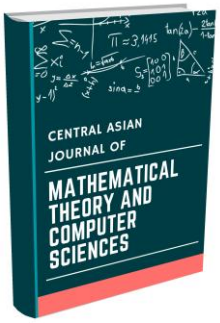

CENTRAL ASIAN JOURNAL OF MATHEMATICAL THEORY AND COMPUTER SCIENCES

https://cajmtcs.centralasianstudies.org

Volume: 04 Issue: 02 | February 2023 ISSN: 2660-5309

Advantages and Disadvantages of Operating Gas Cylinder Vehicles

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Annotation

This article covers the use of gas cylinder cars, properties, advantages and disadvantages of gas fuel. The difference between gas cylinder cars and diesel and gasoline cars. Currently, the problem in the operation of gas cylinder cars and ways to solve it are highlighted.

ARTICLEINFO

Article history:
Received 28 Dec 2022
Revised form 25 Jan 2023
Accepted 28 Feb 2023

Key words:
gas cylinder, compressed gas, liquefied gas, gas cylinder car, fuel mixture, gas reducer, electromagnetic valve, gas pressure, combustion temperature, cylinder explosion, octane number.

The increase in the number of cars in our republic, the increase in the demand for gasoline and diesel fuel, requires the use of alternative fuels, and now the use of natural gas, which is cheaper in terms of cost, is being introduced.

According to the State Statistics Committee, as of January 1, 2022, the total number of passenger cars owned by individuals in our republic is 3,051,734, and there are an average of 87 passenger cars per 1,000 permanent residents. This indicator has increased by 6 compared to the corresponding period of 2021.

Most of these light vehicles are equipped with gas. By 2022, more than 1,570,000 vehicles will be equipped with gas cylinders adapted to run on liquefied natural gas, more than 2.5 million methane gas and more than 200,000 vehicles. Therefore, the operation of gas cylinder cars is also important and it is important to fulfill the safety requirements of gas cylinders.

Permits have been issued to 150 enterprises and organizations authorized to test gas cylinders.

More than 1,200 gas filling compressor stations for cars and more than 800 liquefied gas filling stations for cars are operating in the country. Security requirements of these branches were also considered an important factor.

Why do drivers prefer to use gas?

The cost of gas is cheaper than petroleum products and the superiority of natural gas used as fuel over petroleum products, when using them, high technical and economic indicators of the engine are achieved, because natural gas has very good anti-detonation properties, the property of forming a mixture with air is very good, and air can form mixtures in any proportion. In gas engines, the mixture burns almost completely, and the environment is less harmed due to the fact that the toxicity of the used gases is much lower.

Natural gases used as fuel for cars are divided into two types: compressed natural gas (CNG) and liquefied petroleum gas (LNG). Liquefied gases are in a liquid state at normal temperatures (from –20°C to +20°C) at low pressures (1.0..2.0 MPa – 10..20 kgs/cm^2). The main components of such gases are ethane, propane, butane and unsaturated hydrocarbons close to them - ethylene, propylene, butylene and their isomers. The set of gas cylinders produced in the countries of the Commonwealth of Independent States has a total weight of 40 kg to 60 kg and allows installation in passenger cars. The volume of the cylinder in such equipment ensures that the car can travel a distance of about 300 km, which corresponds to the car's 400 km driving distance when running on gasoline.

Compressed natural gas is a gas under normal conditions at any pressure, and it mainly consists of methane and hydrogen. Methane is of most interest as a vehicle fuel. Because methane is the main part (92-99%) of natural gas extracted.

CNG is mainly produced from gas wells. Part of it is obtained during oil refining, fractionation of gas condensate or production of connected petroleum gas. Natural gases from household deposits mainly consist of methane CH_4 (82-98%), ethane C_2H_6 (up to 6%), propane C_3H_8 (up to 1.5%) and butane C_4H_{10} (up to 1%). Depending on the area of production, the amount of methane can be 40-82%, and the amount of butane and propane can be 4-20% in the connecting gases of oil fields.

