

Noise Emitted by SKM Trains in Gdansk

Introduction

The city of Gdansk is the center of agglomeration, which counts 460 427 inhabitants and covers an area of approximately 261.96 km². It is the fourth largest metropolitan area in Poland [1], [2]. In such a big city public transport play a key role, which at the current number of cars and insufficient road infrastructure is a huge facilitation of access to workplaces, universities, schools and recreation places. SKM is one of the major carriers in the city, next to trams and buses. In 2013 about 35 million passengers used SKM services [3]. SKM manages the railway line No. 250, which has a total length of 31 km (section Gdansk–Rumia). According to the classification of transport it is a first-class line, dedicated for passenger transport only, double-track with a speed limit of 70 km/h [4]. SKM trains runs with variable frequency depending on a time. Every 7 minutes (6.00–9.15 and 13.45–18.45) and 15 minutes (9.45–13.45) in the daytime, during evenings and nights there are longer intervals (every 30, 60, 90 or 120 minutes) [5]. Such a large volume of rail vehicles is associated with audible noise emission. What is more important, SKM line runs through the central part of the city and therefore it runs in the vicinity of residential areas and recreational facilities. To measure noise emissions were located four measurement points along the track. Measurements were performed in daytime (6.00–18.00) when rail traffic is very high. Research was conducted in accordance with the guidelines contained in the Regulation of the Minister of Environment of June 16th 2011 dealing with the requirements for conducting measurements of the levels of substances or energy in the environment by administrator of road, railway, tramway line, airport or port [6]. The diagram below shows the shape of the line operated by SKM in Gdansk, together with the measuring points (Fig.1).

Purpose and research methodology

The aim of this research was to measure an actual level of noise generated by SKM trains running through the city of Gdańsk. As a part of a single measurement equivalent sound level (L_{eq}) was acquired. Individual acoustic events were measured by sonometer Bruel&Kjar 2250. Calibration was performed using a sound level meter calibrator Bruel&Kjaer 4231. The microphone was positioned on a tripod at a height of 4 meters above the ground level and in a predetermined locations in the vicinity of the tracks used by SKM trains (see at Fig.1). Due to the terrain shape, the amount of open space and safety considerations, not all measurement points were located at the recommended distance. In order to recalculate sound level values for a predefined distance of 20 m the equation describing the propagation of noise from a moving source was used:

$$L_{lr} = L_{lrp} - 10lg \frac{r}{r_p} \quad (1)$$

where:

L_{lr} – level acoustic source at a measured distance r (dB)

L_{lrp} – level acoustic sources within recommended distance r_p (dB)

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r – sound source distance (m)

r_p – sound source recommended distance (m)

