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MEASURES FOR TRAFFIC NOISE ABATEMENT

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ABSTRACT

One of the most important environmental issues in densely populated areas, such as Germany or Italy, is the problem of noise. Traffic noise from cars, railway vehicles and airports located in close proximity to the city is not only annoying for residents; it also leads to serious health issues and has an enormous negative economic impact. Therefore, the German Environment Agency has developed noise abatement measures covering road, railway and aircraft noise as well as decision criteria for its applying. Road traffic noise: Further tighten limit values for road vehicles and tires, extent the knowledge of the public (both users, suppliers and other stake holders) about the noisiness class of products like vehicles and tires, continue development and application of low noise surfaces. Railway traffic noise: substitute cast-iron block brakes with even synthetic material or disk brake and maintain high quality wheel and rail smoothness, introduce stricter noise requirements for all freight wagons. Aircraft traffic noise: Introduce tighter limit values of noise certification levels, harmonize noise categories of aircraft, establish permanent incentives to optimize flight procedures regarding noise. Criteria for applying abatement measures: Develop harmonized methods to determine and internalize the costs and benefits of measures to reduce traffic noise.

Keywords: *traffic noise, abatement measures, harmonized methods*

1. INTRODUCTION

Many people are exposed to high levels of noise that adversely affect their health and quality of life. Noise is now experienced virtually every-where and around the clock, in towns and in the country, day and night. As a result of large-scale infrastructure projects such as the construction of new airports or the expansion of existing ones, there is much greater political, scientific, and public awareness of the issue of noise. To a certain degree, noise is a pollutant, which has only a localized effect unlike other pollutants but which can be found virtually everywhere as there are so many areas that are affected by it. Exposure to environmental noise due to transport has a negative impact on people. The World Health Organization Regional office for Europe published an overview in which four main effects are distinguished: general annoyance due to the disturbing effect of noise on the wellbeing, interruption of sleep during the night, stress-related effects on the cardio vascular system of humans and cognitive impairment on children. The increased level of noise is primarily the result of an increased volume of traffic. There are, however, a whole series of measures which can reduce noise pollution, from low-noise car tires to less noisy brakes for freight trains to strategies to avoid use of transport. It is especially important to involve the general public as much as possible in the fight against noise.

2. ROAD TRAFFIC NOISE

Although vehicle technology has advanced considerably in the last 25 years, leading to improved mileage and gaseous emissions, the noise emission has not improved. For cars at high speed, the situation has even worsened Only for heavy duty vehicles under urban driving situations improvements are found. This trend is in clear contradiction to the continuous tightening of type approval limit values from 82 dB(A) in the early eighties to 72 dB(A) from July 1st, 2016. This paradox can be explained by the fact that the 82 dB(A)

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presented a relaxed limit value, which did not have much effect in terms of shifting the noise emission of the vehicle fleet. Then, additional tightening of limit values where often bypassed with a change in test procedure or added allowances for specific vehicles. The most important effect is that under conditions of normal driving the tires contribute most of the emission, while in the test procedure it used to be a much smaller part. There is a relevant effect of vehicle speed on the noise emission. When going from 50 to 120 km/h the sound emission increases about 10 dB(A). The effect on the time-averaged road side level however has to be corrected for the shorter passing time at high speed (with a factor 10·lg(120/50) dB(A)) resulting in a net effect of 6 dB(A) on equivalent road side levels.
Recommendations for road traffic noise abatement:
- Improving the source emission of cars and trucks, by tightening type approval procedures and limits for vehicles and their tires
- Stimulating the buying and usage of low noise vehicles and tires, and taxing noisy ones
- Application of noise reducing road surfaces
- Reducing the driving speed
- Improving driving style by suppressing high engine loads and avoiding high engine speeds through gearing up quicker.

3. RAILWAY TRAFFIC NOISE

Unlike road traffic noise, which occurs virtually everywhere, rail traffic noise is much more localized to individual transport corridors. However, depending on the type of train and the volume of trains, very high levels of noise can be generated, especially along freight corridors on which most of the rail traffic is at night. One example is the Middle Rhine Valley, which is part of the European freight corridor between Rotterdam and Genoa. In many places along this corridor, the noise levels are essentially higher than those considered desirable to maintain good health. The noise caused by rail traffic is therefore the ecological Achilles heel of the railway. However, there are measures for the reduction of noise emitted by rail traffic. The main source of the noise emitted by rail rolling stock at low speeds is the engine; at moderate speeds, it is the wheel-rail contact; and at very high speeds, it is aerodynamic noise along the length of the rolling stock. The most important factor for the general population in terms of noise pollution is the rolling noise. It occurs as a result of areas of roughness on the running surface of wheels and rails and is emitted by them. The measures therefore involve preventing the formation of such areas of roughness on wheels and rails and reducing the emission and transmission of noise. In the case of the rails, it is also important that they are as smooth as possible. Over the past few years, there has already been progress in this respect. New technical processes allow the manufacture of smoother rails. Measures to reduce noise emission are rail absorbers and shields as well as wheel absorbers and optimized wheel geometries. But the most important measure, and also the most cost-effective one, is refitting noisy freight wagons. This involves replacing the cast iron brake blocks previously used with modern composite brake blocks, which do not roughen the surface of the wheels to the same extent and which therefore result in a quieter rolling noise. In Germany, this measure is already accomplished.
Recommendations for railway traffic noise abatement:
- Improving the source emission of railway stock by tightening approval procedures and limits for new railway stock
- Stimulating the usage of low noise railway stock by taxing noisy ones
- Improving the acoustic characteristics of the railway tracks
- Substitute cast-iron block brakes with even synthetic material or disk brake and maintain high quality wheel and rail smoothness
- Optimize the wheel geometry, since the noise reduction potential of optimized wheels is up to 4 dB(A)
- Install noise absorber blinds at the cooling air in- and outlet in order to minimize the noise of driving, standstill and acceleration, the noise reduction potential is up to 5 dB(A)
- Introduce stricter noise requirements for all existing freight wagons.

