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Field Test Calmmoon Rail
Measurement Site Löf/Deutschland

Final Report

Carried out on behalf of
SEKISUI CHEMICAL CO., LTD

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INHALT

1 TASK

The company SEKISUI Chemical GmbH installs Calmmoon Rail Absorber (SSD) on the railway-track between Trier and Koblenz at km 23,25. In order to show if Calmmoon Rail is able to reduce noise even on a line-section with a good track condition (TDR, rail roughness) an acoustic measurement should be realised.

The analysis is carried out in two steps (reference measurement and measurement with installed absorbers) for duration of 7 days. In the first step reference measurements are carried out in order to show the acoustic situation without the absorbers. After the installation of Calmmoon Rail the measurement is continued at the same cross-section to show the acoustical impact of the absorbers.

The pass-by level of each train is measured with the mobile 8 channel automatic measurement system acramos®. In addition to that the meteorological data for every single train pass-by is monitored and inappropriate measurements are automatically deleted.

2 MEASUREMENT STEPS

2.1 Initial State

The monitored railway cross-section is in Löf, Germany at section kilometre 23,25 around 1km away from the local railway station. The whole track is situated near the river Mosel in a valley surrounded by hills. At the cross-section both tracks are a little below street level and are separated at both sides with natural plant cover from the nearby domestic buildings. Acoustically the measurement cross-section is not optimal because of the hill flank and the domestic buildings a free sound propagation is not possible.

Fig. 2-1 Overview of measurement site

The condition of the track was evaluated before (11.07.2011) by measuring the track decay rate and the rail roughness.

The perceived traffic situation can be described as relatively silent. The noise levels of the measured freight trains which in general produce the highest noise levels are compared to the traffic situation of other European measurement sites less noisy, which indicates an already high amount of, with k-bloc refitted, freight trains.

2.2 Calmmoon Rail Elements

The product Calmmoon Rail of the company SEKISUI is used to shield the noise that is produced by the vibration of the rail when the wheels of a railway vehicle roll over the track. This should reduce the overall pass-by level without influencing the function, liability and maintenance. Calmmoon Rail uses a thin metal plate as a basis on which a sound absorbing material is mounted which converts vibration into thermal energy reducing the overall noise contribution of the track. Fig. 2-2 shows a mounted Calmmoon Rail element.

Fig. 2-2 Calmmoon Rail - example of application (left picture source: SEKISUI product-sheet)

3 MEASURING CONCEPT

3.1 Measurement Set-Up

Fig. 3-1 and Fig. 3-2 show the measurement cross section. The microphone M1 and M2 are both 7,5m away from the centre of the track and 1,2m above rail level (M1) and directly at rail level (M2) respectively.

At the measurement track (driving direction Koblenz) two inductive wheel sensors are mounted. Wheel sensor R1 is installed at the measurement cross-section and allows the exact matching of the single axes to the measured sound level. Wheel sensor R2 is installed about 3 meters before the cross section and triggers the automatic measurement before the train actually reaches the cross section. On the opposite track another wheel sensor (R3) is installed to automatically delete measurements with two trains passing by the cross section at the same time.

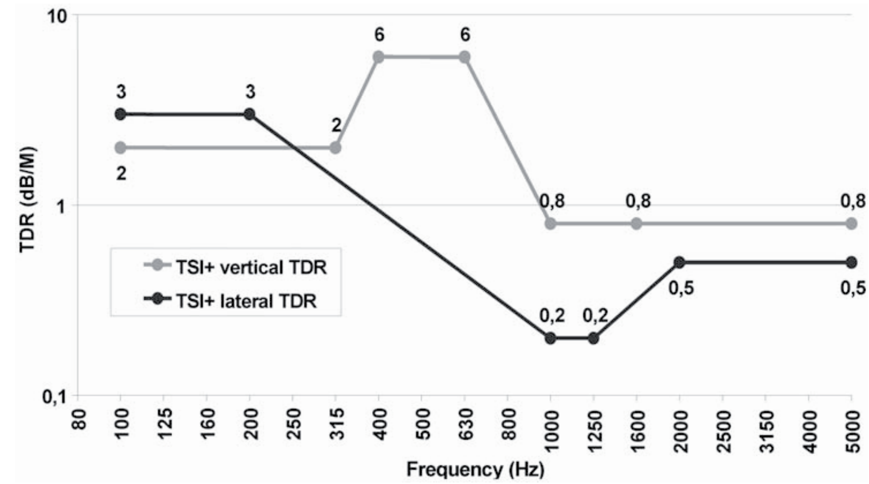

Fig. 3-3 Boundary for the lateral and vertical TDR (source: [1])

As alternative to AEIF methodology the Dutch company TNO has developed a software tool called PBA (pass-by-analysis). With this tool it is possible to calculate the TDR, the transfer function, the roughness of rail and wheel for a single train pass-by and as a result the noise level (Fig. 3-4). The software needs the data of a vertical and a lateral accelerator, the train geometry and the speed of the train.

