

The influence of the correct selection of engine oil on the economic and environmental performance of internal combustion engines with gas-balloon equipment

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Abstract. Research organizations in many countries are looking for alternatives to hydrocarbon fuel. The problem is quite complex and there is still no single solution, although cars with alternative fuel were produced and successfully used not only today, but also in the 20th and even 19th centuries. The world's first self-propelled gas cart "Hippomobil" was created by Jean-Eten Lenuar in 1862 year. Reduction in oil production in a number of countries has led to a decrease in oil production, a decrease in the profitability of its production and transportation, is the main reason for an increase in the cost of petroleum products and an increase in interest in alternative fuel sources.

Keywords: gas cylinder system, compressed natural gas, liquefied gas, reducer, gas cylinder.

Introduction. "The development and well-being of the city, the success of the nation, the progress of the entire human race is determined by the available energy. We should not be satisfied with simply improving steam engines or inventing new batteries. We have something better to work for, a greater challenge. We must develop methods of obtaining energy from sources that are inexhaustible, improve methods that do not require the consumption and expenditure of any materials "Nikola Tesla" Mission of Science ", 1900 [1]

Today, the decline in the profitability of oil production and the growth of costs impose certain restrictions on the economic development of countries and the world economy. Considering that 85% of the energy consumed by an internal combustion engine is generated in heat, and a small part is converted into useful work, serious questions arise about alternative sources of mechanical energy rather than oil. In recent years, research centers of many foreign companies have been conducting research aimed at significant fuel savings and the replacement of traditional liquid petroleum hydrocarbon fuels with new types of gaseous combustible gases. Alternative fuels can be classified as follows: - by composition: esters, hydrocarbon acids (alcohols), hydrogen fuel with additives; - state of aggregation: gaseous, solid, free; - on application: as additives and in full; - Sources of raw materials: oil shale, biomass, peat, electricity, etc.

The main advantages of cars with gas-cylinder equipment (GSE).

Two types of liquefied petroleum gas are commonly used as gas engine fuel - propane-butane mixture and compressed - methane (compressed natural gas).

Although gases have the same principle of operation, the equipment has structural differences due to the pressure difference during storage.

Compressed natural gas (CNG) – natural gas (CH₄), compressed at the compressor station to a pressure of 200-250 bar (196-245 kg/cm²). Compressed natural gas (CNG) is used as a gas motor fuel instead of oil products, as it has a number of advantages, the main of which is high environmental friendliness and low cost [2].

Gas prices. The main advantage is that propane is on average 55-60% cheaper than methane, and methane is 60-65% cheaper. Prices may vary slightly by region.

Object of study. The final cost of re-equipping an average car with a 4-cylinder internal combustion engine of up to 150 horsepower will be from 9,500,000 soums for propane and 16,400,000 soums due to the cost of a similar methane cylinder (as an example, a GAZ-322132 minibus is given). Therefore, it is necessary to expect rapid savings, taking into account the costs of purchase, installation, design and maintenance of gas equipment. To justify the cost of one year of operation, a car with a gas engine must travel at least 1500 km per month, and fuel consumption must be at least 10 liters per 100 km. Table-1 of used fuels and current fuel prices,

Table-1

№	Type of fuel	Cost UZS / liter UZS/cubic meter	Consumption increase factor
1	Petrol АИ-80	6700 UZS / liter	1
2	GSE	2100 UZS/cubic meter	1,15

With an average annual mileage of 180,000 km and an average annual gasoline consumption of 17.2 liters per 100 km, the payback period for a LPG kit for a minibus (GAZ-322132) will be:

❖ calculate the cost of gasoline for the operation of a minibus (GAZ-322132) for one year:

$$180000 * x = 100 * 17,2;$$

$$x = (17,2 * 180000) / 100 = 30\ 960\ \text{L};$$

$$30\ 960 * 6700 = 207\ 432\ 000\ \text{UZS}.$$

❖ calculate the cost of gas fuel, which we will spend on the operation of a minibus (GAZ-322132) for one year, taking into account the consumption increase factor:

