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Ismatov JF
Tashkent Institute for the Design, Construction and Operation of Roads, Uzbekistan

Ashirov VR
Tashkent State Polytechnic Institute Named After Islam Karimov, Uzbekistan's

Correspondence Author:
Ismatov JF
Tashkent Institute for the Design, Construction and Operation of Roads, Uzbekistan

The study of the features of the working process of the engine when using gasoline-hydrogen fuel

Ismatov JF and Ashirov VR

Abstract
In this paper, we analyze the obtained data on the supply of hydrogen to internal combustion engines as a supplement to binzen. Also, it makes the study of the features of the working process of the engine when using gasoline-hydrogen fuel.

Keywords: Study, features, working process, engine, gasoline-hydrogen fuel

Introduction

The program provided for the study of the features of the working process and the removal of the main characteristics of a serial engine and engine using hydrogen additives to gasoline.

One of the main factors affecting the course of the working process, and as a result on the effective and economic performance of the engine, is the angle of advance of the fuel supply (injection). If the lead angle is too large, the start of fuel injection occurs at a relatively low pressure and low temperature, which leads to an increase in the ignition delay period, the accumulation of a large dose of evaporated fuel to the beginning of the rapid combustion phase and an excessively hard course of the combustion process.

The purpose of the tests: the study and determination of the operating conditions of a Cobalt hydrogen car as an additive to gasoline and the determination of fuel consumption for a route of 100 km.

The object of the test is a Cobalt passenger car running on gasoline and hydrogen as additives on the route of 100 km. During the test of a car, Cobalt running on gasoline and with the addition of hydrogen, its loading corresponded to the actual operating conditions.

To obtain statistics on fuel consumption of a Cobalt car gasoline and hydrogen gasoline additive, control measurements of fuel consumption are carried out. Before testing, a check is made of the technical condition of the vehicle.

The test procedure was carried out on the basis of O'zDst 1.6: 2003 GSS Uz, regulatory documents, general requirements for the construction, presentation, design, content and designation, O'zDst 8.016: 2002. Methodology for performing measurements, MI-2377-98. Development and certification of measurement procedures. - M.: VNIIMS, 1998-31p.[1, 2, 3, 4].

Theoretical background

Tests are carried out on cars with serviceable, sealed and verified speedometers. Driving cars should be carried out in the same way as in ordinary operation. During the tests, a survey of operating conditions is carried out, a survey protocol is compiled, which contains the data necessary for the further calculation of the standard coefficients:

- total mileage along the route;
- the number of forced stops on the route;
- the number of regulated and non-regulated intersections on the route;
- number of turns;
- the number of ascents and descents;
- speed limits;

The driver, together with the inspector conducting the inspection, must check before leaving for damage, oil leakage, coolant and shock absorber, check the engine refueling with coolant and oil recommended by the manufacturer, refuel the full tank to the neck, and also make

all other necessary daily maintenance work. In the process of work, they are also obliged to carefully conduct a control inspection and make sure that there are no damage listed above.

The determination of the amount of gasoline consumed is established by the measurement results of the following quantities

- Refuel a full tank to the neck and mark the mark before measuring
- At the end of the test by adding gasoline to the gas tank to the mark on the neck and the amount of fuel consumed is measured;
- Ambient temperature;
- Distance traveled during the test;
- Test time.

Main part

The measuring instruments used must satisfy the requirements given in table 1, which have passed state verification in the prescribed manner. The measuring instrument must be installed and secured in a place where its scale is easily visible to the tester. The sensor for measuring the ambient temperature must be protected from direct sunlight and must not touch hard surfaces.

Table 1: List of measurements

№	Name of the measured value	Unit of measurement	Designation	Recommended Instruments		
				name	Accuracy class	Measuring range
3	Gas (ambient air) temperature	^{0}C	t_2	Thermometer meteorological glass GOST 112	1.0	-10-0+100
4	Test time	sec	T	Stopwatch GOST 5072	0.5	–
5	Vehicle mileage during testing	km	S	Speedometer GOST 12936 (ST SEV 48657)	0.5	–

Note: Tests should be carried out at: wind speed not more than 3 m / s, no precipitation, air temperature from –5 to +25 0C, atmospheric pressure from 730 to 760 mm Hg, atmospheric humidity not higher than 90%.

The method for measuring the amount of gasoline consumed during testing is to determine the change at the end of the test by adding gasoline to the mark.

The amount of gasoline consumed during testing is determined by the formula.

