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THE INFLUENCE OF MUFFLER TYPE OF THE EXHAUST SYSTEM IN THE SPORTS MOTORCYCLE ON THE LEVEL OF THE EMITTED NOISE

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ABSTRACT: The traffic noise is one of the most important factors influencing the reduction of comfort life and also it can cause the increase the possibility to loss health by people. The sports motorcycle are the types of vehicles which exploitation is connected with generating noise of a higher level. In the work, the tests of influence of using different solutions of the muffler type of the exhaust system construction on the level of noise emission by the sports motorcycle are presented.

KEYWORDS: Traffic noise, sports motorcycle, exhaust system

INTRODUCTION

The traffic noise has a significant effect on reducing the life comfort in the habitats [1]. The communication development [2], the number of vehicles increase on 1000 of inhabitants and the density in the communication infrastructure cause that the traffic noise increases [3-9]. This phenomenon has a great importance in this parts of the world which develop quickly and experience system and political changes. One of the development aspects of the communication market is the increase of the sale of single-track vehicle especially motorcycles.

The motorcycles belong to a group of vehicles which characterizes with significant indicator power on unit displacement volume of engine. It causes that their producers have to face important requirements in the construction of exhaust system but the noise decrease generated by the motorcycles is a more difficult task than in case of cars [10-11]. The crucial cause is the smaller size of the vehicle. The norm compliance of the noise level emission can require reduction of the engine power and the loss of some individual acoustic features required by their users [11-16].

One of the categories of the motorcycles on the public ways are the sports motorcycles equipped in engines with the power over 100km and max. rotational speed more over 10000 rpm. The motorcycles use by young people are often individually modified which may cause the level increase of generated noise.

In the work, the test results are presented, their aim was to estimate the emitted noise influence by sports motorcycle equipped in 4 different exhaust systems.

There were conducted tests of the noise according to the norm, additionally in the place of the motorcyclists head and in the position of the pedestrian near the road.

THE OBJECT AND METHODS OF TESTS

For conducting the tests, used sports motorcycle was applied, which was equipped in four-cylinder engine with cylinders in the V configuration set laterally, with engine displacement 781 cm³, which power is 110KM reached by the rotating speed 10500 rpm and the torque 82 Nm reached when the speed is 8500 rpm. The exhaust system of the engine is manufactured equipped in catalyst and the repressive muffler.

In figure 1 there is engine view used in the tests.



Figure 1. The engine of the tested motorcycle Honda VFR 800 - left side [17]

For the tests, 4 different solutions of the exhaust system are used they represent different technical solutions which can be bought on the market of the motor parts as original and accessory models:

- solution 1 (marked R1) - mass exhaust system possessing homologation, which fulfills Polish noise norm for the motorcycles at stopping-place, equipped in muffler of the repressive type,
- solution 2 (marked R2) - accessory exhaust system inside which there is a perforated tube and the suppressive cotton wool, the muffler does not have road homologation,
- solution 3 (marked R3) - similar to muffler 2 but in a short variation the muffler does not have road homologation,
- solution 4 (marked R4) - accessory exhaust system, this solution is used in extreme sports and instead of classic muffler of the exhaust system a short exhaust system was used which directs the exhaust gases from the engine, the system does not have road homologation.

The noise measure was carried out with digital sound analyser 1 class Sonopan DSA-50, according to corrective filter A and the time constant F. The analyser view is presented in figure 2.

The measures were carried out in the open air without any acoustic obstacles nearby. In the initial tests the measures of the acoustic background pressure level were carried out. The recorded values of the level equaled about 55 dB(A) so they did not have a significant influence on the level of values recorded in the fundamental measures.

According to the Polish Norm PN-92S-04051 the general measure conditions were maintained in the atmospheric conditions. During the measures the protection against the wind for the microphone was used owing to the fact that the recorded wind speed was between 3 and 5 m/s.



Figure 2. Sonopan DSA-50

In the tests it was assumed that the measures would be carried out according to the following schedule:

Trial 1. The measure of the equivalent sound level in the distance of 0,5m from the end of the exhaust train:

- at the constant rotating engine speed amounting 5250 rpm (according to the PN-92S-04051),

- at the moment of acceleration by the engine in the scope of rotating speed from 1500 to 12500 rpm.

Trial 2. The measure of the equivalent sound level in the place of position the motorcyclist's head, at the rotating speed like in trial 1.

