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IMPORTANT FACTORS THAT LEAD TO WEAR OF VEHICLE PARTS OPERATING IN DIFFERENT CLIMATIC CONDITIONS

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Abstract:
The article presents the results of the analysis of the causes affecting the wear of car engine parts operating in high temperature and dust conditions, in different climatic conditions. Specific conclusions and proposals are being developed to increase the durability of cars by using an effective system of protection of engines from mechanical (dust) particles of pollutants entering together with fuel, oil and air.

Keywords
Automobile, engine, engine oil, deterioration, climatic conditions, abrasive, mechanical, road dust.

Introduction

The operation of automobile vehicles in various operating conditions, especially in quarries where there is increased dust in the air, causes increased wear of their parts and mechanisms, and with increasing wear of vehicle parts, the consumption of fuel and other operating materials increases, and frequent failures and breakdowns occur.

For example, increased wear of parts of the cylinder-piston group and the engine gas distribution mechanism is one of the main reasons for increased fuel and oil consumption, as well as a decrease in the traction qualities of the car.

Worn parts of the steering and brake system impair vehicle controllability, reducing driving safety. Wear of parts, assemblies and mechanisms causes a change in the original dimensions of parts and their geometric shape, which subsequently leads to a significant increase in the gaps between rubbing parts, the appearance of noise, knocking and vibration. A further increase in wear and tear ultimately leads the car to a critical condition, after which the operation of the car is considered economically unprofitable and unacceptable from a driving safety point of view. The majority of malfunctions and failures occur due to natural wear of parts. An increase in the gap in mating parts is allowed up to a certain limit, which is different for different matings and depends on their design and purpose. When the mechanism operates with a gap exceeding the permissible limit, the wear of parts increases rapidly and can lead to a significant increase in fuel consumption and operating materials, to a strong emission of toxic substances that pollute the atmosphere and to a decrease in the efficiency of the vehicle.

The premature increase in wear of parts and mechanisms of automobiles is influenced by many factors, the main ones of which include untimely and poor-quality maintenance, insufficient and improper lubrication of rubbing parts (use of the wrong brand of lubricant, etc.), severe operating conditions (for example, work in conditions of high air temperature and dustiness, off-road and bad roads, overload and others).

When designing cars and their engines, as a rule, they are designed to operate in conditions of a moderate flat climate, although natural and climatic conditions, especially extreme cases, have a significant impact on the reliability and wear resistance of engines.

Below we have analyzed the influence of natural and climatic operating conditions on the numerical values of wear of car parts. There are three main types of natural-climatic territorial zones where the largest number of cars are operated: moderate, extremely cold and hot.

Due to the fact that the climatic conditions of European zones are moderate, we believe that the influence of such operating conditions on the wear process of machine parts is minimal in comparison with other extreme cases. When operating vehicles in temperate climatic zones, the wear of parts is mainly influenced by technical factors of maintenance and repair. A large number of cars are operated in the climatic conditions of the Far North and in hot, dry, highly dusty zones of Central Asia. If the temperature in the Far North in winter drops to -50^0 C, then in Central Asia the heat can reach +50^0 C and higher. Let's consider what impact these climatic operating conditions have on the intensity and type of wear of car parts.

Due to the fact that engine parts are subject to the greatest friction and wear, and 43% of all costs for car spare parts fall on the engine, in order to reduce the large amount of work, we consider it advisable to further consider the essence and degree of influence of climatic conditions on the wear rate of parts in relation to the engine .

There are the following main types of wear of engine parts: abrasion and scuffing of rubbing surfaces. Under normal engine operating conditions, wear occurs mainly on cylinder liners, piston rings, liners and bearings. It can be mechanical, corrosive and abrasive in nature. Under normal operating conditions, it is the wear of parts that determines the service life of the engine. The table shows the components of the general operational wear of automobile engine cylinders for the temperate climate zone and the Far North.

Table 1 - Components of the general wear of cylinders of automobile engines in operation (in percent) [1,2.]

Components of general wear	**Temperate climate zone**				**Extreme North**
	ZIL-130	**ZMZ-53**	**YaMZ - 236**	**YaMZ-238**	**YaMZ-238***
General operational**	100	100	100	100	100
From normal thermal conditions	15,1-32,1	15,8-30,8	19,8-29,7	19,3-29,0	15,3-22,9
From reduced thermal conditions	5,0-10,7	5,3-10,3	4,2-6,3	4,1-6,1	33,6-50,4
From inter-shift starts	10,9-23,4	2,4-4,7	8,412,7	8,9-13,3	15,9-23,9
From dust entering the engine	33,8-68,9	54,3-76,5	51,3-67,7	51,6-67,5	2,8-35,2

*When transporting ore.

