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ABATEMENT OF RAIL NOISE IN GERMANY – MONITORING

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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. Due to this, it is of primary importance for city planners, engineers and politicians to make our cities quieter. 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 exposure is up to 25 dB(A) above the threshold given by the World Health Organization, which is to be aspired in terms of a precautious health protection of the people. Noise is a frequent reason for complaints and of high relevance with respect to any expansion, upgrade or construction measures of railway infrastructure. Along one of the most used railway corridor Rotterdam-Genoa, the opposition from residents is very high. Numerous people in Germany are protesting against rail noise, especially in the Middle Rhine valley. In order to abate the rail noise, the German government decided that iron cast brake-blocks now used in freight wagons are to be exchanged by composite brake-blocks by the end of 2020. To evaluate the abatement effect of this measure, it is necessary to monitor the noise of the rail transport after 2020. The expert-report "Strategies for effective reduction of rail freight noise", published by the German Environment Agency, investigated how an effective monitoring system in Germany can be implemented. One finding is, that in Germany 15 stations are needed in order to monitor more than two thirds of the rail-freight traffic. Moreover, in the presentation we give an overview about technical specifications for monitoring stations to measure emission and immission of rail freight transport.
Keywords: rail noise, abatement, monitoring

1. Introduction

One of the most important environmental issues in densely populated areas is the problem of noise. Noise emerged by roads, railways and airports located in close proximity to agglomerations is not only annoying for residents; it also leads to serious health issues and has an enormous negative economic impact. According to a representative survey carried out in 2016, about a third of those interviewed complained of being disturbed or annoyed by rail noise in Germany [1].

Noise is an important issue causing one of the most common public complaints in Germany and within the EU. The most important source for railway noise is freight trains that operate around the clock, which is an enormous ecological problem. During night-time, the noise exposure in hot spot regions is up to 25 dB(A) above the threshold given by the World Health Organization (WHO) [2], which is to be aspired in terms of a precautious health protection of the people. Therefore, noise is of high relevance with respect to any expansion, upgrade or construction measures of railway infrastructure and it is widely agreed to enlarge noise protection measures. Further details on the general measures are presented in a position paper on the European strategies and priorities for railway noise abatement [3].

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‘ - noise TSI Noise exists [4]. This TSI Noise constitutes general requirements for the transnational railway traffic in Europe including noise emission thresholds of the rolling stock. In order to abate the rail noise, the German government decided that iron cast brake-blocks now used in freight-wagons are to be exchanged by composite brake-blocks by the end of 2020. In order to evaluate the abatement effect of this measure, a comprehensive, independently managed noise monitoring system is indispensable. The system should allow assigning noise levels to single wagons and the locomotives. Results should be publicly available. The expert-report “Strategies for effective reduction of rail freight noise”, published by the German Environment Agency, investigated how an effective monitoring system in Germany can be implemented [5]. One finding is, that in Germany 15 stations are needed in order to monitor more than two thirds of the rail-freight traffic. Moreover, in the presentation we give an overview about technical specifications for monitoring stations to measure emission and immission of rail freight transport.

2. Monitoring of rail noise in Germany

Although rail noise is a severe environmental issue in Germany, until now a comprehensive monitoring system is missing. Strategies and measures for an abatement of rail noise should be accompanied by a monitoring, meaning a long-term measurement system spread over different locations in order to obtain representative and reliable information about the real noise situation generated by the rolling stock. Moreover, these data are to be evaluated. This makes it possible to display the actual noise impairment, the effects of the abatement measures taken and the development of the rail noise in the long run. Furthermore, a monitoring allows to combine controlling and the use of political instruments to protect the people from rail noise. As Switzerland already installed a monitoring system which can be taken as an example also for Germany, it will be described in further detail.

