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# NOISE LEGISLATION, NOISE POLICY AND SILENT PAVEMENTS ON MOTORWAYS IN THE NETHERLANDS: PAST, PRESENT AND FUTURE.

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## 1 INTRODUCTION

Whether it comes from traffic or from your neighbours, too much noise is always a problem. Legislation and regulations for preventing this are not a new thing. Ancient Rome, for example, two thousand years ago, already had regulations for reducing traffic noise. Vehicles with iron banded wheels driving along the roads – which were then by no means flat – caused a lot of disturbance during the night-time periods. And in order to reduce the noise nuisance to neighbours, it was forbidden during the reign of Queen Elizabeth I in England to beat your wife after 10 in the evening.

In the Netherlands, the social, political and policy-based interest in noise nuisance dates to more recent times. This interest has over the course of time resulted in a copious dossier in terms of legislation, regulations and policy, for restricting noise nuisance. In this contribution, the past, the present and the future of the noise dossier are described. It is done from the perspective of noise nuisance alongside the national roads in the Netherlands. This approach allows the reader to make a journey through past, present and future.

## 2 NOISE LEGISLATION, NOISE POLICY AND SILENT PAVEMENTS: THE PAST

### 2.1 Start

The start of environmental policy by the Dutch authorities does not occur at a clearly demarcated point in time. It is certainly so that the environment came to be more and more prominent on the political agenda from 1970 onwards. The report by the Club of Rome[1] appeared in 1972. The conclusion was: 'If the present growth trends (...) continue unchanged, the limits to growth on this planet will be reached within the next one hundred years.' In 1972, the Emergency Memorandum on Environmental Hygiene[2] was published. This memorandum is generally seen as an important milestone in the initial period of national environmental policy. The tone set by the Emergency Memorandum on Environmental Hygiene was alarming, as was the Club of Rome report. The general feelings of worry about the current state and for the future of the environment were strengthened once again by international developments such as the oil boycott of the Netherlands by Arab countries at the end of 1973. People said that 'a new era was beginning'.

### 2.2 Noise legislation

The circular[3] entitled 'Noise Nuisance' appeared in 1973. This circular included guidelines for the permissible noise nuisance by road traffic. The national government has been using this guideline for the construction of motorways or national roads since 1973. This circular became one of the key building blocks for the Noise Abatement Act. The draft legislation[4] was submitted to the States General in 1975. The act came into effect from 1979/1980, in a number of stages. In broad terms, the Dutch legislation for traffic nuisance boiled down to the following points:

- Within a zone alongside the road, noise levels at houses and other noise-sensitive premises such as schools, hospitals, etc must comply with the standards of the Noise Abatement Act. The width of the zone depends on the number of lanes of traffic. For instance, a motorway with two carriageways of two lanes each outside built-up areas has a zone 400 metres wide on both sides of the road.
- A distinction is made between existing and new situations. There is an 'existing situation' for housing that was present on 1 March 1986 and that then were subject to a noise level of more than 55 dB(A) Letm as a consequence of the road. The construction of new housing within the zone alongside the road is an example of a 'new situation'. This also applies to the construction of new national roads.
- For an existing situation, the preferred noise level is 55 db(A) Letm at the facade of the housing. The preferred noise level when constructing a new road has been set at 50 dB(A) Letm. When reconstructing an existing road, the noise level before the change is usually the preferred noise limit.
- In addition to the preferred noise levels, the legislation also defines a maximum allowed noise level. In existing situations, this value is 70 dB(A) Letm. When a new motorway is being built, the maximum allowed noise level is 60 dB(A) Letm. In existing situations, the preferred noise level indoors is 45 dB(A) Letm; in new situations it is 35 dB(A) Letm.
- In order to determine whether the limits are met when a new national road is being built or after reconstruction of a national road, an acoustic survey is carried out. An acoustic survey must always determine two noise levels: the average noise level during the daytime (between 07:00 and 19:00) and the average noise level at night (between 23:00 and 07:00). 10 dB(A) has to be added to the night-time noise level. The greater of the two noise levels, known as the 24-hour value LAeq or in Dutch 'Letm', is checked against the limits stated in the Noise Abatement Act. For national roads, the value during the night-time period is almost always the determining one.
- Because measurements are complex, expensive and time-consuming, noise levels are calculated in almost all cases. How the investigations are to take place is described in detail in the noise calculation and measurement protocol[5]. Based on the noise calculation and measurement protocol, a number of larger acoustics consultancy agencies have written computer programmes. These programmes make allowances for a large number of factors that can affect the level of noise nuisance.
- If the acoustic survey shows that housing is subject to noise that exceeds the legal limits, measures have to be taken. The most efficient measures are those targeted at the sources: quieter engines, quieter tyres and quieter road surfaces such as porous asphalt or two-layer porous asphalt. The noise reduction due to porous asphalt is approximately 4 dB(A) in comparison with solid asphalt; for two-layer porous asphalt it is approximately 6 dB(A). If the source measures do not provide sufficient noise reduction, other measures such as noise screens and/or walls have to be considered.

