NOISE REDUCTION AT MARSHALLING YARDS

Dr. Brigita Altenbaher, Darja Goltnik
Elpa d.o.o.
Paka 39 d
3320 Velenje
Slovenia
brigita.altenbaher@elpa.si; darja.goltnik@elpa.si

KEYWORDS: Marshalling yard, noise reduction, wear out reduction, active protection

ABSTRACT
People living around marshalling yards are exposed to high levels of noise which have a very negative impact on their health. Therefore, the aim of our research was the development of a complete technology which would reduce the high frequency noise at its source and solve this world's insoluble problem. In our research we started by developing a new composite material which would not change braking properties, would be capable of taking extremely high pressure loads, would reduce noise and would be environmentally friendly. In the next phase of our research we developed a new technology for applying the developed material onto the wheels. Timely and precise measuring of the applied material onto a wagon wheel creates an intermediate layer of material which is decomposed thermally in the braking process. After developing the system we mounted the technology on the brakes at different marshalling yards and measured the noise reduction effect before and after installation. The noise reduction results were very good for all marshalling yards and showed a decrease of the high frequency noise almost completely (by 99 %) at its source. With our technology we had also reduced general noise by more than 30 dB(A).

INTRODUCTION

In the past marshalling yards were located outside the cities and therefore the inhabitants were not exposed to the high frequency (squealing) noise, but an increase in the population growth has led to the fact that the local people are now living in their direct vicinity. These people are exposed to high levels of noise which have a very negative impact on their health. One in three individuals is annoyed during the daytime and one in five suffers from sleep disorder at night because of the rail noise (WHO Report, 2011). In 2002, the Directive on the Assessment and Management of Environmental Noise (Directive 2002/49/EC, 2002) was adopted by the European Parliament and the Council. This Directive aims to "define a common approach intended to avoid, prevent or reduce on a prioritized basis the harmful effects, including annoyance, due to the exposure to environmental noise". The need to reduce railway noise, particularly from freight transport in international traffic, is recognized by all stakeholders in the field. Solutions are currently available to provide a significant reduction, and research is underway to investigate further options. Several recent studies show clearly that noise abatement at the source (i.e., vehicles and track) is to be preferred over solutions that affect noise propagation (e.g., barriers) or noise reception (facade insulation) when it comes to overall life cycle cost (de Vos; 2003). In spite of these three important conclusions, the necessary noise reduction at source is not yet taking place, with some small-scale exceptions. In this paper a complete solution is presented which consists of new friction material and new technology for applying it. According to the results and feedback from end-users the potential of these solutions is very high.

EXPERIMENTS

Noise reduction measurements

Measurements were made at two points in two marshalling yards, according to Standard method (EN ISO 3095, 2005). For measuring the Bruel & Kjaer brand 2250 and 2270 sonometers were used with programmed modules. The acoustic measurement program consisted of short-term measurements when a certain railroad composition passed by that railroad section.

CHFC material

The CHFC material used in our research contains more than 40 % of solid particles, is capable of taking over extremely high pressure loads and is environmentally friendly. Some of the characteristics of CHFC material are presented in Table 1. However, more information cannot be given because it is confidential. Before using the CHFC material it was tested according to numerous Standard methods and, according to these results and according to the characteristics of CHFC material, we had presupposed that this material could be used efficiently.

Table 1: Characteristics of CHFC material

Appearance	Paste
Color	Gray
Odor	Mild
Solubility in water	Insoluble
Hazardous reactive properties	None
Consistency – NLGI (DIN 51818, ASTM-D 217)	2
Worked penetration (ISO 2137)	265-295 mm/10
Density (at 20 °C) (ISO 12185)	1.4 g/cm^3
Viscosity (at 40 °C)(ISO 3104)	26.5 mm^2/s
Flash point	> 300°C
Ignition temperature	> 350°C
Thermal decomposition	> 370°C
Drop point (ISO 2176)	Not applicable
Separation of base oil (40°C, 7 days) (DIN 51817)	0 %
Behavior of the product in the presence of water (DIN 51807-1-40)	< 1

BREMEX ANNSYS “Basic” anti-noise system

In our research we also developed a device which would be capable of distributing the new developed material directly onto the wheels, like a multipoint system. The solution essentially comprises trackside sensors, electronics cabinets, reservoirs containing a composite material and special floating applicators that “capture” the wheels of the passing wagons (Fig 1). As the wagons pass the sensors, the sensors capture vital data based on the direction of the wheel, weight of the wagon and speed – this is transmitted directly to the electronics which are controlling the dosage.

