



Abatement of rail noise – especially of locomotives – in Germany

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ABSTRACT

Environmental noise is an important issue causing one of the most common public complaints in Germany and within the EU. Noise causes health threats, like cardiovascular effects and cognitive impairment and has an enormous negative economic impact. The most important source for rail noise is freight trains that operate around the clock. The enormous ecological "Achilles' heel" of railway traffic is the noise. Especially during the nights, the noise impairment is up to 25 dB(A) above the threshold, which is to be aspired in terms of a precautious health protection of the people. Noise is of high relevance with respect to any expansion, upgrade or construction measures of railway infrastructure. Therefore, it is agreed to enlarge noise protection measures to a wide degree. There are a number of technical measures available, e.g. retrofitting of the freight wagons to alternative brake systems. Moreover, legal measures like the Technical specification for interoperability relating to the subsystem 'rolling stock' the TSI Noise exists. This TSI Noise constitutes general requirements for the transnational railway traffic in Europe. The presentation gives an overview on technical measures – especially for locomotives – to efficiently abate railway noise in Germany more ambitious than the legal limits of the TSI Noise.

1. INTRODUCTION

One of the most pressing environmental issues in our cities 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. This is why making our cities quieter is of primary importance for city planners, engineers and politicians. The most important source for rail noise is freight trains that operate around the clock. Railway traffic has an important function for a sustainable mobility in Germany and Europe. Therefore, it is planned to transfer more traffic from the roads towards the railway. The politicians and the majority of the people support this. However, in contrast to that is the enormous ecological "Achilles' heel", the noise emissions. Especially during the nights, the noise impairment is up to 25 dB(A) above the threshold, which is to be aspired in terms of a precautious health protection of the people. Noise is a frequent reason for complains and of high relevance with respect to any expansion, upgrade or construction measures of railway infrastructure. Along of one of the most used railway corridors Rotterdam-Genoa, the resistance of the people is high. Many people in Germany are protesting against railway noise and any more railway traffic in their region, especially in the Middle Rhine valley.

2. TECHNICAL MEASURES TO REDUCE RAILWAY NOISE

Railway freight traffic is mainly because of their braking technology the predominant railway noise issue in Europe, followed by high speed and inner-urban railway lines. The Federal Environment Agency recommends measures to reduce noise at the source, i.e. vehicles and tracks, which are more cost-effective and generally more effective. Freight trains still use cast iron brakes and are therefore much noisier. Wheel roughness together with rail roughness is the main source of noise in conventional rail, the main cause of wheel roughness being the use of cast iron brakes. This problem is still more urgent considering that these trains often operate at night. Now it is therefore necessary to

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replace the iron brakes by new composite or similar brakes. However, this is not sufficient to solve the problem of railway noise. The research study “strategy for an effective reduction of noise by rail freight transport”¹ gives a good overview for noise abatement measures in the future. In this paper, we present some of the measures especially for locomotives.

2.1 Noise Absorber blinds at the cooling air in- and outlet

This measure can be used to minimize the noise of driving, standstill and acceleration. Because of the lamellas, the air particles be diverted and the kinetic energy of the air particles will be convert into heat. The absorber blinds should be designed to ensure that the engine get enough air for cooling. It is easy to install this measure in stock and not expensive. The noise reduction potential is up to 5 dB(A).



Figure 1 – Noise Absorber blinds at the Blue Tiger²

2.2 Screw Cormpressor

This device can be installed in order to minimize the noise of driving, standstill and acceleration. The advantage is that the screw compressor do not emit beating sounds like the conventional compressor. The reason for that is that a screw compressor produce continually compressed air. The investment costs are 7000 € and the subsequent costs are the same like the conventional compressor. The noise reduction potential is up to 5 dB(A).

2.3 Optimized blade shape for the cooling fan

In Figure 2, an optimized blade shape is shown. Like the other two described measures, this helps to minimize the noise of driving, standstill and acceleration. The optimized blade shape reduces the noise of the cooling fan. The costs for this measure is estimated to be 1.000 € for a new locomotive and 12.000 € for existing stock. The higher costs for stock is due to the need of adapt the electronics. The noise reduction is up to 6 dB(A).