## 2.3 Noise policy

In the Netherlands, the use of porous asphalt actually started in 1988, when the maximum speed limit on motorways was increased from 100 to 120 km/h. In order to make this increase possible, the Ministry of Transport made agreements with the Ministry of the Environment. It was agreed that porous asphalt would be used in order to compensate for the increase in noise levels along national roads due to the increase in the maximum speed limit. Porous asphalt was applied as part of the regular maintenance schedule for the roads. Road surfaces of dense asphalt were replaced at the end of their lifecycle by porous asphalt pavements. Express roads with less than 35,000 vehicles per day were initially excluded from the regulation. The low intensity of vehicular traffic was thought not to be sufficient to keep the pores in the porous asphalt open properly. This exception was dropped just a short while later. When the Second National Traffic and Transport Structure Plan[6] (SVV-II) appeared in 1990, this policy was tightened up: the entire main road network was to be given quieter road surfaces (porous asphalt), unless there were technical objections to applying a silent, open-structured road surface.

## 2.4 Silent pavements

The story of asphalt begins long ago. The first recorded use of asphalt as a road-building material was in Babylon, around 625 B.C. Porous asphalt, however, dates from the end of the Second World War. The open texture was needed to clear water from runways in order to prevent fast incoming aircraft from aquaplaning in wet conditions. The first test section[7] using porous asphalt in the Netherlands was laid in 1977. This test section remained in place until the mid 90s without any significant problems with ravelling. Test sections were laid on other roads later on. The use of silent road surfaces, in particular porous asphalt, really took off because of the policy agreements (see section 2.3) and the legal context (see section 2.2).

# 3 NOISE LEGISLATION, NOISE POLICY AND SILENT PAVEMENTS: THE PRESENT

## 3.1 Noise legislation

Over the course of the years, the Noise Abatement Act – which was already far from simple – became more and more complex. In addition, it has become clear over previous years that the current Noise Abatement Act does not provide sufficient protection against the consequences of autonomous traffic growth. As long as the national road authority does not modify the infrastructure, the current Act allows the growth of traffic and noise nuisance to occur unhindered. This results in uncontrolled increases in noise levels at surrounding housing, increases that are not subject to regulations. This was reason enough to examine the Noise Abatement Act in detail to see if improvements were possible.

This was the start of a process that was supposed to ensure fundamental modernisation of the instruments controlling the way in which the Netherlands dealt with noise nuisance. The first attempts to submit a legislative proposal to Dutch parliament failed in 2002. During the final meeting of the caretaker cabinet, it was decided that the debate on the legislative proposal would be left for the next cabinet, and the legislative proposal was therefore not submitted to the House of Representatives. The Secretary of State for the Environment wanted to continue the developments that had been set in motion, but not in the form of a separate legislative proposal. It was decided to modify the current Noise Abatement Act in phases, first for national roads (see section 4.1) and later for the provincial and municipal roads. The proposal to review the Noise Abatement Act, focusing on the national roads and railways, was submitted to the Dutch parliament in December 2009[8].