Trial 3. The measure of the equivalent sound level of the motorcycle moving at the constant speed in relation to the microphone which was set at the height of 167cm and in the distance from the moving motorcycle about 200cm. The trial was conducted at the speed 50, 70 and 90 km/h, respectively II and IV gear.

The tests conducted in trials number 1 were to compare the level of the sound emitted with the values given in the Norm and the estimation of change of the level at accelerating the speed by the engine, the measures in the 2nd trial were to estimate the influence of the sound level on the motorcyclist and the measures in 3rd trial were to check the influence of the moving motorcycle on the noise received by the pedestrian near the road.

The measure position used in the 1st and 2nd trial are presented in the figure 3.

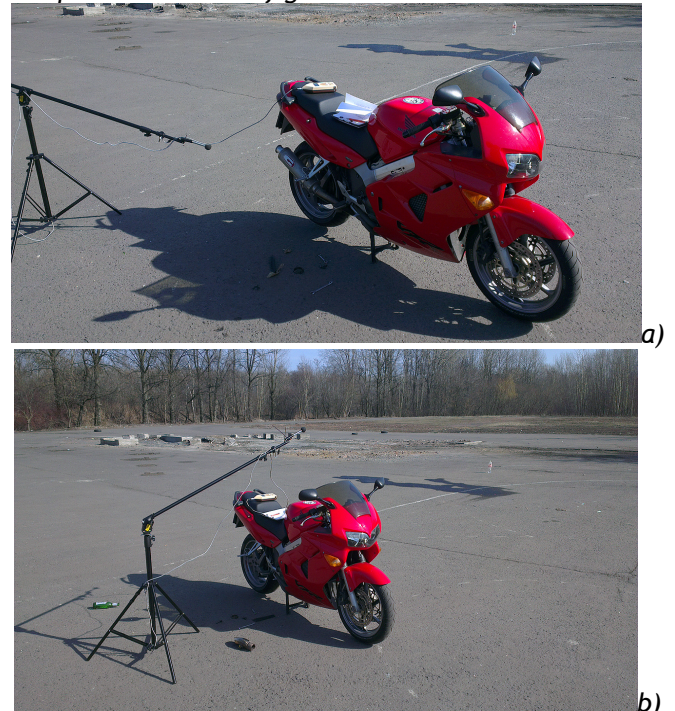


Figure 3. The measure position during 1st trial (a) and 2nd trial (b)

THE TESTS RESULTS AND THEIR ANALYSIS

In figure 4 there are the results of the measures of the equivalent sound level at 1st trial. The recorded values of the sound level prove that only solution 1 and 2 of the exhaust system fulfill the requirements of PN-92S-04051. The other two solutions do not fulfill the requirements of the acceptable level 96 dB(A) given in the Norm. The values of sound level L_{Aeq} present during accelerating the speed by the engine exceed 100 dB which at a longer time of being present near such a motorcycle can be harmful for our health. The tests results confirm that there are significant differences in the sound level recorded during the measure compatible with the Norm (at the constant rotating speed) and measuring the engine

working in the full scope of rotating speed. From the measures it is seen that the difference of these values can amount even 16 dB(A) and even for the solution of the exhaust system having homologation it exceeds the acceptable values.

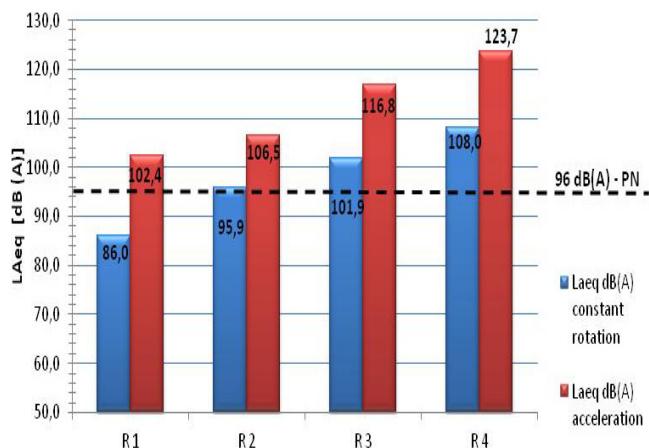


Figure 4. Values of the sound level - trial 1

The carried out measures of the sound level at the position of the motorcyclist's head (trial 2) showed similar dependences but the sound level was lower (figure 5). It can be noticed that the level at the constant rotating speed of the engine exceeds the values 80 dB(A) and at accelerating the speed - the level 98 dB(A). The measure results show that despite isolating the motorcyclist from the surrounding with the helmet the recorded values of the sound level can be still too high and harmful for their health.

