

AP15473335 “Development and research of ultrasonic method of cleaning of exhaust gas of internal combustion engines of transport vehicles” – p.m. Sarsembekov B.K.

Relevance:

Hypothesis of the study - the possibility of cleaning exhaust gases due to the action of ultrasonic emitter located in the muffler of the car and increase in hydrodynamic coagulation of exhaust gases of the internal combustion engine of the car. The relevance of the study is determined by the lack of such designs and methods of their study.

The project purpose:

The purpose of the study is to obtain results that allow the calculation, design of ultrasonic automobile muffler and development of its prototype.

Expected and achieved results:

The following results have been achieved in the course of the study on purification of automobile exhaust gas from harmful impurities and soot particles:

- report and user's manual, technical specifications for the design of ultrasonic automobile muffler for cleaning exhaust gases of internal combustion engines of transportation equipment were formed. Ultrasonic automobile muffler is an additional equipment intended for purification of exhaust gases from harmful impurities, connected to the exhaust system of automobile and transport equipment;

- published article "The Influence of the Frequency of Ultrasound on the Exhaust Gas Purification Process in a Diesel Car Muffler", authors: Adil Kadyrov, Michał Bembenek, Bauyrzhan Sarsembekov, Aliya Kukeshewa, Saltanat Nurkusheva, submitted to the journal Applied Sciences (Switzerland), included in the International Scopus database 1st quartile, percentile 79. Appl. Sci. 2024, 14(12), 5027; <https://doi.org/10.3390/app14125027>

In accordance with the proposed hypothesis, the purification of exhaust gases should be carried out due to acoustic coagulation of its particles directly in the muffler. The scheme of operation of ultrasonic automobile muffler is shown in Figure 1.

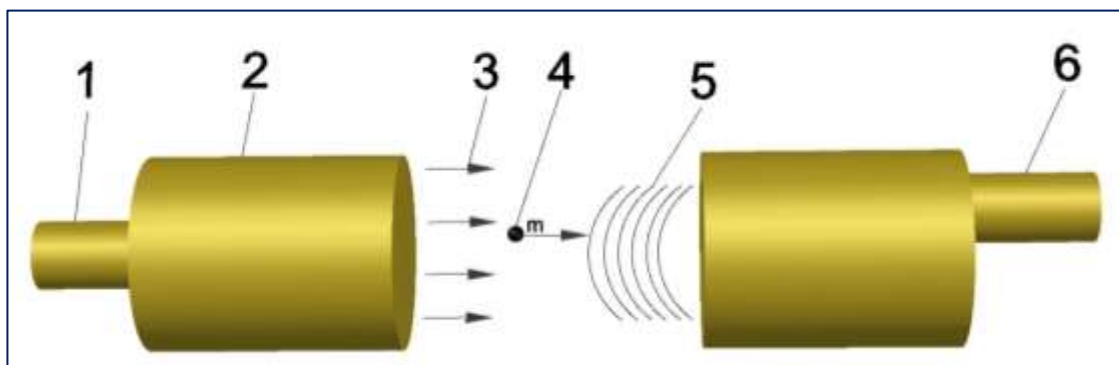


Figure 1 - Scheme of gas particle motion in an ultrasonic automobile muffler:

1 - engine outlet manifold; 2 - muffler body, 3 - vector of exhaust gas motion with velocity ϑ ; 4 - unit gas particle of mass m ; 5 - ultrasonic wave; 6 - exhaust pipe

The authors have analyzed the possibility of investigating existing theoretical developments to describe the proposed process.

Mathematical modeling, taking into account all factors, can only determine the direction of the experiment, but not specific numerical data. In this regard, in order to properly set up the experiment, Figure 2 shows the physical picture of the particle motion in the silencer.

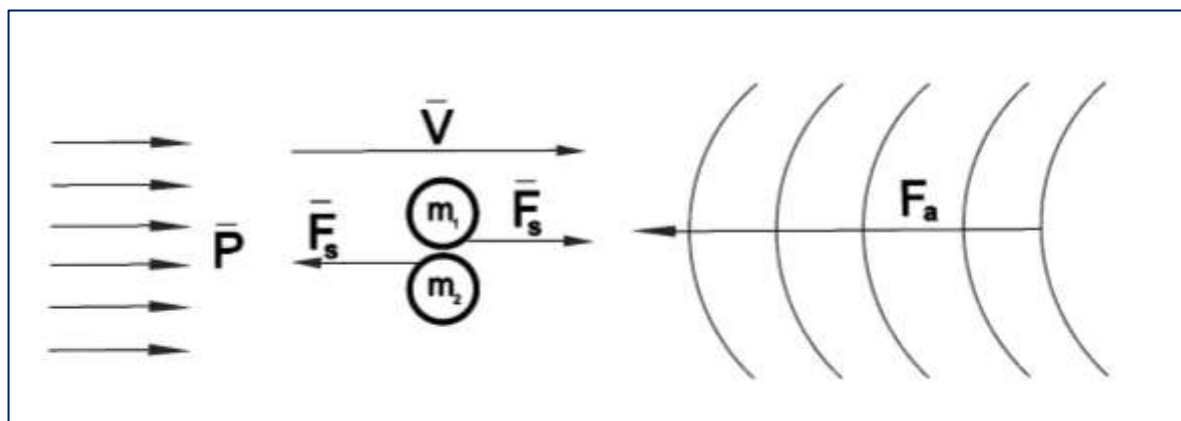


Figure 2 - Scheme of forces acting on gas particles during motion

On the particles m_1 and m_2 there is a pressure force P from the side of the motor manifold, forcing the particles to move with velocity v . On the opposite side there acts a pressure force F_a , from the side of the ultrasonic silencer, causing the particles to oscillate with frequency f . As they interact, a force F_s – the hydrodynamic Stokes friction force, is generated. As a result of this friction there is coagulation, aggregation of particles, some of which settles in the silencer. Taking into account that the speed of motion is much higher than the speed of oscillations under the action of ultrasound, it is correct to take into account this force as directly proportional to its magnitude.

Expected Results:

- The article “Application of electric pulse and ultrasonic mufflers for increasing the degree of exhaust gas purification in car engines”, authors: Adil Kadyrov, Bauyrzhan Sarsembekov, Aliya Kukesheva, Kirill Sinelnikov was sent to the journal “International Journal of Innovative Research and Scientific Studies”;

- patent for industrial design “Ultrasonic automobile muffler” was filed;

- an application for a certificate of state registration of intellectual property rights was filed.

List of publications:

- “The Influence of the Frequency of Ultrasound on the Exhaust Gas Purification Process in a Diesel Car Muffler”, by Adil Kadyrov, Michał Bembenek, Bauyrzhan Sarsembekov, Aliya Kukesheva, Saltanat Nurkushева, submitted to the journal Applied Sciences (Switzerland), part of the Scopus International database 1st quartile, percentile 79. Appl. Sci. 2024, 14(12), 5027; <https://doi.org/10.3390/app14125027>

- Sarsembekov B., Sinelnikov K., Suyunbaev Sh., Kukesheva A., Dyusenbaev E. Republican Journal "Proceedings of the University", Karaganda: NPJSC "Karaganda Technical University named after Abylka Saginov". 2023, No. (92), C.284-290. DOI: 10.52209/1609-1825_2023_3_284

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Information for potential users:

A full-size ultrasonic automobile muffler for cleaning automobile exhaust gas is fabricated. Theoretical and experimental dependences allowing to determine the effective parameters of the ultrasonic automobile muffler are obtained.

Scope:

Transportation engineering. Automobile transportation.

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