There is also European legislation, in addition to national legislation. The Environmental Noise Directive[9], for instance, was published in July 2002. The purpose of the directive is to avoid, prevent or reduce the harmful consequences of exposure to environmental noise. In addition, the directive was intended to provide a basis for the development of European source policy, such as tightening up the requirements on motor vehicles and tyres. The EU directive was implemented in the Netherlands in July 2004. It made provisions for the construction of the noise map for national roads in 2007, and the action plan in 2008. At the same time, the introduction and application of the harmonised noise nuisance indicator, Lden (instead of Letm) was provided for by law.

## 3.2 Noise policy

There have inevitably been changes over the years since the 1990s not only affecting legislation but also in terms of policy. Together with the current Noise Abatement Act, the Mobility Policy Document[10] that was published in 2006 currently determines what the road maintenance authority must and must not do in terms of tackling noise nuisance along national roads. In addition to the

normal execution of the Noise Abatement Act, the state will also deal with areas in which noise levels along the road network exceed values of more than 65 dB(A) Lden. As of 2006/2007, where this is cost-effective, silent road surfaces with the acoustic quality of two-layer porous asphalt will be applied on the main highway network in residential areas and possibly also in areas within the primary ecological structure.

## 3.3 Silent pavements

Despite all policy efforts, traffic has increased since the 1980s. The growth of traffic, together with the raise of the speed limit on parts of the motorways, caused noise levels to increase along the motorways. These developments have been displayed in figure 1.

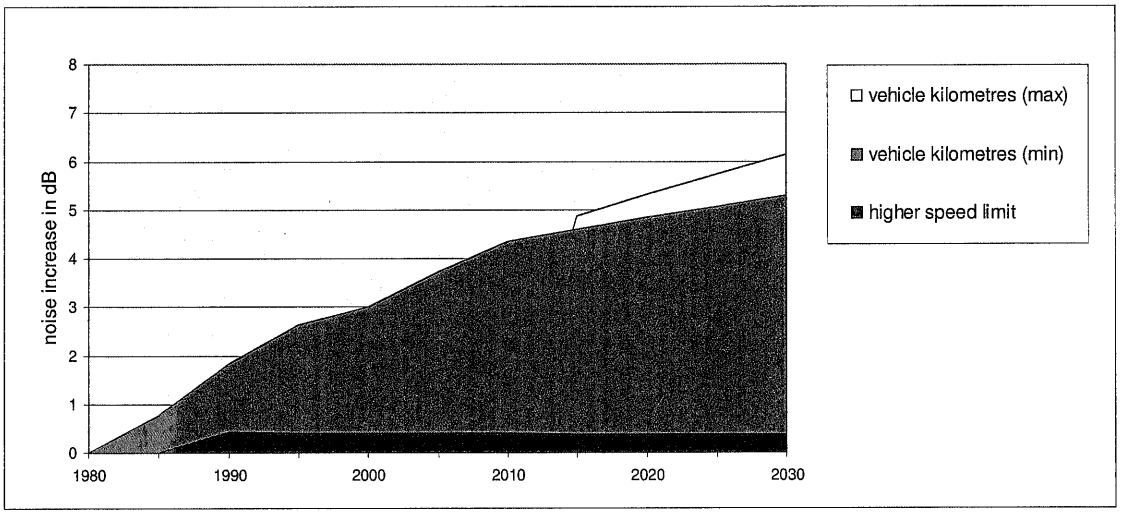


Figure 1. Increase in noise along Dutch motorways.

