ISSN NO: 2770-4491
Date of Publication:18-10-2022

Study of Engine Operation Features Depending on the Boiling Point of Gasoline for Hot Climates

Alimova Zebo Hamidullayevna
(Candidate of Technical Sciences, Professor);
Sabirova Dilorom Kabulovna
(Candidate of Technical Sciences, Associate Professor);
Niyazova Gulkhayo Parpiyevna (Senior Lecturer)
Tashkent State Transport University, Uzbekistan

Abstract. The article analyzes the dependence of the wear of engine parts on the evaporation temperature of gasoline. It is known that only the fuel that is in a gaseous state burns in engines. Therefore, for the completeness of combustion, it is necessary that the entire liquid phase of the fuel passes into a vaporous phase, and there is a thorough mixing of fuel vapors with air to form a combustible mixture.

To ensure optimal engine operating conditions in hot climatic conditions, we suggest that the temperature of the beginning of the distillation of gasoline boiling should not be lower than 40^0C ÷ 43^0C, the distillation temperature of 10% gasoline should not be lower than 70^0C, also the boiling of 90% should not be higher than 180°C, and the temperature of the end of distillation is 195 °C.

Keywords: gasoline evaporation, engine parts wear, combustion completeness, piston rings, starting qualities of gasoline, distillation temperature.

Introduction

Easy starting of the engine, its warming up, reliable operation of the warmed-up engine under various modes, as well as a partial reduction of resinous deposits in the power system and cylinders during engine operation depends on the fractional composition. The main reason for the rapid wear of engine parts when using fuels with poor evaporation is the flushing of oil from rubbing parts with non-evaporated fuel.

Research analysis

In hot weather, the main problem is the formation of steam jams as a result of the evaporation of gasoline in the fuel pump and in the fuel supply pipelines, which limits the supply of fuel to the engine. This leads to a depletion of the mixture and a deterioration in pick-up or to a stop of the engine.

The evaporability of gasoline should ensure the optimal composition of the fuel-air mixture in all engine operating modes. At a low temperature of the beginning of distillation, especially in hot weather, vapors are formed in the power system, the volume of which is 150-200 times greater than the volume of gasoline, which causes engine interruptions or shutdown.

It is known that only the fuel that is in a gaseous state burns in engines. Therefore, for the completeness of combustion, it is necessary that the entire liquid phase of the fuel passes into a vaporous phase, and there is a thorough mixing of fuel vapors with air to form a combustible mixture.

The dependence of the maximum air temperature (t_a) at which the engine stops due to the formation of steam plugs on the boiling point ($t_{b.p.}$) of gasoline can be determined by the following formula:

$$t_a = 1{,}85\, t_{b.p.} - 29 \qquad (1)$$

If there are not enough low-boiling fractions in the fuel composition, then when starting a cold engine, part of the gasoline does not have time to evaporate and enters the cylinders in a liquid state. The use of very light gasoline causes other operational difficulties, such as the formation of steam plugs in the power system, especially in the summer. From the point of view of the starting properties of gasoline, it is desirable to have a higher content, and from the point of view of the formation of steam plugs, preferably a lower content of low-boiling fractions. The optimal content of them depends on the climatic conditions of operation of the car.

ISSN NO: 2770-4491
Date of Publication:18-10-2022

In hot weather, the main problem is the formation of steam jams as a result of the evaporation of gasoline in the fuel pump and in the fuel supply pipelines, which limits the supply of fuel to the engine. This leads to impoverishment of the mixture and deterioration of pick-up or, in extreme conditions, to engine shutdown.

For the southern regions of the country in the summer at an ambient temperature of $+40^0C \div +50^0C$ if the beginning of the boiling of gasoline is 35^0C, steam plugs form in the power system, which can lead to malfunction of the fuel pump. Based on the formula (1), we determine the boiling point at which the engine can stop due to the formation of steam plugs (t_a):

$t_a = 1{,}85\ t_{b.p.} - 29 = 1{,}85 \cdot 35 - 29 = 35{,}75^0C$;

$t_a = 1{,}85\ t_{b.p.} - 29 = 1{,}85 \cdot 40 - 29 = 45^0C$;

$t_a = 1{,}85\ t_{b.p.} - 29 = 1{,}85 \cdot 43 - 29 \approx 50^0C$.