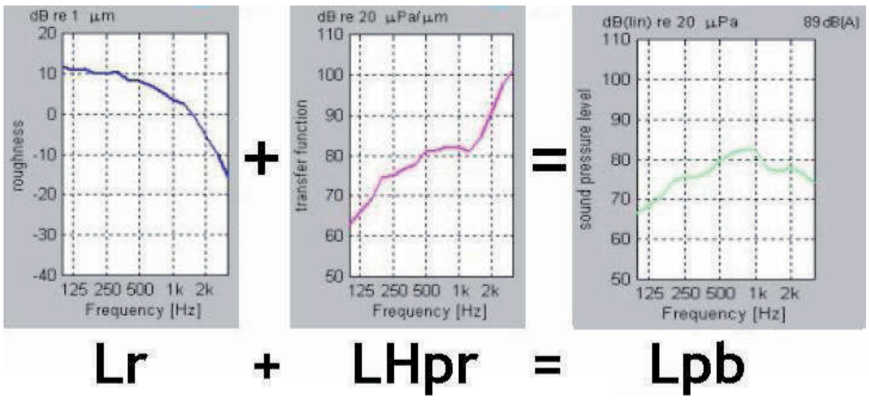

Fig. 3-4 Noise separation according to STAIRRS (source: de Beer/Jansen/Dittrich 2002)

3.3 Rail Roughness

The rail roughness gives information on the condition of the rail. A rough rail similar to a rough wheel leads to higher emissions by the wheel/rail contact. To be able to separate the impact of the rail on the overall pass-by noise level and thus makes measurements better comparable the ISO 3095 [2] and the STAIRRS measurement protocol [3] gives guidelines for the acquisition of the rail roughness. Fig. 3-5 shows the sections that need to be measured in order to get significant rail roughness results.

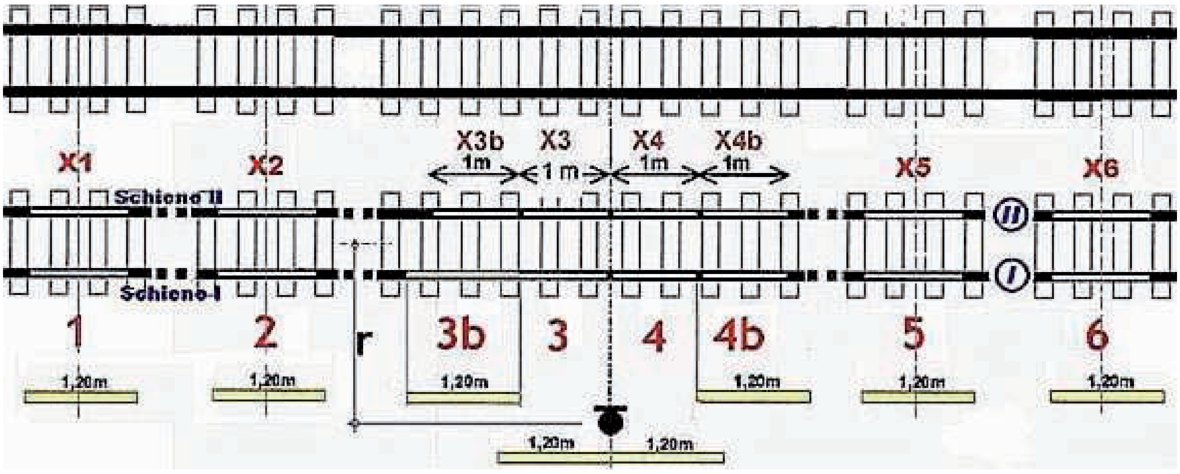

Fig. 3-5 Sections for the measurement of the rail roughness

For the measurement of the rail roughness the measurement system ODS TRM-01 is used. The system measures with three parallel sensors along three parallel lines 1,20m of the rail surface. The dynamic range of each sensor is 1mm with a resolution of 0,06 μm.

4 RESULTS

4.1 Track Decay Rate

For a better evaluation of the collected acoustic data, the TDR was measured on the 11th July 2011. As an indicator for the radiation of the rail the vertical and the lateral TDR according to the ON EN ISO 3095 [2] and TSI-CR-Noise [1] is used. For the measurement track (track1) the vertical and lateral TDR was measured with the AEIF methodology (measurement of the unstressed rail). In addition to that the TDR of the stressed rail was determined with the software-tool PBA.

Fig. 4-1 shows the results of the vertical TDR. In general the TDR is clearly above the TSI-limit. Only in the frequency range from 3200Hz to 5000Hz the threshold is exceeded. Fig. 4-2 shows the results of the lateral TDR. At the frequencies of 400Hz and 500Hz the results exceed the TSI-CR-Noise limit, in the remaining range of frequencies the TSI limit is met.

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