Since 1980, noise has increased by about 4 dB. And as traffic increases in future, so will noise levels. By 2030 we will have to cope with an extra 2 dB due to the predicted growth of traffic on our motorways. In order to comply with the regulation in the Dutch Noise Abatement Act, the national road authority has been taking noise control measures since 1980. First of all, we build noise barriers and noise walls. The first of these dates back to 1977. On a local scale, noise barriers are highly effective in reducing high noise levels. Now there are 526 kilometres of noise barriers and 290 kilometres of noise walls along either side of the 3,100 km of motorways in the Netherlands. At the national scale, the effect of noise barriers and noise walls is rather small. Secondly, since 1989, the national road authority has been using porous asphalt as the standard surfacing material on the motorways. Nowadays, about 80% of Dutch motorways have this silent surface. By 2020, almost the entire network will have porous asphalt. Due to this high degree of use of porous asphalt on our network, the effect at the national scale is large (see figure 2).

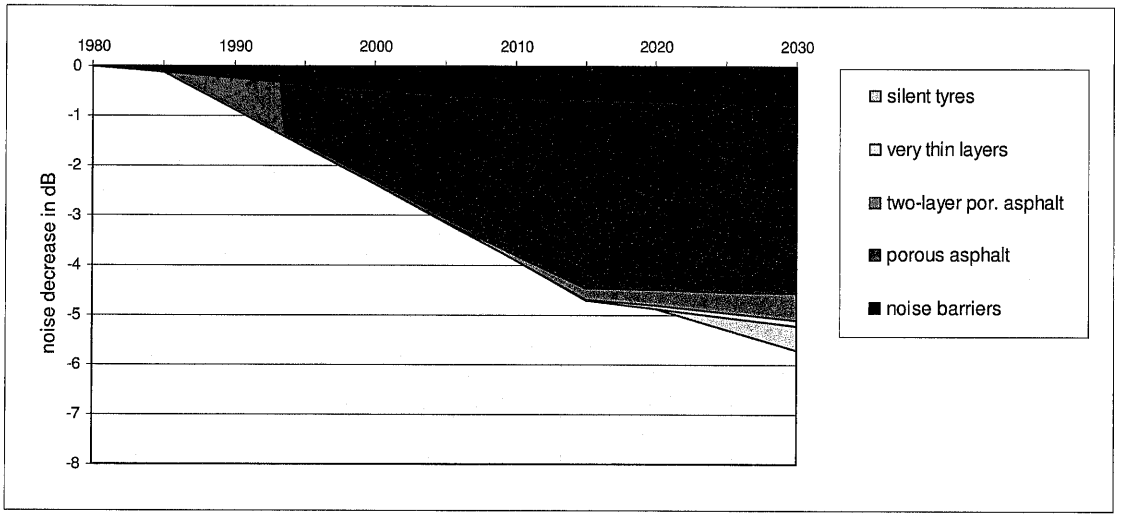


Figure 2. Decrease in noise along Dutch motorways.

Up until now, these two noise measures together were capable of compensating almost completely for the noise increase as a result of more and faster traffic. In the future, other noise measures such as two-layer porous asphalt, silent tyres for cars and new developments such as very thin noise reducing layers will be necessary to cope with the predicted extra 2 dB. But so far, the national road authority has done a great job in handling noise along the motorways (see figure 3).