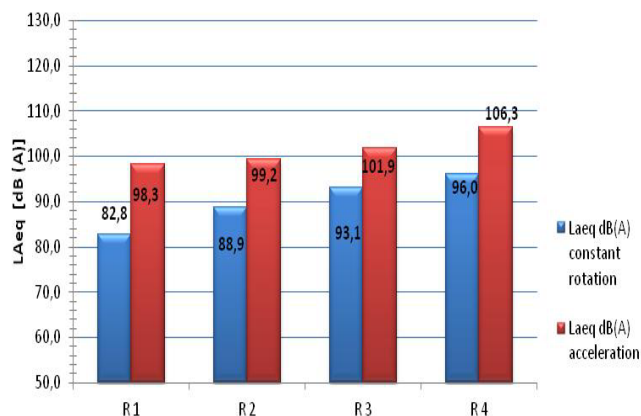


Figure 5. Values of the sound level - trial 2

The tests of influencing the emitted noise by the passing motorcycle on the pedestrian standing near the road were carried in case of solution of the exhaust system 1 and 4. The results at the speed of 50, 70 and 90 km/h with II and IV gear of the motorcycle are present in figures 6 and 7.

As it is seen from the measures even the exhaust system having the homologation causes noise reaching to the pedestrian with the equivalent level above 69 dB(A). The values can be onerous for the people present in the closest neighbourhood of the road and may cause general irritation and deterioration of mood. In case of using professional exhaust system (4) the recorded values of the sound level are higher for above 14 dB(A) and may cause deterioration of mood and health of the pedestrians.

In the cases the received values of the sound level exceed also the established values acceptable in the build-up area.

The measures were conducted at different gears (II and IV) so at different rotating speed of engine they show the beneficial influence of using the same speed of the gear with lower transmission so at lower rotating speed of engine. The difference of level of emitted sound by moving motorcycle at II and IV gear at the same speed was about 4 dB(A).

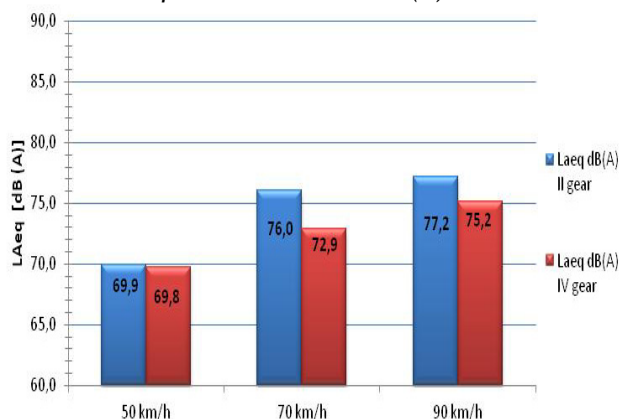


Figure 6. Values of sound level - 3rd trial - exhaust system solution 1

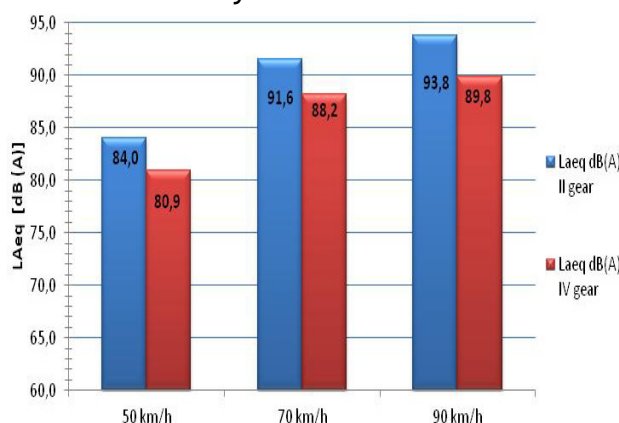


Figure 7. Values of sound level - 3rd trial - exhaust system solution 4

CONCLUSIONS

In the work, the measure of level of emitted noise by sports motorcycle equipped in different technical solutions of exhaust system were carried out. The results showed that noise generated by the engine of motorcycle is significant problem of road traffic. The possible solutions of the exhaust system only in two cases fulfilled the requirements of Polish Norm dealing with acceptable noise level generated by motorcycle. The conducted measures of all exhaust system according to experiments more similar to the real use of motorcycles allow to draw a conclusion that the generated sound level is high and can influence the health both of the motorcyclist and of the people who are close to them.

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