4. AIRCRAFT TRAFFIC NOISE

It is not just ground-based transport that is the cause of considerable noise pollution. Many people are also affected by aircraft noise. Unlike with road and rail traffic, in the case of aircraft, a building has no quiet side shielded from noise, where people can sleep, for example. Protecting people from aircraft noise at night is therefore especially important. A sufficiently long period of undisturbed sleep is essential for mental and physical rest. Although there are individual differences in sleeping behavior, people on average need eight hours of unbroken sleep. The flight path can also have a considerable impact in terms of aircraft noise on people living near airports. Different flight paths should be used during the day and at night in order to protect the people near airports. All aircraft need to pass

certification tests that includes noise emission. Since aircraft noise is mainly an issue around airports the noise tests are based on two noise measurements made on the ground when the aircraft is taking-off (fly-over and side-line) and one measurement when the aircraft is landing (approach). In the first, and now outdated, classification of a low noise aircraft (Chapter 3) a maximum allowed noise level is defined at each of these positions. The noise values are expressed as EPNdB's a measure that is defined slightly different from the generally used dB(A) value. The limit levels are made dependent on the maximum allowed take–off weight and for fly-over also on the number of engines. Chapter 3 limits are introduced in 1972 and in 2001 a tightening was introduced with a 10 dB lowering cumulative over all measuring positions, referred to as Chapter 4. These values became mandatory in 2006 for all new aircraft. 2021, an additional tightening of 7 dB (cumulative over all measuring positions) came into force. Although the service life of aircraft is shorter than for rail wagons, it is longer than of road vehicles. So, in addition to improving the noise emission of new aircraft, the replacement of existing noisier aircraft is also stimulated. Apart from a total ban on Chapter 2 aircraft in Europe, in about 40% of the airports the landing and take-off charges are (for a part) based on the noise category of the aircraft. No general categorization of the noisiness of aircraft exists. In many cases the certification values are used but the definition of the categories differs, in other cases (Germany and Switzerland in particular) the classification is based on own measurements. For several airports, restrictions exist for the usage of noisy aircraft in the noise-sensitive night period. Also, at quite a few airports there exists a limit to the total number of operations (or more effective for noise control, the total noise emission) over a yearly period. The freedom to introduce such restrictions is however limited due to European law. Noise abatement operational procedures include a series of measures aiming at reducing the immission levels on the ground by optimization of the flight procedures during take-off and landing. Modern aircraft and airport navigation, including GPS-based steering, enable more controlled routing both in horizontal as in vertical sense, compared to the conventional instrument-based flight procedures. For instance with reduced drag procedures (faster retraction of flaps in take-off and reduced flap settings during approach), Noise Abatement Departure Procedures (NADP) and Continuous Descent Approach (CDA), take-off and landing operations can be performed with less noise impact on the ground. Specific nuisance is suppressed by restricting the use of reverse thrust after touch down and the engine run-up before take-off. The application of such procedures must not jeopardize safety and have to be balanced against the capacity. However, with capacity very often fixed priory and with safety as inflexible condition, there is usually very little space for to noise optimized operational procedures.

Recommendations for aircraft traffic noise abatement:

- Introduce tighter limit values of noise certification levels and the approval system for new aircraft
- Harmonize noise categories of aircraft
- Establish permanent incentives to optimize flight procedures regarding noise
- Taxation of the usage of noisy existing aircraft.

5. CONCLUSIONS

In a comprehensive concept for noise reduction, measures to limit noise emissions based on state-of-the-art technology play a particularly important role together with a reduction in the use of transport (slogan "city of short distances") and greater use of more environmentally friendly means of transport. These measures "at the source" have an impact everywhere and in this respect have priority before noise mitigation barriers or soundproof windows, which only have a local impact. The goal of noise reduction tools is to make vehicles, their operation, and the roads or tracks on which they travel all quieter. With this in mind, noise thresholds in particular must be consistently adjusted to consider advances in technology. The development of technology, in turn, must be actively supported and tax incentives used to create further technological potential for noise reduction in the future. An essential part of a modern transparent noise reduction strategy is the direct involvement of as many members of the public as possible. People know very well what the local noise issues are and often already have a clear idea about how they can be resolved. Better use needs to be made of this local knowledge. Research into the impact of noise has shown that noise is often perceived as less loud if people are directly involved in the decision-making process. The mutual trust of those involved in the process is also a very important factor. A series of investigations have shown that there is a correlation between the trust people have in the goodwill of those in positions of responsibility, or conversely their lack of trust in them, and their annoyance reaction. Trust is therefore key to the acceptance and successful implementation of noise reduction measures. Once trust has been established with those affected, the likelihood of the relevant measure being effective is that much greater.