The applicators apply the environmentally friendly composite material directly onto the part of the wagon wheel flank being in contact with the rail brake. Timely and precise measuring of the applied material onto a wagon wheel creates an intermediate layer of material which is decomposed thermally in the braking process.

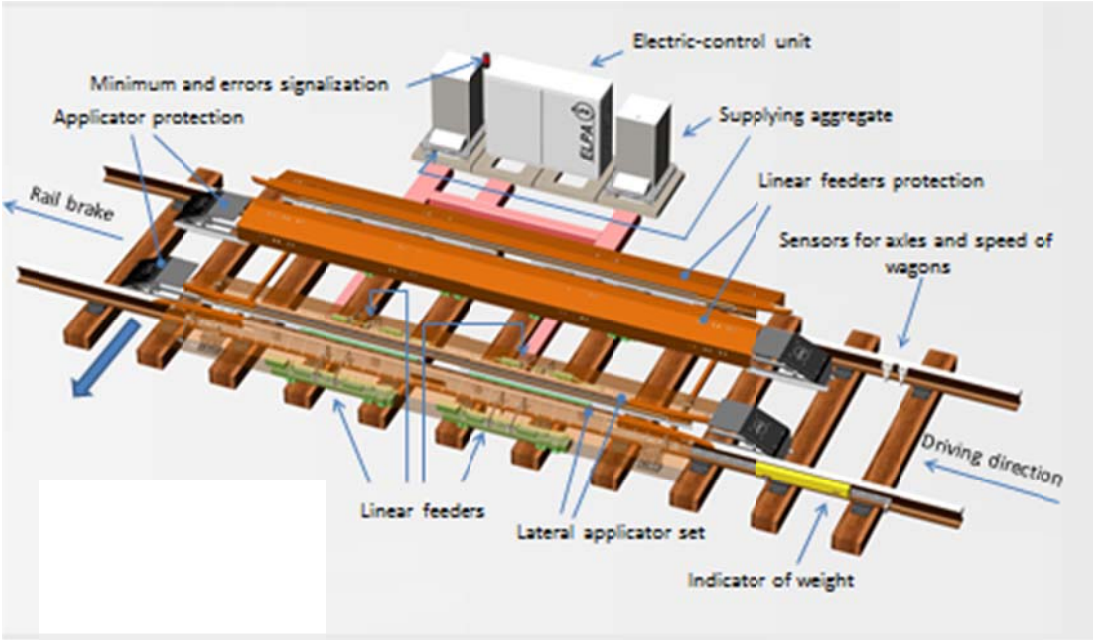

Figure 1: BREMEX ANNSYS “Basic” anti-noise system

RESULTS AND DISCUSION

After the implementation of BREMEX ANNSYS “Basic” system the difference between the measurements before and after was on average more than 23 dB(A) for the first marshalling yard and on average more than 30 dB(A) for the second one (Tables 2 and 3). The results have shown a high level of efficiency compared to other known solutions (e.g. on average, environmental noise barriers reduce A-weighted noise levels by 3-7 dB, depending on their design and height (Arenas, 2008)).

The main positive effects noticed were achieved as soon as the devices had been installed. Our solution also doesn´t have negative effects such as loss of sunlight and lighting like barriers have (Arenas, 2008). Bentsen (1994) observed that people living behind a noise barrier tend to forget very quickly the previous noise levels and become dissatisfied with the loss of view. However, the solutions presented by us don´t have any negative impact on the people`s life or on the environment. On the contrary, the noise pollution is notably lower and, consequently, quality of life is better.

Table 2: Noise reduction at the hump yard Brno Malomerice

Measuring point	Before the application*	After the application**	Difference
1 (dBA)	112.97 ± 4,97	87.35 ± 8.09	25.62
2 (dBA)	107 ± 4.23	84.77 ±7.01	23.62

* Number of measurements: 18, ** Number of measurements: 29

Table 3: Noise reduction at the hump yard Zalog-Drca

Measuring point	Before the application*	After the application**	Difference
1 (dBA)	115 ± 5	85 ± 3	30
2 (dBA)	117 ± 4	84 ± 2	33

* Number of measurements: 4, ** Number of measurements: 5

CONCLUSION

The anti-noise system BREMEX ANNSYS "Basic" for rail brakes on hump yards enables the input of a high added value because it eliminates the high frequency braking noise of 130 dB almost completely at

its source (by 99 %). Because other present noises reach 90 dB or more, these noises also limit the measured common effect of our system on up to 30 dB reduction of general noise, which is, in comparison to other noise solutions, a significant added value to noise mitigation on railways. However, Directives and law must be taken into consideration also when dealing with noise, mainly because a solution to these problems is now possible.

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