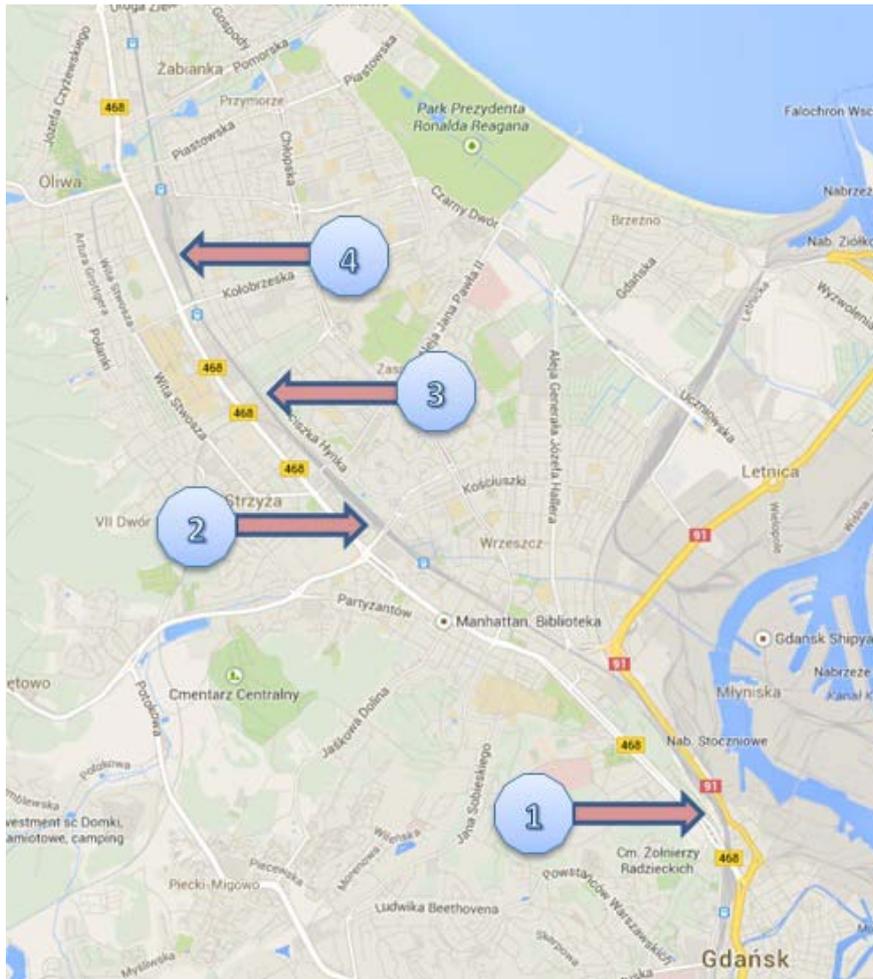


Fig.1. Diagram of SKM network in Gdansk with measuring points (red dots-stops; 1,2,3,4 - measuring points)

Source: <http://www.skm.pkp.pl/o-nas/mapa-trasy-skm/>

Measurement points

Measurements were performed at four locations given below:

The neighbourhood of SKM Gdańsk–Stocznia platform (1)

The first measurement point was located in the vicinity of SKM Gdańsk–Stocznia platform (54.362694 N, 18.643109 E). The photo showing the described location was presented in Fig.2. The microphone was located within the following distances from the railheads:

- 46 m (for vehicles coming towards Gdynia Main Station)
- 42.5 m (for vehicles coming towards Gdansk Main Station)

These distances were chosen because of the lack of other possible locations in the area that would meet safety requirements, and were free from external noise sources that could disturb measurements.

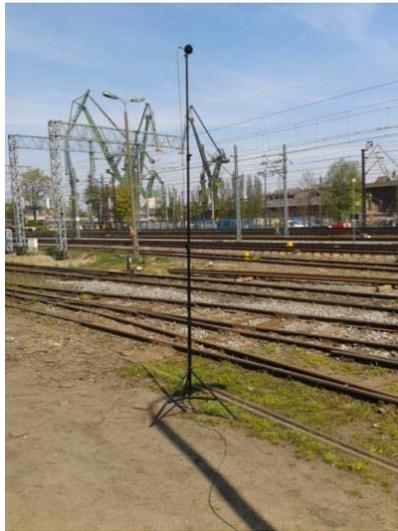


Fig. 2. Location of the measuring point in the vicinity of SKM Gdansk–Stocznia platform

Source: *The Author's material*

The neighbourhood of SKM Gdansk–Wrzeszcz platform (2)

The second measuring point was located in the vicinity of the SKM Gdańsk–Wrzeszcz platform (54.385038 N, 18.598721 E). The photo showing the described location is presented in Fig. 3. The microphone was located within the following distances from the railheads:

- 20 m (for vehicles coming towards Gdynia Main Station)
- 25 m (for vehicles coming towards Gdansk Main Station)



Fig. 3. Location of measuring point in the vicinity of SKM Gdansk–Wrzeszcz platform

Source: *The Author's material*

The neighbourhood of SKM Gdansk–Przymorze platform (3)

The third measuring point was located in the vicinity of the SKM Gdańsk–Przymorze platform (54.396964 N, 18.581488 E). The photo showing the described location is presented in Fig. 4. The microphone was located within the following distances from the railheads:

- 15 m (for vehicles coming towards Gdynia Main Station)
- 20 m (for vehicles coming towards Gdansk Main Station)



Fig. 4. Location of measuring point in the vicinity of SKM Gdansk Przymorze platform
source: *The Author's material*

The neighbourhood of SKM Gdansk–Oliwa platform (4)

The last fourth measurement point was located in the vicinity of the SKM Gdańsk–Oliwa platform (54.405031 N, 18.574003 E). The photo showing the described location is presented in Fig. 5. The microphone was located within the following distances from the railhead:

- 14 m (for vehicles coming towards Gdynia Main Station)
- 10 m (for vehicles coming towards Gdansk Main Station)



Fig. 5. Location of measuring point in the vicinity of of SKM Gdansk–Przymorze platform
Source: *The Author's material*

Meteorological data

Meteorological data obtained from Agency of Regional Air Quality Monitoring in the Gdańsk metropolitan area. Data is shown in the table below:

