Railway carriage mass impact on retarder noise

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Abstract. The paper is aimed on railway brake noise on set up track in a Teplicka nad Vahom arranging station. On the basis of noise measurements, it is possible to determine the presumption of impact of rail brake operation on municipalities in the vicinity of the set up rail area and to adjust its technology in the time frame so that the statutory noise limits are not exceeded. Also is possible to determine, if it is possible to use the technology in praxis to pass requirements for statutory noise limits. For operators of the arranging station and railway brakes is very important to set time schedule properly for every freight train set. It is precisely for this reason that technology can be designed according to the catchment density and the duration of the individual wagon alignment so that the freight trains concerned are not delayed. It is also possible to take into account that a shifted group of wagons with lower weight per axle will cause less braking noise.

1. Introduction

In the ŽSR railway network are many marshalling yards, but only few of them are classified as a hump yards. Equipment of those hump yard differs and in some occasions does not fulfil requirements for efficient train marshalling. Those marshalling yards can be equipped with various types of retarders. In general, equipment of ŽSR marshalling yards does not fulfil required standard every time [1]. The paper is focused on the weight impact on a retarder noise. The measurements were performed on the retarder PHB 04-S0 (RO), which is used in the Teplička nad Váhom marshalling yard [2].

2. Principle of a retarder

The braking effect of a single retarder unit is formed by two brake pads with brake rails pivotably mounted along one rail. The pressure is transferred by a hydraulic system to the brake pads which clamp the wagon wheels. For the reliable operation of the unit in the working pressure range, a hydraulic power unit located in a separate building near the retarder together with a four-stage hydraulic control. Hydraulic distributions are made by pressure hoses placed in plastic tubes with branched shafts. The output speed is evaluated by an electronic control unit with a radar speed meter. When the set output speed is reached, the retarder is activated (automatic mode). The retarder can be placed on the left or right rail, straight track or arc track with radius up to 160 m. The rail shape can be S 49 or R 65 for both flat and inclined mounting. According to the STN 34 2600 standard, the retarder is designed for work in an environment with a temperature range of -30 °C to + 40 °C [3].
3. PHB 04-S0 (RO) retarder

PHB 04-S0 (RO) retarder is single rail type of the retarder with spring-hydraulic mechanism, consisting of a set of four or more pads. The device is designed to regulate the speed of marshalling carriages in a gravity-type hump yard of marshalling station. It is designed as a modular element of mechanization and automation of the marshalling yards. To achieve a desired braking effect, the retarders consist of different numbers of pads. The smoothness of the carriage speed is ensured by their appropriate location. The brake is controlled by a hydraulic power unit that provides proportional contact force to the wheels of the carriage and thus the braking power. Wheelset mass is measured by tensometric sensor, and then appropriate braking force is calculated. Retarder consists of microprocessor control also. Control of the retarder can be performed manually or semi-automatically. Automatic control of the retarder can be done with microprocessor control unit. The retarder can be part of higher grade of automation [4].
4. Noise level of the retarder in the Teplička nad Váhom marshalling yard
On the basis of noise measurements performed at the Teplička nad Váhom marshalling yard, it is possible to determine the assumption of the impact of rail brake operation on municipalities in the vicinity of the marshalling yard. The PHB 04-S0 (RO) retarder is used in the marshalling yard. Various types of freight carriages were measured to determine how the carriage weight affects the retarder noise. Measurements were performed by STN EN ISO 3095:2013-12 standards, 7.5 m from track, in 1.2 m height, located in the middle of retarder.

![Fig. 3. Measurement configuration.](image)

![Fig. 4. Noise level of 89 t carriage.](image)

Weight of the carriage has got significant impact on overall noise of the retarder, because increased brake force has to occur.

![Fig. 5. Frequentation analysis of 89 t carriage.](image)
Weights of measured carriages were in range of 21 t up to 89 t. When frequentional analysis was performed, we found out that weight of the carriage affects frequency also (Figure 5).

![Figure 6. Noise level of 21 t carriage.](image)

In comparisons of noise level, huge increase of noise was measured with heavier carriage (Figure 4 and Figure 6).

![Figure 7. Freqention analysis of 21 t carriage.](image)

Dominant frequency of the noise is reducing with increasing weight of the carriage. Lighter carriages achieved frequencies in range of 3200, 5400, 6200 Hz. Heavier carriages achieved frequencies in range of 1600, 2100, 3500 Hz (Figure 5 and Figure 7) [5].

5. **Impact of a retarder operation in the marshalling yard on a surrounding municipalities**

Unfortunately, the operation of the marshalling yard with retarders has a negative impact on the population in the surrounding municipalities [6]. From this point of view, it would be possible to adjust the marshalling technology and schedule the activity so that the marshalling yard has the least impact on the inhabitants of the municipalities in terms of the time effect of noise during the day. However, organizing the arrangement of heavier wagons that generate more noise out of the evening and night time of the day is unrealistic, so other solutions are possible [7].

6. **Conclusion**

Other solutions to reduce the impact of the marshalling yard on the surrounding municipalities are to build sound proof barriers or other objects such as buildings, vegetation [8]. With combination of those solutions is possible to reduce impact of the marshalling yard on surrounding municipalities [9]. Marshalling yards can have negative impact if build near municipalities. More effort is needed to reduce impact on the municipalities. Nowadays is possible to reduce impact in multiple ways [10].
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