2.1 Monitoring system in Switzerland

In Switzerland, currently six stationary monitoring stations are existing. Additionally, they use also one mobile station. The whole project including development, installation and operation ran from 2003 until 2015 and was organized by the Swiss Government. The stations are used for the control of the Swiss emission plan 2015, giving noise values for all railways in Switzerland from 2015 on. If values are too high, the infrastructure operators have to install noise abatement measures at their own costs. Moreover, the noise monitoring is also used to increase the acceptance of the public for noise prognosis and noise remediation. Due to the measurements and the public availability of the noise data, the protest of the people declined. In Figure 1a and 1b, a stationary monitoring station is shown.

Figure 1a: Swiss stationary monitoring container

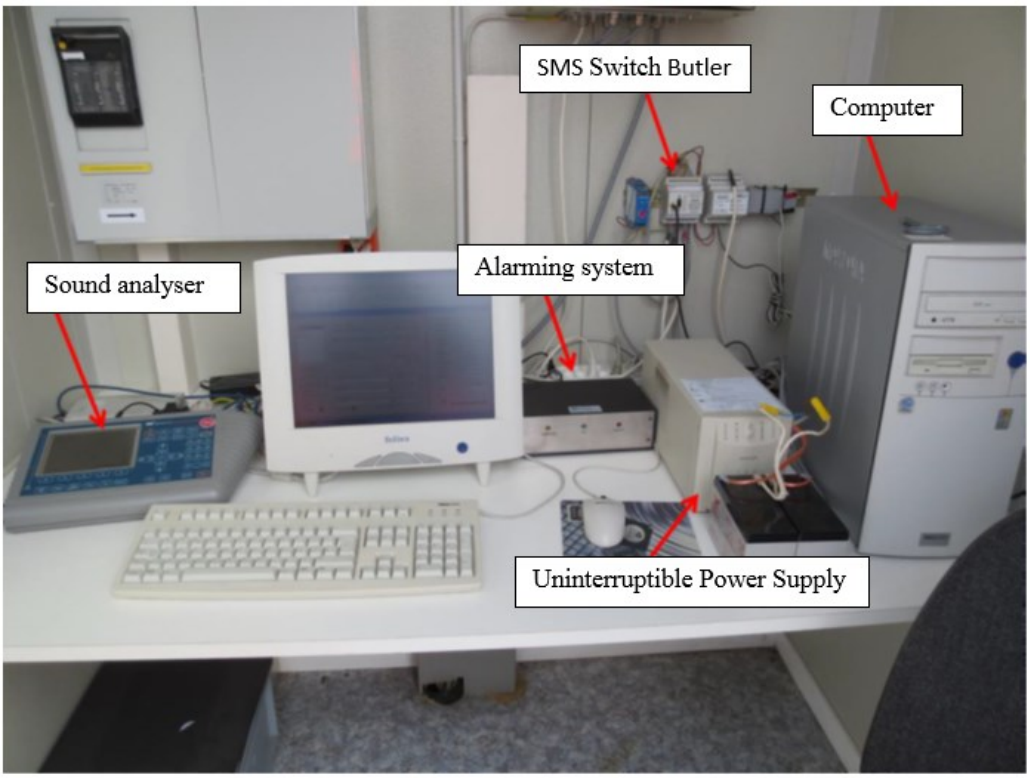

Figure 1b: Measurement device used for Swiss stationary monitoring system

Inside the container, standardized measurement devices are installed in order to reduce technical problems. Via two microphones, data such as speed, length and type of the train are collected and will be analyzed by a software especially designed for that purpose. A warning system via a SMS-signal is used in case the device does not work properly or does not send the data.

2.2 Measurement and monitoring of rail freight transport in Germany

Up to now, there is no legal or technical framework for a monitoring system of rail noise existing in Germany. Following that, there is no data acquisition for the railway net under way comparable to Switzerland. However, there are some measurement points located at hot spots performed since 2010. As these stationary devices and the measurement programs are all different, a comparison of the data is not possible. Along the Middle Rhine Valley – one of the most rail-noise disturbed regions in Germany – there are currently four devices installed.