Figure 2 – Optimized blade shape³

2.4 Spiral Silencers

The Spiral Silencer can be used to minimize the noise of standstill and acceleration. The costs is estimate to be 2.000 €. The Spiral Silencer is a combination of a conversion and absorption silencer. The noise reduction is up to 10 dB(A).

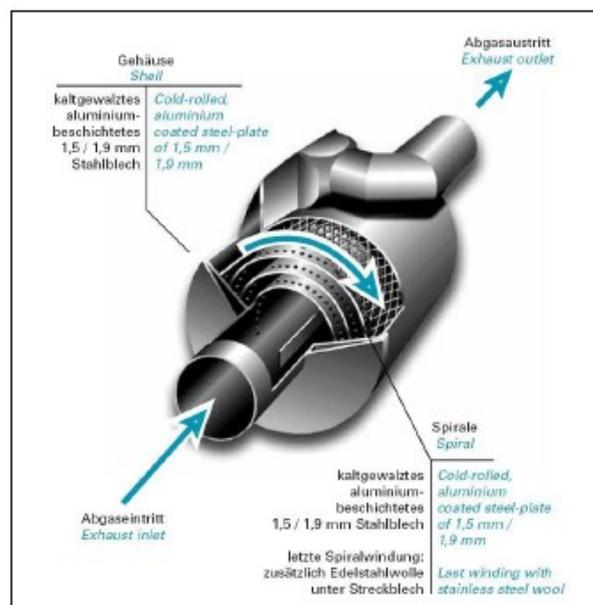


Figure 3 – Spiral Silencer⁴

2.5 Low Noise Gear Units

One example for a low-noise gear unit is shown in Figure 4. As the Spiral Silencers, a Low Noise gear unit abates the noise of driving and acceleration. This is achieved through the reduction of the size of the gearwheels and teeth of the gears and a helical gearing about 7°. The noise can be reduced up to 5 dB(A).



Figure 4 – Low Noise Gear Unit³

2.6 Life cycle costs of the measures to abate railway noise

It is widely accepted, that the abatement of railway noise is costly. All described measures in this paper costs more than the conventional parts. On the other hand, it should be taken into account that noise is not only harmful for the people but that it is expensive too, especially the health costs as well as losses for properties and re-modelling costs for buildings like soundproof windows. Table 1 shows the life cycle costs of measures to reduce the railway noise for new and stock locomotives in Euro/dB(A).

Table 1 – Selection of measures to abate the railway noise with costs for the installation in new locomotives¹

Measures		Costs per year [Euro/dB(A)]		Noise Reduction [dB(A)]
		New	Retrofitting	
Technical measures at the locomotive	Optimized blade shape	4	50	6
	Spiral Silencers	10	10	10
	Low Noise Gear Units	20	250	5
	Screw Compressor	70	70	5
	Noise Absorber blinds at the cooling air in- and outlet	150	170	5

3. Conclusions

Unlike road traffic noise, which occurs virtually everywhere, rail traffic noise is localized to specific transport corridors. Depending on the type of train and the volume of trains, high levels of noise can be generated in these regions, especially along freight corridors on which most of the rail traffic is operated at night. Therefore, it is contrived to restrict the access for noisy wagons or trains on certain sensitive lines and at certain times, especially during the night.

The establishment of ambitious noise thresholds is necessary, but up to now it does not include current locomotives, which typically have a long operating life. In terms of noise abatement, however, the locomotives cause a major problem. There is an urgent need to refit locomotives with new noise abatement technologies. The research study “strategy for an effective reduction of noise by rail freight transport“¹ present more than 25 of those for the locomotives, freight wagons and the infrastructure. However, further new measures are necessary to get a high level of protection and for an efficient protection of the people from rail noise. Reducing of noise, especially but not only in the night, are important to reduce health risks as well as to improve the life quality.

4. REFERENCES

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