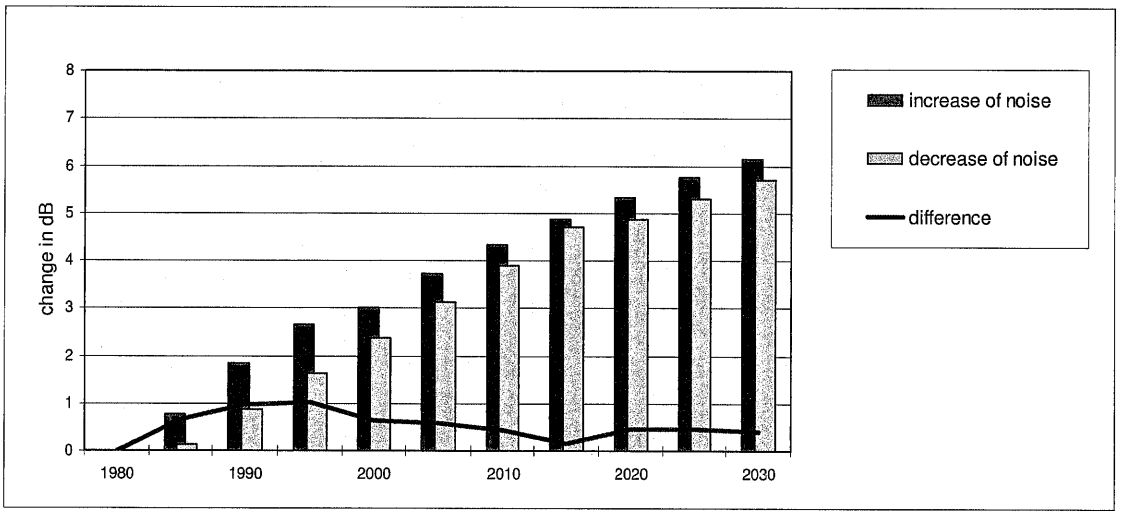


Figure 3. The difference between increase and decrease in noise along Dutch motorways.

# 4 NOISE LEGISLATION, NOISE POLICY AND SILENT PAVEMENTS: THE FUTURE

## 4.1 Noise legislation

The objective of the revision of noise abatement legislation is to make an end to the growth of noise nuisance and to protect houses and other noise sensitive premises better against noise nuisance. At the same time, it will also substantially simplify the regulations. This should result in a more effective array of legal instruments that will in practice offer a greater degree of legal certainty to

citizens and at the same time ensure that improvements in the infrastructure can be carried out more rapidly.

Current legislation offers insufficient opportunities for reducing increases in noise levels due to autonomous traffic growth, except when a road is reconstructed. This will be resolved by the introduction of a new system, although as yet only for roads that are managed by the state and for the main rail network. The new system is based on three pillars: controlling noise levels, reducing high noise levels, and increased use of source measures. Each of these pillars has its own instruments. Noise production ceilings are to be introduced as a legal instrument for controlling noise levels. High noise levels will be tackled by large-scale cleanup operations (remediation). Instruments to improve the implementation of source measures will include additional requirements imposed on the minimum acoustic quality when roads are built or reconstructed.

### 4.1.1 Noise production ceilings

The noise production ceiling states the maximum noise level that road traffic may produce at a so-called reference point. These points are located on both sides of the motorway (see the black spots in figure 4).

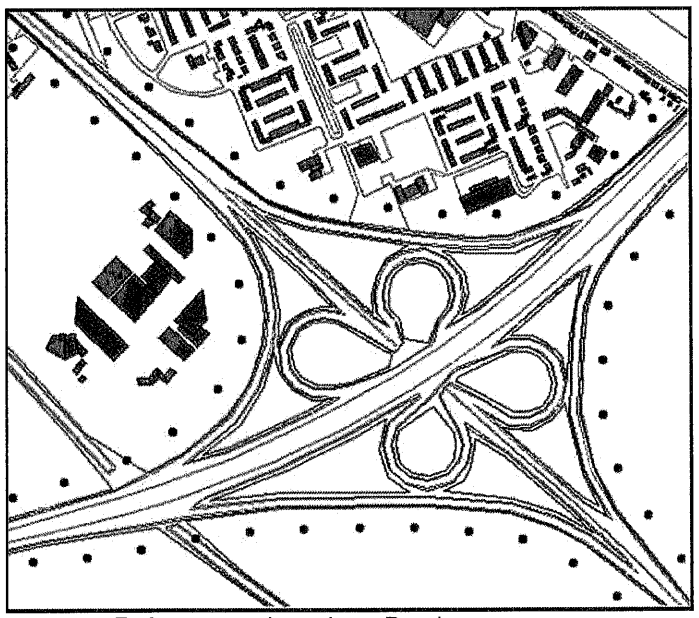

Figure 4. Reference points along Dutch motorways.