Table1. Meteorological data

Location	Temperature (°C)	Wind speed (m/s)	Pressure (hPa)	Humidity (%)	Rainfall
1	15.0–18.8	1.0–1.5	1004.9–1005.4	32.3–59.5	No
2	8.9–9.0	1.8–2.0	1018.7–1018.9	53.7–55.6	No
3	8.2–8.6	1.7–1.8	1017.7–1018.5	51.9–52.4	No
4	12.1–13.6	1.8–2.9	1014.7–1016.0	60.4–65.3	No

Source: *Meteorological data obtained from Agency of Regional Air Quality Monitoring in the Gdańsk metropolitan area*

Results and Discussion

According to the regulation of the Minister of Environment of October 1th 2012, the allowed sound level is 65 dB for all measurement points and they were much above the limits for all measurement points. Measured noise levels were in the range of 69.0 dB to 76,8 dB. The highest values were observed in location no.1 in spite of the fact that speed of trains was the lowest at that location. The lowest levels of noise emission were noted for location no. 2. This can be a result of relative low speed of trains on this section. In location no. 3 the authors observed a typical noise levels emission for trains moving with that speed. In the last location (no. 4), comparatively to location no.1, levels of noise emission are much higher than would have resulted from the train speed.

Table 2. Results of measurements of noise levels emitted by SKM trains

Location		Leq (dB) (calculated for 20 m)	Number of tested vehicles	Average speed (km/h) (standard deviation)
1	Gdynia direction	70.8	6	9.1 (0.3)
	Gdańsk direction	76.7	6	16.1 (1.1)
2	Gdynia direction	69.0	6	41.4 (1.5)
	Gdańsk direction	69.0	8	44.1 (2.0)
3	Gdynia direction	74.7	5	51.2 (1.7)
	Gdańsk direction	72.7	7	49.8 (1.9)
4	Gdynia direction	76.6	7	33.6 (1.7)
	Gdańsk direction	74.0	9	36.5 (1.8)
Summary			54	

Source: The Author's material

Conclusions

The measured noise levels at all test points were about from about 4 up to about 12 dB above limits. It can be a nuisance for people living near the SKM tracks. This problem was partially solved by placing noise barriers in the area extensively exposed to noise. This was a necessary compromise between an efficient public transport, and its negative impact on the environment.

Abstract

High intensity traffic of SKM trains in Gdansk carries a significant level of noise emission. SKM line runs through the central part of the city and therefore in the vicinity of residential areas and recreational facilities. This research was planned and performed to find out what was the real noise emission of SKM trains and to determine whether the measurement noise values are within allowed limits. Individual acoustic events were measured using the sound level meter and the average of noise levels was calculated. The measured noise levels at all test points were about 4–12 dB above the allowed noise limits.

Keywords: Railway noise, railway transportation

HAŁAS EMITOWANY PRZEZ POCIĄGI SKM W GDAŃSKU

Streszczenie

Wysokie natężenie ruchu pociągów SKM w Gdańsku wiąże się ze znacznym poziomem emisji hałasu. Linia SKM przebiega przez centralną część miasta, a więc w pobliżu obszarów mieszkalnych i rekreacyjnych. Badanie zostało zaplanowane i przeprowadzone tak, aby dowiedzieć się, jaki był prawdziwy poziom emisji hałasu pociągów SKM i określić, czy wartości zmierzonego hałasu mieszczą się w dozwolonych granicach. Poszczególne zdarzenia akustyczne zostały zmierzone za pomocą sonometru i został obliczony średni poziom hałasu. Zmierzone poziomy hałasu we wszystkich punktach pomiarowych były o około 4–12 dB wyższe od dozwolonych limitów.

Słowa kluczowe: pociągi SKM, poziom emisji hałasu, transport kolejowy

References

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- [3] http://www.rynekkolejowy.pl/50662/kolej_traci_pasazerow_ponad_16 mln_w_przewozach_regiona_lnych_ponad_4_5 mln_w_pkp_intercity.htm
- [4] <http://www.skm.pkp.pl/infrastruktura/parametry-techniczno-eksploatacyjne/>
- [5] <http://www.skm.pkp.pl>
- [6] Rozporządzenie Ministra Środowiska z dnia 16 czerwca 2011 r. w sprawie wymagań w zakresie prowadzenia pomiarów poziomów substancji lub energii w środowisku przez zarządzającego drogą, linią kolejową, linią tramwajową, lotniskiem lub portem 9Dz.U. 2011 nr 140 poz. 824)

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