So, the result shows that for an air temperature of 45^0C in summer, the boiling point ($t_{b.p}$) of gasoline should not be less than 40^0C, and for an air temperature of 50^0C, the boiling point ($t_{b.p}$) of gasoline should not be lower than 45^0C.

The complete evaporation of gasoline in the engine is determined by temperatures of 90% and the boiling point temperature. At high values of these temperatures, part of the gasoline does not have time to evaporate and enters the engine cylinders as part of a combustible mixture in liquid form.

It has been experimentally proved that the fuel quality deteriorates slightly with a change in the distillation temperatures of $t_{10\%}$ and $t_{90\%}$ of the fuel volume, but decreases sharply with an increase in $t_{50\%}$. A further decrease of $t_{50\%}$ does not lead to a significant improvement in the rapid warming up of the engine and its acceleration. The combustion rate of such a mixture decreases, the mixture burns out during expansion, which leads to a decrease in power and efficiency of the engine. Fuel consumption increases.

At high boiling point values, heavy fractions of gasoline do not completely evaporate in the combustion chamber, and the non-evaporated part flows through the piston ring locks into the engine crankcase. An increase in the boiling point of gasoline leads to increased wear of the cylinder-piston group of the engine and, accordingly, to an increase in fuel consumption. The oil begins to burn in the cylinders, forming carbon deposits and causing oil overspending. At the place of oil flushing, semidry friction of parts occurs, accompanied by increased wear.

Conclusions:

Thus, in order to ensure optimal engine operating conditions in hot climatic conditions, we suggest that the temperature of the beginning of the distillation of gasoline boiling should be at least $40^0C \div 45^0C$, and the distillation temperature of 10% gasoline should be at least 70^0C. Non-evaporated gasoline does not burn, and flushes oil from the cylinder walls into the crankcase, reduces the viscosity of engine oil, which leads to increased wear of engine parts.

References

1. Dzherikhov V.B. Automotive operational materials: textbook. St. Petersburg: SPGASU, 2009.
2. Magerramov A.M., Akhmedova R.A., Akhmedova N.F. Petrochemistry and Oil Refining: A Textbook for Higher Educational Institutions. - Baku: Baki Universiteti, 2009.
3. Ostrikov V.V. O. A. Kleimenov, V. M. Bautin. Lubricants and their quality control in the agro-industrial complex - M.: Rosinformatekh, 2008, 172 p.
4. Alimova Zebo, & Usmanov Ilkhomjon. (2022). The dependence of the wear of engine parts on the evaporation temperature of gasoline. *The American Journal of Interdisciplinary Innovations and Research*, *4*(03), 7–11. https://doi.org /10.37547/ tajiir/Volume04Issue03-02.
5. Alimova Z. Research of change of quality of motor oils when operating the engine and improving their. Industrial Technology and Engineering. 2020, 3 (36): p.11-17.
6. Khamidullaevna, A. Z., & Irgashevich, M. K. (2022). The dependence of the fuel efficiency of the car on the temperature regime of the main units during operation in a cold climate. *European International Journal of Multidisciplinary Research and Management Studies*, *2*(06), 19-22.

ISSN NO: 2770-4491
Date of Publication:18-10-2022

7. Zebo, A., & Ilkhomjon, U. (2022). The dependence of the wear of engine parts on the evaporation temperature of gasoline. *The American Journal of Interdisciplinary Innovations and Research*, *4*(03), 7-11.
8. Dr. Zebo X. Alimova, Ilkhom Sh. Usmonov, Fahriddin I. Sidikov, & Dr. Anvar G. Kodirov. (2021). Influence Of Gasoline Evaporation Temperature For Engine Running. *The American Journal of Engineering and Technology*, *3*(12), 90–94. https://doi.org/10.37547/tajet/Volume03 Issue 12-1.