The main objective of a monitoring system is the acquisition of the rail noise focusing on rail freight traffic. In a first step, the current noise situation is to be displayed. These data can be used to evaluate the accuracy of the calculated values and to alter them if necessary. Secondly, after a longer operational period combined with a sophisticated analysis, a prognosis of the expected development of the rail noise situation is to be performed. Based on that objective data set, it will be possible to display the effect of rail noise abatement measures and technical innovations in order to protect the people from rail noise. It is indispensable that these measurements are comprehensible and transparent giving a realistic picture of rail noise in Germany.

2.3 Concept for a monitoring system

2.3.1 Determination of rail freight noise

As the most important source for rail noise is the rail freight transport, the system is focussing on the determination of rail freight noise in Germany. Therefore, 15 stationary monitoring devices are to be installed in the whole railway net. They are positioned along the main and heavily used lines between Hamburg/Bremen – Hannover – Fulda and Köln/Bonn – Koblenz – Mainz, and at the national boarders, e.g. at Frankfurt/Oder, Pirna, Passau, and Emmerich. This design covers all the noise hot spots. In Figure 2, a map shows the location of these monitoring devices in Germany. However, these stations does not check whether a train was already measured, i.e. the same train can be recorded repeatedly.

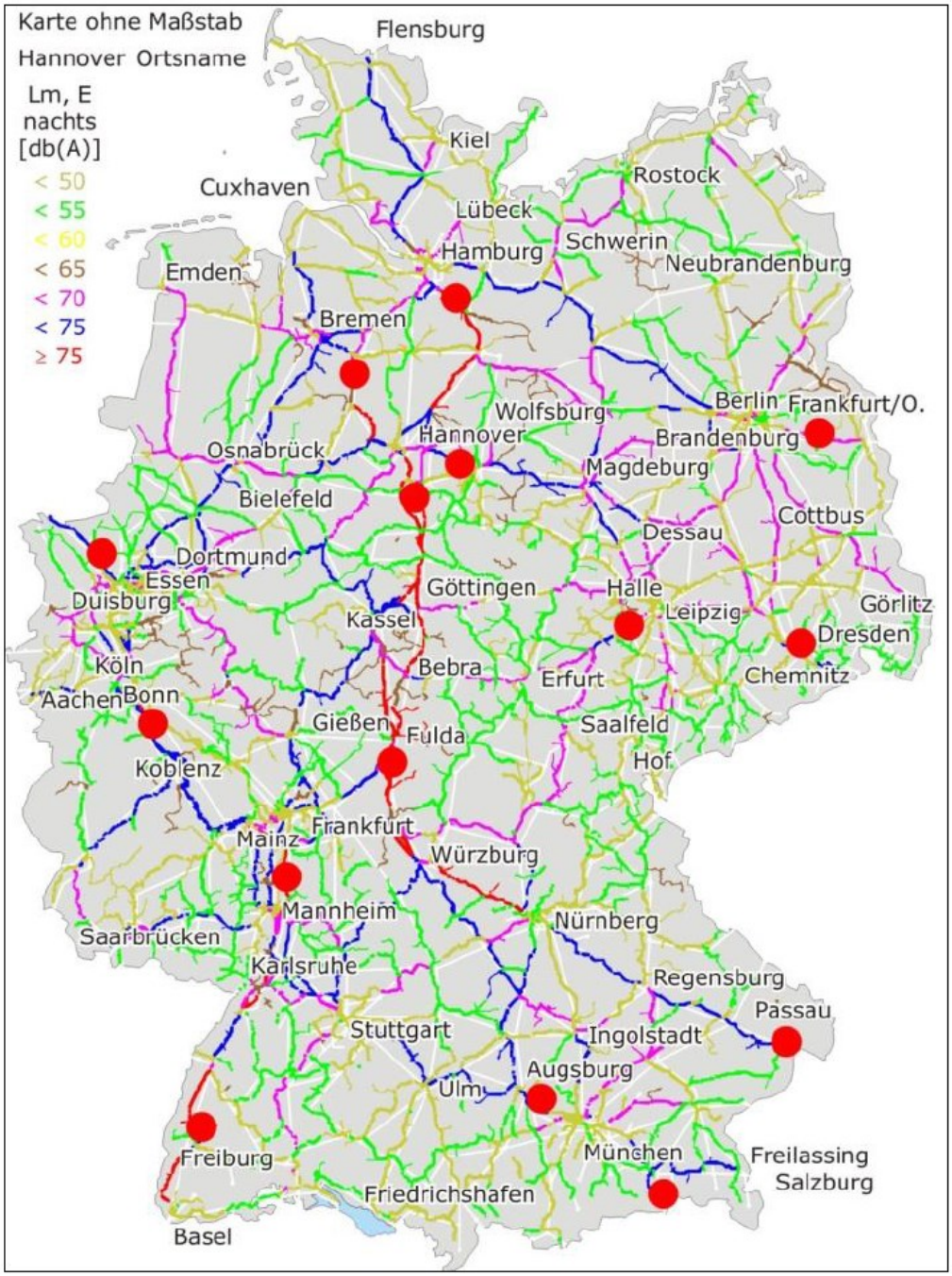

Figure 2: Proposed location of monitoring stations in Germany

These 15 monitoring stations record about 69% of the German rail freight transport. Already six stations record 49% of the rail freight transport. However, as it is planned to monitor the majority of the rail freight transport, 15 stations are needed.

The 15 stations described above only allow an overall noise recording of rail freight transport. If a more reliable system is necessary, e.g. for the use of regulatory legislation, a sophisticated monitoring should be applied. Therefore, a double-measurement is recommended in order to evaluate a train as “loud” only if it was recorded at least at two stations as “loud”. In this case, 16 stations at 8 different locations are to be installed.

2.3.2 Costs of the monitoring system