$Q_б=Q_п-Q_{пд}$, л (1)

Where

$Q_б$ – fuel consumed, l

$Q_п$ – the volume of a full tank of fuel to the neck, l

$Q_{пд}$ – residual fuel tank during the test, l

Example: during testing of a Cobalt car with gasoline consumed fuel:

$Q_б=Q_п-Q_{пд}$=46l-38,7l= 7,3l;

during tests of the Cobalt car with the addition of hydrogen to gasoline spent fuel

$Q_б=Q_п-Q_{пд}$=46l-40,3l= 5,7l;

Defining $Q_б$, knowing the mileage S car and useful work done W You can calculate mileage or vehicle fuel consumption:

$$Q_п = 100 \cdot Q_б / S, \quad м^3/100км \qquad (2)$$

$$Q_m = Q_б / W, \quad м^3/мкм \qquad (3)$$

Where

$Q_б$ – petrol expenses, l;

S – car mileage, $км$;

W – useful work done, $м \cdot км$.

Table 2: Shows the results of measurements of fuel consumption along the route 100 km "Tashkent - Chirchik - Tashkent" and in the city of Chirchik Cobalt.

Fuel	Ride number	Distance of rides, km	Level of the petrol, л		Action pressure	Actual consumption fuel to run, l/100 km*	Actual consumption fuel to run, l/100 km**
			Up to test	At the end of the test			
1	2	3	4	5	6	7	8
petrol	1	100	46	38,81	Tashkent city - Chirchik city - Tashkent city	-	7,29
	2	100	46	38,69		-	7,31
	Average value					-	7,3
Gasoline with hydrogen	4	100	46	40,32		-	5,68
	5	100	46	40,28		-	5,72
	Average value					-	5,7

Note:

* - fuel consumption rate using a heater.

** - fuel consumption rate without using a heater.

Based on the initial data obtained during the control measurements of fuel consumption, a generalized table is compiled, in which the following data is entered:

- state number of the tested car, its brand (model);
- total mileage according to the speedometer in kilometers;

- actual fuel consumption in liters;
- the value of the calculated actual fuel consumption in liters per 100 kilometers.

The test processing results for the route "Tashkent - Chirchik - Tashkent" for the Cobalt car are shown in table 3.

Table 3: The test processing results for the route Cobalt car

Fuel	Average consumption	Deviation from the average value $x_i - \bar{x}$	$(x_i - \bar{x})^2$
petrol	7,29	-0,1	0,01
	7,31	0,1	0,01
Gasoline with hydrogen	5,68	-0,2	0,04
	5,72	0,2	0,04

With petrol $\bar{x} = 14{,}4 : 2 = 7{,}2$ л/100 км

Gasoline with hydrogen $\bar{x} = 11{,}4 : 2 = 5{,}7$ л/100 км

Standard deviation

With petrol $\sigma = \sqrt{\frac{\sum_{i=1}^{n}(x_i - \bar{x})^2}{n}} = \sqrt{\frac{0{,}02}{2}} = \sqrt{0{,}01} = 0{,}1$ л/100 км

Gasoline with hydrogen =

$$\sigma = \sqrt{\frac{\sum_{i=1}^{n}(x_i - \bar{x})^2}{n}} = \sqrt{\frac{0{,}08}{2}} = \sqrt{0{,}04} = 0{,}2 \text{ л/100 км}$$

Dispersion

$$\sigma^2 = \frac{\sum_{i=1}^{n}(x_i - \bar{x})^2}{n} = \frac{0{,}08}{2} = 0{,}04$$

The root-mean-square error of the measurement result or the standard of an individual measurement is determined:

$$S = \sqrt{\frac{\sum_{i=1}^{n}(x_i - \bar{x})^2}{n-1}} = \sqrt{\frac{0{,}08}{1}} = \sqrt{0{,}08} = 0{,}282$$

The root-mean-square error of the summary measurement result or the arithmetic mean standard is calculated by the formula:

$$S_{\bar{x}} = \frac{S}{\sqrt{n}} = \frac{0{,}282}{\sqrt{2}} = \frac{0{,}282}{1{,}41} = 0{,}2.$$

Accuracy indicator:

$$\frac{S_{\bar{x}}}{\bar{x}} * 100\% = \frac{0{,}2}{7{,}2} * 100 = 0{,}27 \quad \%.$$

Therefore: - confidence boundary:
With gasoline

$I_{н1}$=7,2–0,01=7,19 л/100 *км*

Gasoline with hydrogen:

$I_{н2}$=5,7–0,04=5,66 л/100 *км*

Conclusion

The operational standard fuel consumption per mileage of 100 km for a passenger car is Cobalt with gasoline 7.3 l / 100 km and hydrogen gasoline additives 5.7 l / 100 km. Fuel economy is up to 20%. If one car drives an average of 200 km per day, then saving gasoline per 100 km - 1.6 liters, 200 km - 3.2 liters. Now one liter of gasoline costs 4,500 soums ($ 0.4774) (the dollar exchange rate for the Central Bank of the Republic of Uzbekistan is September 24, 2019, $ 1 = 9424.54 soums). Then we get, saving one car: per day 3,2*4500 = 14 400 sum (3,2*0,4774 = 1.5279$), for month 25*14 400 = 360 000 sum (25*1,5279 = 38,1975$) and for a year 12*360 000 = 4 320 000 sum (12*38,1975 = 458,37 $).

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