Local CNG can be of two types: A or B. They differ only in density and heat content due to the different volume content of methane and nitrogen. Volume content of STG: methane (95±5% in CNG A class; 90±5% in CNG B class); ethane - no more than 4.0%; propane - no more than 1.5%; butanes - no more than 1.0%; pentanes - not more than 0.3%, carbon dioxide - not more than 1.0%; oxygen - no more than 1.0%; nitrogen (in CNG brand A - 0-4%; CNG brand B - 4-7%) [6].

According to energy parameters, 1 m3 of natural gas is equal to 1 liter of gasoline.

Unlike other hydrocarbon gases, methane (Table 1.1) is much lighter than air. Therefore, if there are cracks, it evaporates and accumulates in the upper parts of the room.

Table 1.1 LNG va CNG yoqilg'isining gaz fazalarining nisbiy zichligi

Methane	Ethane	Propane	Butane	Pponylene	Isobutylene
0,554	1,048	1,510	2,091	1,481	2,064

Methane is compressed to a pressure of 20 MPa and stored in thick-walled cylinders. Ethane, propane, and butane become liquid at a pressure of 1,6 MPa, and they are also stored in cylinders at this pressure.

One of the most important problems in the efficient use of CNG in road transport is related to the need to keep it dry (moisture content should not exceed 9 mg/m^3.

Non-observance of this condition leads to freezing of gas reducers during CNG operation. The combustion temperature of CNG is 3 times higher than the combustion temperature of gasoline and is in the range of 608-625° C (at the pressure in the engine combustion chamber). This makes it difficult to start the engine, especially at low ambient temperatures. The lower specific heat of combustion of the combustible methane mixture (3218.6 kJ/kg) is 9.5% lower than that of gasoline (3553.0 kJ/kg) [3].

Gas fuel requirements

The specified power, fuel-economy, environmental and gravity-dynamic indicators of cars, their stability in operation can be ensured if cars are filled with standard fuel. The quality of CNG and LNG should be such that when they are used in vehicles with CNG cylinders, the following is ensured:

- good mixing with air to form a homogeneous combustible mixture;
- high-calorie composition of the combustible mixture;
- lack of detonation during combustion in engine cylinders;
- low amount of formation of tarry substances and mechanical compounds that contribute to the formation of carbon in the power system and the engine, low amount of various substances that cause corrosion of the surface of parts, oxidation and dilution of oil in the engine crankcase;
- formation of small amounts of toxic and carcinogenic substances in combustion products;
- the ability to maintain the uniqueness of content and features over time and volume.

LNG used as vehicle fuel must additionally provide:

- The excess pressure of saturated vapors in the temperature range of -30℃..+45℃ is 0.1-1.6 MPa;
- good volatility without the formation of liquid precipitation when the pressure in the gas supply system of the engine is reduced.[4]

The choice of vehicles (in particular, gas-cylinder cars) is made taking into account its performance characteristics.

Despite the technical, economic and environmental benefits of using gas, many operational malfunctions and breakdowns occur in cars using gas in our Republic, and most of these malfunctions lead to the explosion of gas cylinders of cars, which poses a danger to human life.

The advantages and disadvantages of using gas fuel are presented in Table 1.2. [1]

Table 1.2. Comparative performance of vehicles with STG and SNG cylinders compared to base vehicles

Advantages	Disadvantages
1. High detonation resistance (the octane number of gas fuels is 95-110 units), so the compression ratio of gas engines can be 23-25% higher than gasoline engines of basic models. 2. A large power reserve, because after running out of gas, you can quickly switch the engine to full gasoline operation. 3. When switching to gas-diesel mode, the nominal power of the diesel engine does not change. 4. The toxicity of waste gases decreases according to the main control parameters: carbon monoxide (CO) 3-4 times, nitrogen oxide (NOx) 1.2-2.0 times; hydrogens (CH) 1.2-.4 times. In free acceleration mode, gas-diesel engine smoke emissions are 2-4 times lower than operating on diesel fuel. 5. Reducing the noise of the gasoline engine by 8-9 dB, the noise of the diesel engine by 3 - 8 dB. 6. Overhaul of a gas engine is 1.5 times higher than a gasoline engine, as it operates in more favorable conditions.	1. The transition of a gasoline engine to STG with a constant compression ratio reduces its maximum power by 5-8%, and the transition of a gasoline engine to CNG under the same conditions reduces the maximum power by 15-20%. 2. Rapid corrosion of valves and their seats. 3. The higher cost of gas than the total cost of the car. 4. The metal capacity of gas cylinder cars increases by 65-250 kg when using CNG, and by 400-950 kg when using STG, and the carrying capacity of the car decreases by 14-18%. 5. When using CNG, the labor volume of technical service and current repairs increases by 3-5%, and when using SNG, by 12-15%. Inadequate monitoring of the technical condition of gas equipment is accompanied by a 16% increase in the cost of maintenance and current maintenance of gas cylinder equipment. 6. On average, mileage is halved for a single fill-up with gas compared to a full fill-up

