JOURNAL OF INTERNATIONAL SCIENTIFIC RESEARCH
Volume 4, Issue 6, July- August 2026 Online ISSN: 3030-3508
https://spaceknowladge.com

CONVERTING THE PRESSURE EXERTED BY VEHICLE WHEELS ON THE ROAD SURFACE INTO COMPRESSED AIR AND ELECTRICAL ENERGY USING AIR-CUSHION SYSTEMS

Kholmirzayev Oybek Toramirzayevich
Turan International University, Faculty of Business Administration, Associate Professor (PhD), Department of Business Administration. (Namangan, Uzbekistan). e-mail: oybekjon88@inbox.ru

In recent years, various studies have been conducted on generating energy from vehicle traffic. Some scientific works have proposed generating electrical energy from the pressure produced by car wheels using **piezoelectric sensors** [1; 2]. This technology can achieve high efficiency, but it is expensive and prone to failure. Other studies have explored ideas for utilizing the **heat** or **vibration** energy generated by vehicle motion [3; 4]. However, these methods are often limited to harvesting small amounts of energy or require complex technologies.

The proposed device is designed to be installed on roadways and consists of elastic, compressible air chambers (rubber cushions). These cushions are laid parallel to the road surface, approximately 4 meters long and 10 centimeters in diameter. When the wheels of a moving vehicle pass over these cushions, the air inside the chamber is compressed and passes through a special one-way valve into an air pipe.

For the calculations, average values were used: a length of 4 m, an outer diameter of 12 cm, and an inner diameter of 8 cm.

Let us calculate the volume of air in this air cushion and the air pressure inside it.

As is known, the interior of the air cushion is circular in shape, and its cross-sectional area is calculated using the following formula.

Let us calculate the air pressure inside the air cushion.

$$P = nRT / V = (0.473 \cdot 8.314 \cdot 300) / 0.002 = 107{,}199 \text{ Pa} = 0.107 \text{ MPa} \quad (1)$$

The air pressure inside the air cushion was calculated from expression (1). Here, P is the standard pressure inside the air cushion, n is the number of air molecules inside the air cushion, m is the mass of the molecules in the air cushion, T is the temperature, taken as 300 K (room temperature), and V is the internal volume of the air cushion.

$$V = 2V_1 = 2 \times 0.0007 = 0.0014 \text{ m}^3 = 1400 \text{ cm}^3 \quad (2)$$

We obtain expression (2).

Using the results obtained, let us examine the calculation of the change in pressure inside the air cushion. As is known, the pressure inside the air cushion is equal to normal atmospheric pressure,

that is: $P_1 \sim 10^5$ Pa.

The resulting pressure can then be found as follows:

$P_2 = P_1V_1 / (V_1 - V_{total}) = (10^5 \times 0.0113) / (0.0113 - 0.0014) = 1145 / 0.0099 = 115{,}657$ Pa (3)

We can obtain the pressure from expression (3).

$\Delta P = P_2 - P_1 = 115{,}657 - 101{,}325 = 14{,}332$ Pa (4)

From the value obtained in expression (4), we can see the change, and this pressure is the pressure transmitted to the compressor.

Our calculations show that the piston's inlet area is:

$S_1 = \pi r_1^2$, where $\pi = 3.14$, $r_1 = 5$ cm ≈ 78.5 cm² (5)

And the outlet area is:

$S_2 = \pi r_2^2$, where $\pi = 3.14$, $r_2 = 0.5$ cm ≈ 0.785 cm² (6)

Based on expressions (5) and (6), the following result was obtained:

$P_2 / P_1 = S_2 / S_1 = 78.5 / 0.785 = 100$ (7)

Conclusion

Collecting and utilizing the pressure generated when vehicle wheels press against the road surface, in the form of compressed air, is an energetically efficient solution. The device we propose consists of an air cushion, a piston, and a compressor. The air cushion is installed on roadways. The air cushion is 12 cm wide and protrudes 2 cm above the road surface. When vehicle wheels press on this air cushion, it compresses and transfers air to the piston, which generates high pressure and delivers it to the compressor.

References

[1] Mehdi Karimi Rozbahani, Generating electricity from air resistance caused by a moving vehicle. Apr. 14, 2016, Sheet 2 of 7.

[2] Vaibhav Barot, Arpan Kadia, Chintan Rabari. Power generation using kinetic energy of vehicles. Volume 04, Issue 4, 2017.

[3] P. Krishnam Raju, K. Durga Prasad, P. Narayana, V. Anil Gopi. Techniques for generation of electricity from moving vehicle. Vol. 10, Issue 06, 2021.

[4] Dr. Gavendra Norkey, P. H. Sai Sumanth, Thoomu Goutham Yadav. Generating electricity from rotational wheels in vehicles. 2021, vol. 7, p. 4179–4180.