From 1997 till 2004, major maintenance was necessary, yearly. The open structure showed too little resistance against wear which is caused by the open structure. In conventional asphalt types the stone is fixated completely. In porous asphalt, however, the stone is fixated by only a limited number of contacts. Especially in curves and near parking places ravelling occurred (see figure 1).

Figure 1 – Ravelling of 2-layerd porous asphalt (left photo). Ravelling continues in the lower layers (right photo)

Because of the intense heavy traffic also in curves and on crossings damage occurred [2]. As soon as the first stones are lost raveling is progressing rapidly. That is why raveling is a criterion for the durability of open mixtures. On one location the top layer had to be replaced within three years. At only one location the porous

asphalt seems to function satisfactorily and there its estimated life time is about 7 years.

Thin layers

The first test with thin layers was in 2000. The initial noise reduction was 3 dB(A). Since then, the noise reduction reduced 1 dB(A) per year. At this moment there is no more noise reduction, however, the surface is still in good condition and will probably last some years more.

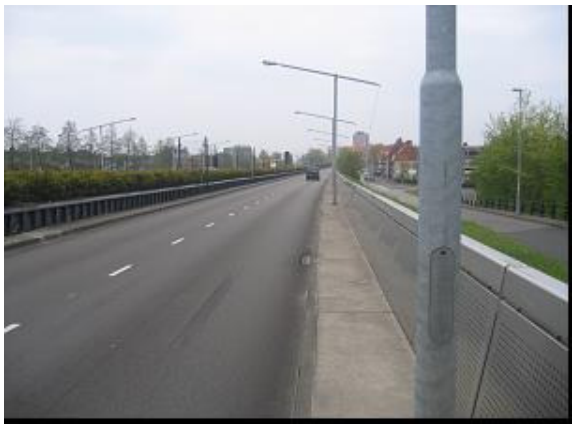

Figure 2 –Parkwegviaduct with thin noise reducing layer

In 2002 the first *semi-dense* thin layer was applied on a road. The initial noise reduction was 3.8 dB(A). It was expected that these kinds of roads show better resistance against wear because of their limited number of air voids. In practise this was underlined and, therefore, the noise reduction remained more or less equal. In 2003 on two other roads these thin layers have been applied and again the noise reduction showed only very little change. Apparently, the product development showed major improvement concerning quality.

In 2004 it was decided to replace the porous asphalt at three locations by an thin *open* layer with a labelled noise reduction of 4.3 dB(A). The damage of the old porous asphalt reached a level at which repairing was not possible. First measurements showed that the actual noise reduction is equal or better than that of 2-layered porous asphalt. So, by applying these types of roads the legislation demands (preferable noise levels) were met. No long-term contract with the contractor was needed in this case, since maintenance risks were covered by the so-called ZOAB-fund (En.: Porous Asphalt fund).

Also, in 2004, on other four new locations thin layers have been applied. The initial noise reduction was 4.6 dB(A) on all locations.

FINANCIAL ASPECTS

Financial maintenance consequences

Construction – The costs for thin layers are a little higher than for conventional asphalt. This is caused by the higher costs of the applied materials.
Small maintenance – This can be included in the daily routine because it is very similar to maintenance of conventional asphalt. Costs of small repairing are equal.
Major Maintenance – From experience (see previous section) it follows that 2-layered porous asphalt requires a lot of maintenance. Every five years the top layer had to be replaced. Producers indicate that the life time of thin layers is 8 till 10 years. This corroborates out experiences. Developments continue and, therefore, a life time of 10 years seems realistic.

Fund higher maintenance costs

Maintenance risks were covered by the earlier mentioned ZOAB-fund that was raised in November 1999. City counsel decided to account for the financial consequences of porous asphalt by raising the initial costs by the capitalised (extra) maintenance costs. These extra costs in case of 2-layered porous asphalt were: construction, monitoring (visual inspections and noise measurements), replacing top layer (every 7 years) and replacing both layers (every 15 years).

Since 2000, for every applied m^2 of noise reducing asphalt (2-layerd porous asphalt or thin layer) a certain amount was donated in the ZOAB-fund. Because of the disappointing experiences with 2-layered porous asphalt, the fund seems to have become redundant. This, however, is partly true. Micro layers are a suitable alternative for porous asphalt. Despite their costs are significant lower, they still are more expensive than conventional asphalt types because of the earlier mentioned extra costs –however, much lower- that also apply to thin layers. Relative to conventional asphalt thin layers cost € 17.00/m² or € 0.85/m² per year (cycle 20 year). Only when for every applied m² noise reducing asphalt € 0.85 times 10 yrs. = € 8.50 is donated to the fund then after 10 years a new noise reducing asphalt can be financed.

Since a number of years, the application of thin layers is synchronised to programmes of road planning and regular maintenance. National funds are to be applied to be able to continue application of noise reducing asphalt.

CONCLUSIONS

If everything would be alright then noise reducing asphalt is a product you hear little of. But everything is not alright yet. The application of 2-layered porous asphalt in urban areas is problematic. Raveling is a major problem and, therefore, this road type has to be checked regularly. Intensive and often maintenance is necessary and noise

reductions vanishes quickly and often there is even more noise. Porous asphalt has to be cleaned two times per year in order to maintain drainage. The claimed life time of 7 years is in practice much less. Besides the high initial costs also the extra costs for maintenance are a major disadvantage. Applicability is, therefore, limited in urban areas. Furthermore, funds for road maintenance are getting less and less. **In Groningen, 2-layered porous asphalt was unsuccessful.**

A good alternative are thin layers. First experiences in Groningen are positive and seem to confirm that their noise reduction remains longer. However, also thin layers are more expensive than conventional asphalt. Therefore, thin layers are only applied where it is necessary in order to meet legal noise limits. The accompanying extra costs are included by the developing and not by the regular maintenance.

OVERVIEW NOISE REDUCING ASPHALT IN GRONINGEN

streetname	**surface**	**year**
Zuiderweg	thin layer	2003
Johan van Zwedenlaan	thin layer	2003
Paterswoldseweg I	thin layer	2000
Paterswoldseweg II	thin layer	2009
Paterswoldseweg III	thin layer	2010
Verlengde Hereweg I	thin layer	2003
Verlengde Hereweg II	thin layer	2008
Helperzoom I	thin layer	2004
Helperzoom II	thin layer	2006
Helperzoom III	thin layer	2007
Goeman Borgesiuslaan	thin layer	2004
Zonnelaan	thin layer	2003
Kraneweg	thin layer	2004
Rodeweg	2-layered porous asphalt	2000/2003
Kurkstraatje	2-layered porous asphalt	2000
Emma-/Parkwegviaduct	2-layered porous asphalt / thin layer	1996/2004
Peizerweg	thin layer	2004

streetname	**surface**	**year**
Oranjesingel	thin layer	2002
Eendrachtskade Nz and Zz	2-layered porous asphalt / thin layer	2000 / 2005
Europaweg I	2-layered porous asphalt	1996
Europaweg II	2-layered porous asphalt / thin layer	1999 / 2006
Kastanjelaan	thin layer	2006
W.A. Scholtenstraat	thin layer	2006
Hereweg I	thin layer	2007
Hereweg II	thin layer	2008
Oostersingel	thin layer	2010

LITERATURE

[1] http://www.trl.co.uk/silvia/Silvia/pages/index.html

[2] Keulen, W. van, Schuddeboom J. “On the numerical effects of replacing silent roadtypes by non-silent roadtypes on roundabouts,” 13th ICSV, Vienna (2006).