7. The service life of spark plugs is 40% longer in gas engines than in gasoline. 8. In urban transport, when the nature of the transported cargo does not allow full use of the maximum carrying capacity of gasoline vehicles, CNG vehicles are more efficient. In this case, the coefficient of utilization of the carrying capacity of gas cylinder cars increases. 9. Compared to gasoline modifications, specific fuel costs when using LNG and CNG are 45-55% and 35-40% lower, respectively, due to their lower cost compared to gasoline.	with gasoline. 7. At an ambient temperature of at least -5° C, gas engines do not differ from gasoline engines in their starting qualities. At lower temperatures, it is difficult to start a cold engine on gas. 8. A decrease in engine power when using CNG is accompanied by a deterioration of the following traction dynamic and operational characteristics of cars: reduced by 5-10%; The duration of acceleration to a speed of 60 km/h increases by 30-42%; Acceleration duration increases by 9-12% on a 1000 km section; the limiting angles of overcome climb are reduced by 30-40%.

We are watching. In our republic, on average, 70% of passenger cars and 90% of trucks are equipped with gas cylinders. Therefore, it is important to study the causes of such explosions.

Therefore, it is important to study the causes of such explosions.

According to the analysis, the explosion of car cylinders is caused by [2]:

- use of low-quality (metal composite) cylinders;
- technological defects during the production of cylinders;
- poor quality of installation and testing of cylinders in cars;
- gas injection at a higher pressure than allowed for compressed gas injection into cars;
- Failure to control the maintenance of vehicles according to the requirements.

Many drivers believe that a foreign gas cylinder will not explode. But the explosion of the cylinder is not related to where it was made, but to improper use. Because the quality of gas cylinders produced in Uzbekistan is not inferior to foreign ones. However, domestically produced gas cylinders are exported abroad. Currently, the most cases of gas cylinder explosions are observed in Kashkadarya, Surkhandarya, Bukhara, Samarkand and Jizzakh regions.

Today, gas cylinders intended for cars are produced in Navoi, Tashkent and Fergana regions. Also, such products are imported from Italy, South Korea, Russia and China.

Between 2020 and November 2021, 17 explosions occurred in vehicles equipped with gas cylinders across the country, resulting in human deaths and large economic losses.

In the process of studying the reasons listed above, it is mostly observed that the installation of cylinders on cars and the poor quality of testing work, gas injection into cars at a higher pressure than allowed, and failure to control the performance of the technical service of cars according to the requirements are mostly observed. Based on these reasons, we can say that the technicians are not paying attention to the technical process carried out in the car, and we can see that the majority of the drivers do not have an understanding of the operation of gas cylinders and their technical service. Exploding gas cylinder cars are mostly old cars and gas cylinders that have not passed technical inspection and the period of technical inspection is not considered at all [9].

Unfortunately, such cars are currently in operation, and the driver continues to endanger not only his own life, but also that of other road users.

Risks are also increasing as a result of gas filling stations not paying attention to safety requirements and injecting compressed gas into cars at higher pressures, which artificially reduces the service life of gas cylinders.

Figure 1. Exploding of gas cylinders due to over pressurization of gas cylinders and neglect of technical operational requirements.

To increase the responsibility of the employees of the enterprise that authorizes the testing of gas cylinders, to strictly control the process of issuing documents to cars in the case of realistic organization of testing processes, to organize a base of tested cars, and to constantly provide information about the approaching test. to increase the number of enterprises authorized to provide information and carry out testing according to regions and to constantly monitor their activities, as well as not to increase the gas pressure at gas filling stations, and to reduce the number of malfunctions and malfunctions that endanger human life during the operation of gas cylinder cars were [10-11].

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