** Including unsteady engine operating modes in terms of speed and load.

Engine operation in the Far North during the cold season is considered extremely difficult. Extremely low ambient temperatures can cause a drop in power and increased fuel consumption, cylinder jamming and others. When the temperature of the coolant drops from 80^0 C to 60^0 C, wear of parts increases by 30%, and when it drops to 40^0 C, by 140% [3-4]. In this case, the wear of parts is corrosive in nature and with a decrease in the temperature of the coolant of the cooling system, the amount of this type of wear increases greatly.

The change in the wear rate of engine cylinders at low temperatures is caused by the following reasons: the presence of semi-dry friction between the cylinder walls and the piston rings; corrosion destruction of surface layers of metals.

Reduced thermal conditions, including cold starts, unsteady conditions, increased load and speed conditions, as well as the severity of the operating process have different effects on the wear rate of engine parts. However, in normal operation, the wear of parts of the cylinder-piston group is most influenced by abrasive dust that enters the engine from the ambient air in various ways [2, 3].

High and dry ambient temperatures contribute to the appearance of detonation combustion in the engine, which is also one of the reasons for the increased wear rate of the cylinder, piston rings and piston. It is known that with severe detonation, the engine overheats, which can result in molecular-mechanical wear, burnout and breakage of the compression rings and piston grooves.

High heat with inefficient operation of the cooling system leads to overheating of the engine, as a result of which engine power drops and specific consumption increases.

The climate in Central Asia is sharply continental: summers are long and very hot, and winters are short and cold.

During the day, the absolute maximum air temperature in the shade reaches + 45^0 C, $+47^0$ C, sometimes $+50^0$ C and more, and at night it drops to $+5^0$...10^0 C. In mountainous areas, after intense heat ($40\text{-}47^0$ C), a car passing through mountain passes falls into conditions where the air temperature is $0\text{-}10^0$ C, i.e. a sharp temperature drop is 40-46 ^{0} C. At mountain altitudes, air density and pressure decrease by 18.5% and 21.5%, respectively (at an altitude of 2000 m above sea level) [4].

As a result, the filling of the cylinders decreases, the mixture becomes richer, incomplete combustion and engine smoking occurs, excessive fuel consumption and intensive wear of the cylinder-piston group parts occur.

Road and atmospheric dust has a significant impact on the wear rate of parts. Air dust content in a significant part of Central Asia reaches 3.5 g/m^3, and during strong winds and storms -17 g/m^3, which is more than 10 times higher than air dust content in the temperate zone (0.003...1.42 g/m^3) m^3). To clarify the idea, it is enough to say that when the dust content of the air is 0.8-1.2 g/m^3, visibility is completely lost [3].

Dust entering the engine causes abrasive wear of its parts. This is explained by the fact that the dust contains quartz, the content of which ranges from 50 to 95%. The hardness of quartz (1000-1200 kg/mm^2) is greater than the hardness of structural materials, which is why it causes abrasive wear of engine rubbing parts. Underestimation of this factor during the design and operation of the engine can lead to an unjustified increase in the wear rate of parts and a sharp decrease in its reliability [2,3,7].

Abrasive particles entering the engine have different effects on the wear of its parts. Abrasive dust entering the engine along with air and fuel causes the greatest wear of the cylinders in the upper part, i.e. in the area where the piston stops at TDC, the upper compression rings and the piston grooves. Abrasive particles entering the engine along with the oil cause the greatest wear on the crankshaft bearings, cylinders in the middle part, oil scraper rings, piston pin and bushings (Fig. 1) [5].