$$17,2 * 1,15 = 19,78\ \text{L};$$

$$180\ 000 * x = 100 * 19,78;$$

$$x = (19,78 * 180\ 000) / 100 = 35\ 604\ \text{L};$$

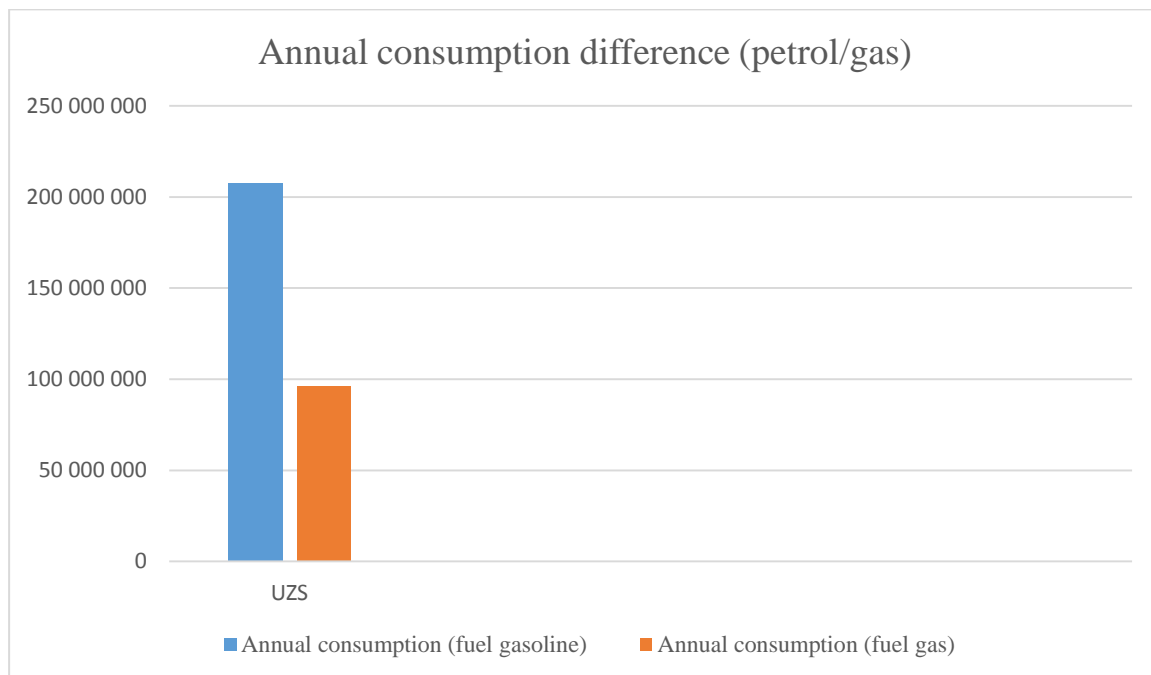
$$35\ 604 * 2700 = 96\ 130\ 800\ \text{UZS}.$$

❖ the difference in costs (savings on the cost of fuel) on the cost of fuel for the operation of a minibus (GAZ-322132) for one year and monthly is:

$$207\ 432\ 000 - 96\ 130\ 800 = 111\ 301\ 200\ \text{UZS};$$

$$111\ 301\ 200 / 12 = 9\ 275\ 100\ \text{UZS}.$$

❖ Let's calculate the payback period for the GAZ minibus (GAZ-322132):
 $16\,400\,000 / 9\,275\,100 = 1.7$ month



Increased power reserve. The advantages of GSE include the possibility of using two types of fuel. As a result, the mileage of the car increases. This is especially true in areas with long distances and poor road infrastructure.

Performance and engine life. The octane rating of methane/propane is higher than that of gasoline (approximately 105-110), resulting in reduced knocking loads, which makes the engine run smoother. In addition, gas combustion occurs flat due to the better formation of the fuel-air mixture, which also reduces shock loads on the cylinder-piston group, reducing the level of mechanical noise and vibration of the internal combustion engine.

After combustion of gaseous fuel, a minimum amount of coking is formed. Therefore, the transfer of a car to gas helps to reduce the amount of impurities and abrasive particles in engine oil, which leads to an increase in the replacement interval, as well as an increase in the life of engine parts. The direction of the effect of washing off the oil film from the walls of the cylinder can significantly increase the service life of the cylinder and piston group.

Since gas burns more slowly and at higher temperatures than gasoline, burn-out of the valves occurs. However, the correct adjustment of the gas supply system eliminates the problem.