The noise production ceiling shall in general be determined by two factors:
- the noise level in each reference point at the moment that the new noise legislation comes into effect and
- what is known as a 'working space' of 1.5 dB.

This working space is linked to an obligation on the national road authority to prepare noise reduction measures in good time and to implement them in order to prevent the noise production ceilings being exceeded; these measures will mostly reduce noise production to a noise level lower than the level at the moment that the legislative proposal comes into effect. The shift from porous asphalt to two-layer porous asphalt for instance has a noise reducing effect of 2 dB. The acoustic effect of a noise barrier is a local reduction of noise levels of up to 10 or even 15 dB. Taken over a longer timeframe, this means that the noise production at the reference points will on average remain roughly the same level, 1.5 dB below the noise production ceiling.

### 4.1.2 Noise hot-spot remediation

In addition to preventing new situations in which there is too much noise nuisance, it is also extremely important that existing hot-spots should be cleaned up – remediation – to avoid significant negative health effects. In order to improve these existing situations in which there is too much noise nuisance, the government has a subsidy scheme since the 1980s. This is operated by the Ministry of Environment; they arrange for the financing of noise abatement measures for situations close to national roads or railways in which the noise levels were already too high at the time when the Noise Abatement Act was introduced. When national roads or railways are modified, the remediation work is carried out by the national road authority. This existing remediation work does not, however, envisage an approach to new noise hot-spots that have arisen after the introduction of the Noise Abatement Act due to traffic growth, i.e. undesirable situations will still remain after the ongoing remediation work is completed. The realisation that the existing remediation activities are not complete and not progressing quickly enough has led to an additional noise abatement objective being defined in the Mobility Policy Document for national roads. A budget of 515 million euros has been reserved for the national roads, as part of the budget for the Ministry of Transport. This means that there are two remediation operations, one by the environmental ministry and one by the transport ministry. With a view to efficient execution of the remediation work for the national roads, it has been decided that the remediation activities of both ministries should be merged to a single remediation operation. The Ministry of Transport will be charged with implementing it. The remediation operation will run from 2011 to 2020, will be budget-controlled and will be based on the principles of a threshold value of 65 dB (Lden) and a target value of 60 dB (Lden).

### 4.1.3 Source policy

Merely tackling situations where there is a high noise level is not sufficient. There is a desire to limit noise nuisance further, and traffic is probably going to continue to increase. Additional generic measures are therefore needed to ensure that noise pollution increases as little as possible, or preferably even drops. This can be done by taking source measures. Source measures are available that have effects that are large in proportion to their costs. In current policy, major efforts are being made both nationally and internationally to introduce measures aimed at the source. Examples of the implementation of this policy are the Noise Innovation Programme[11] (Dutch: IPG), Dutch efforts to get noise requirements on road vehicles and car tyres tightened up in Brussels and Geneva, and a national stimulus for the use of quieter car tyres. This legislative proposal provides a number of angles for supporting this source policy.

First of all, road surfaces being laid or replaced must comply with a minimum acoustic quality. This minimum is also referred to as the 'minimum standard' and it is intended, where reasonable, to prevent road surfaces being used that will result in relatively high levels of noise production. A list is being defined containing the standard (source) measures that must be put in place as a minimum when a road (or part of a road) that is maintained by the national road authority is being laid or replaced. When drawing up the standard measures, the baseline will consist of measures that are in line with the current state of technical knowledge, that are generally applicable and that are not associated with financially unacceptable additional costs. The minimum standard for roads will basically involve using porous asphalt. This product is not prescribed; however, the noise reduction achievable with it is. Taking other measures that are acoustically equivalent will therefore also be permitted.