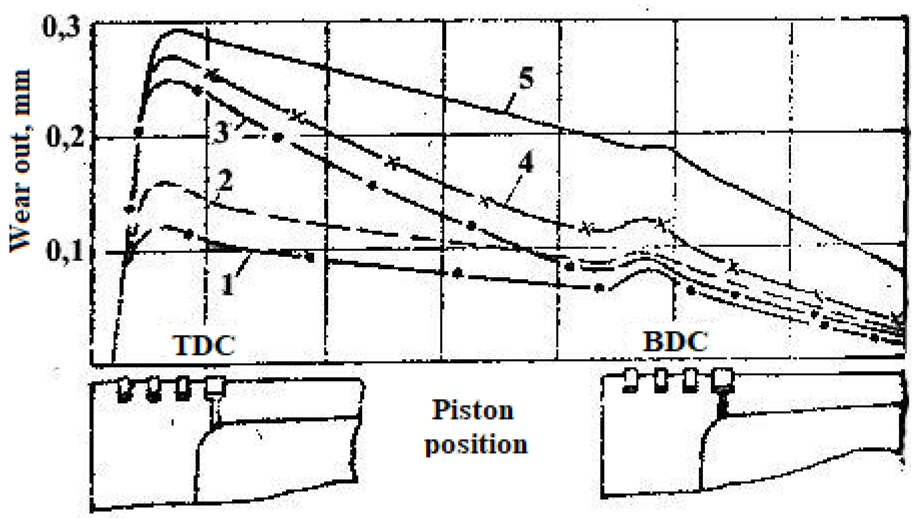

Fig.1 The degree of influence of an abrasive dust particle on the wear process of engine cylinders.

From Fig. 1 it is clear that with an increase in the amount of dust entering the engine along with air, fuel and oil, the wear rate of its parts increases and in this case the wear becomes abrasive in nature. It should be noted that the wear rate of rubbing parts depends on the ratio of the surface hardness of the parts and abrasive particles. The lower the surface hardness of the parts and the higher the hardness of the abrasive, the greater the abrasive wear.

An increase in fuel temperature affects its density and viscosity. A decrease in density and viscosity causes a decrease in the mass supply of fuel to the cylinders and increases the amount of fuel flowing through the gaps in the plunger pairs. In this case, the high temperature of the fuel pump causes semi-dry and dry friction in the plunger pairs and parts lubricated by fuel, which leads to their intense wear and scuffing.

The listed reasons lead to a reduction in the service life of fuel equipment by 1.5-2 times compared to operation at normal temperatures [8].

Thus, an analysis of the influence of various causes on the wear process showed that the wear of automotive engine parts is influenced by many factors, such as load and speed operating conditions (determining the amount of molecular mechanical wear) and thermal operating conditions, including start-up and warm-up periods (determining the amount of corrosion-mechanical wear). However, the wear process of engines is decisively influenced by natural factors - climatic and road conditions. At high temperatures and increased dust content in the air, the wear of engine parts, mainly the parts of the cylinder-piston group, wears out intensively and under these conditions, abrasive wear of parts is of predominant importance.

It follows from this that if the engine is insufficiently protected from dust particles, abrasive wear of parts increases sharply and this becomes especially important for vehicles operating in the Central Asian zone, where the atmospheric air is high in temperature and dusty. A particularly strong influence of road and climatic conditions on the wear of parts and mechanisms is observed in MAN, KamAZ, etc. vehicles operating in quarries.

Therefore, we believe that the most accessible and cost-effective way to reduce wear of engine parts, regardless of the climatic area of their operation, is to effectively clean air, fuel and oil and seal all places where dust can enter the engine.

REFERENCES

1. Григорьев М.А., Долецкий А.В. Обеспечение надежности двигателей. -М: Стандарты,1978.- 378 с.
2. Крамаренко Г.В., СалимовА.У., Каримходжаев Н., Каюмов К.К.Качество топлива и надежность автотракторных двигателей. –Ташкент: Фан, 1992.– 126с.
3. Каюмов Б.А. Обеспечение надежности системы питания современных бензиновых двигателей условиях жаркого климата.– Андижан,Андижоннашриёт-манбаа,2019.- 104 с.
4. Эксплуатация двигателей в экстремальных условиях. Kovsh.com/ library/ice/climatic conditions/*ekspluadvigatel*ekstremuslov. 2019.
5. Эфендиев А.М. Повышение надежности автотракторных двигателей в условиях пустынь с высокой концентрацией солесодержащей пыли в воздухе. – Ташкент,1994.- 180 с.
6. Кадыров С.М. Долговечность автотракторных дизелей в условиях Средней Азии.–Ташкент: Укитувчи, 1982.-270 с.
7. Шеховцев А.Ф. и др. Конструктивные отличия и особенности эксплуатации ДВС в условиях стран Азии, Африки и Латинской Америки. Основы климатической приспособленности ДВС.–Киев:УМК ВО, 1988.-285с.
8. Recommendations for Cleaning and Pretreatment of Heavy Fuel Oil Alfa Laval. London. 2012. -124 p.