For the estimation of the costs for the system, it is to be differentiated between investment and operational costs. Moreover, there are costs emerging for the software, the network and for the server, which cannot be assigned for a single monitoring station. Taken that into account, for one station the investment costs are about 185.000 Euro and the operational costs are 56.000 Euro per year. This includes also a Video-Identification system. These costs are to be multiplied with the number of stations. For the network, investment costs of 305.000 Euro and operational costs of 590.000 Euro per year are estimated. Following that estimations, for the 16 stations for the sophisticated monitoring investment costs of 3,265.000 Euro and operational costs of 1,486.000 Euro emerge.

3. Conclusion

Unlike road traffic noise, which occurs virtually everywhere, rail traffic noise is more localized to specific transport corridors. However, depending on the type of train and the volume of trains, high levels of noise can be generated, especially along freight corridors on which most of the rail traffic is operated during the night.

The EU Commission has established pan-European noise emission thresholds for new types of rolling stock in the Technical Specifications for Interoperability (TSI). These values are valid for new rolling stock also in Germany. The 16th BImSchV (Traffic Noise Protection) establishes noise immission limits for the protection of local neighbourhoods on new lines. A major instrument of German noise policy towards rail noise is the substitution of cast-iron brake blocks by composite brake blocks in freight wagons, which typically have an operating life of around 40 years. This is expected to be finished by 2020. But even then, rail noise will remain on the political agenda. Accordingly, additional technical measures to further reduce rail noise and policies to promote their adoption: solutions for infrastructure, locomotives and freight wagons are necessary. When cast-iron brake blocks have been removed, a number of technical measures - often with a smaller reduction potential but also with lower costs - should be used to retrofit the existing freight fleet. An efficient abatement of rail noise including legal, technical and operating measures is necessary in order to reduce health risks as well as to improve the life quality of people. For that purpose, an independent noise monitoring system is a necessary prerequisite. The German Environment Agency encourages respective research studies and the German Government is considering national legislation to abate efficiently rail noise.

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