Another focal point is the ceiling system itself. Source measures do in fact offer the national road authority a large number of benefits under the new system. The use of source measures can allow the road maintenance authority to improve its infrastructure without individual legal decrees about noise levels being involved (with all the associated legal procedures). Not only that, but it is also possible to avoid procedures if, for example, traffic growth is threatening to result in the ceiling

being exceeded. It is expected that the noise production ceiling will be a driving force for the implementation of source measures within the infrastructure.

## 4.2 Noise policy

An impulse is to be given to the noise source policy over the coming years. An ambitious objective has been adopted of a reduction of 3 dB by 2025 in the actual noise levels at houses on the remediation list for municipality roads. This is based on quieter tyres, more silent road surfaces and reduction of engine noise. Large-scale introduction of electrical (delivery) vehicles can generate positive effects not only local air quality, but also on noise levels. In order to make as many new measures as possible available for vehicles and roads in the shortest possible time, for application in urban areas, an Urban Noise Innovation Programme will be set up by the provinces, municipalities and the Ministry of Environment. In the long run however, this initially urban noise policy will also have some positive effects on noise levels along motorways.

## 4.3 More silent pavements

The Noise Innovation Programme developed measures to tackle traffic noise at the source, in order to make Dutch highways quieter. Quieter road surfaces were an important measure for tackling the source of traffic noise. Two-layer porous asphalt, as it is known in Dutch, consists of two layers of the well-known porous asphalt. When two layers are placed one on top of the other, the road surface contains even more hollow spaces, which absorb noise. More hollow spaces means greater noise absorption. In the end, noise production is reduced by roughly 6 decibels compared with non-porous or dense asphalt. This noise reduction measure has been tested as part of the IPG and found to be effective. The measure has now been approved for use, which means that two-layer porous asphalt may be applied in the Netherlands. Right now there are about 200 kilometres carriageway with two-layer porous asphalt on Dutch motorways and this figure will increase considerably in the near future. Another road surface innovation from the IPG is thin noise reducing pavements. These are predominantly micro-grade coatings that derive their noise reducing properties from a fine surface texture. These road surfaces were specially developed for express roads with a speed limit of 80 km/h.

As for the far future: a development known as a poroelastic road surfacing (PERS) looks promising. The EU-subsidised project PERSUADE[12] is aiming to develop the experimental concept of PERS into a feasible noise abatement measure as an alternative to e.g. noise barriers. Experimental projects in Japan and Sweden have demonstrated that very large noise reductions can be achieved, up to 12 dB(A) in comparison with conventional dense, non porous asphalt. The specific feature of this new type of road surfacing is that it consists principally of rubber granules made from recycled car tyres bonded with a synthetic resin such as polyurethane. However, given current knowledge about the technique, its durability remains inadequate. The project programme comprises extensive investigations in the laboratory to develop a durable mixture, the construction of seven test sections in five partner countries, a monitoring effort for the test sections (noise, rolling resistance, skid resistance, durability, winter behaviour, etc), and a study of all conceivable environmental and economic aspects. The general goal is to remove doubts about the technical and economic feasibility of the PERS solution for abatement of road traffic noise by demonstrating successful full-scale applications.

# 5 CONCLUSIONS

The journey through past, present and future has shown that the Dutch national road authority (Rijkswaterstaat) has been making efforts to prevent and combat noise nuisance along national roads since 1980. Rijkswaterstaat has over recent years taken the actions necessary within the framework of the current Noise Abatement Act to minimise the consequences of continuing growth

in traffic. In particular, the use of porous asphalt has contributed to the fact that increases in traffic have not led to increased noise nuisance along national roads. This battle will continue to be fought over the coming years. The new legislation for noise abatement offers good angles for allowing increases in traffic in future without it resulting in more noise nuisance along the Dutch motorways. It is expected that existing noise nuisance may even decrease as a result of the new measures for tackling noise hot-spots. It is to be hoped that the developments relating to source measures, more silent road surfaces and quieter tyres, will be able to make a significant contribution also to match the demands for mobility and the demands for good noise quality alongside Dutch motorways.

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