Ecological components. Gas is an environmentally friendly fuel with minimal negative environmental impact, especially for densely populated cities.

During the combustion of compressed natural gas, exhaust gases contain about 10 times less harmful substances, which is a significant advantage over gasoline or diesel fuel. In addition, the load on the catalyst and the exhaust system of the car is reduced.

Security. Often the possibility of gas cylinders exploding is an obstacle to the passage of gas, and the reasons for this are:

- ❖ installation of used cylinders (expired or untimely service)
- ❖ poor system installation and maintenance
- ❖ installation of non-certified, obsolete, or substandard hardware components.
- ❖ violation of the terms of service of gas equipment
- ❖ non-compliance with the basic rules for operating a car with a gas system

It should be noted that when focusing on gas equipment, the multi-level security system of modern 4th generation gas equipment completely eliminates the possibility of any emergency situations.

The main disadvantages of cars equipped with gas cylinders. In addition to the obvious advantages, there are a number of disadvantages that must be considered when converting a car to gas.

A serious obstacle to the installation of gas equipment is the lack of space for a gas cylinder in the car.

The installation of a gas cylinder will inevitably reduce the usable capacity of the cargo hold.

So, trucks or buses have the ability to mount gas cylinders outside the usable volume of the body (frame, rear of the cab) and their mass is much less than the weight of the car and its load.

Increase in car weight. An empty all-metal methane cylinder with a capacity of 50 liters weighs 60 kg. Of course, there are also lighter types of methane cylinders, but their cost and reliability are still in doubt.

In addition, excess weight significantly reduces the carrying capacity of the car. This is especially true for commercial vehicles.

Additional expenses. Set and forget forever - this is not about gas appliances. Regular and timely maintenance of gas equipment allows you to ensure maximum economic efficiency and trouble-free operation of the system.

As a rule, equipment maintenance is combined with vehicle maintenance. The power reserve is 10-15 thousand kilometers, which greatly depends on the quality of gasoline. The list of operations includes:

1. Replacement of filter elements
2. Check, search and elimination of possible gas leaks
3. Diagnosis of the operation of internal combustion engines and LPG equipment
4. Adjust nozzles

Like any household appliance, gas appliances have their own resource, after which the components will need to be replaced or repaired. This is especially true for rubber parts (diaphragms, seals).

Based on this, the additional fuel system requires some attention, and also adds financial costs.

Disadvantages of vehicles with gas-balloon engine equipment. Often when driving on gas, there is a loss of vehicle dynamics (about 5-15%). This disadvantage

is felt only in small engines. The power loss is not noticeable in cars with medium and high internal combustion engines. Ensuring the correct selection, installation and configuration of equipment.

Adhere to the rules of operation and storage of a vehicle with a gas cylinder system. Although the 4th generation gas cylinder system operates in automatic mode, it is necessary to know some operational requirements to ensure the functionality of the car parts.

For example, for stable operation of the engine, as well as to prevent damage to the reducer-igniter, the internal combustion engine should be started only on gasoline, especially at cold ambient temperatures.

In addition to everything else, it is forbidden to park a vehicle with a gas leak in an enclosed garage and leave it for long-term storage when the gas cylinder is full. Owners of vehicles are not allowed to park gas cars in closed parking lots.

So is it worth installing gas appliances. Gas cylinder systemic yes or no.

Table-2 Pivot Analytic Table

Table-2

Gas prices	Shrinkage of the trunk
Security	Decreased load capacity
Provide two fuel-efficient operating distances	Difficulties in registering for a gas cylinder system
Smooth engine operation	Additional costs
Increase in IKE service resource	Loss of power
Ecology	Special requirements for the operation of vehicles

Conclusion. With all the pros and cons of a gas cylinder system, the issue of installation in the end is individual to the needs of each car and its owner.

In general, it is very useful and safe to operate a vehicle with a gas cylinder system. However, in order to achieve this safety, it is important to remember about preventing bugs in a timely manner.

It makes sense to install a gas cylinder system on a long-distance vehicle: the longer the vehicle travels, the more savings the vehicle owner will make. Even taking into account the costs of installation, registration and periodic maintenance, the savings in the use of personal vehicles will be higher. If we talk about commercial transport (freight or passenger transport), then the benefits will be more pronounced.

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