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Improving efficiency use of Kamas engines-740 in mountainous conditions

Sarvar Kodirov, Mirgani Fayziev, Ergashev Obidjon

Professor and Senior Lecturer in Internal engines department, Tashkent Institute of Design, Construction and Maintenance of Automotive roads
Senior Lecturer in Internal engines department, Tashkent Institute of Design, Construction and Maintenance of Automotive roads
PhD candidates in department of Internal engines, Tashkent Institute of Design, Construction and Maintenance of Automotive roads

ABSTRACT: Themountain conditions of exploitation of automobiles differ the specificityand therefore increase of their efficiency of use under these conditions present problem. Therefore, it is possible to say that studying of working process of engines in mountain conditions at movement of transport is very actual scientific problem. The analytical type of the formula is proposed to bring the effective indicators of diesels to normal atmospheric conditions, taking into account the change of pressure and temperature of high-altitude air. The application formulas of bringing of effective parameters of engine Kamaz-740 to normal atmospheric conditions have been proposed.

KEYWORDS: Kamaz engines, Internal engines, Analysis, Mountainous, transport

I INTRODUCTION

It is known that mountain conditions of exploitation of automobiles differ the specificity, and therefore increase of their efficiency of use under these conditions presents scientific problem. Therefore, development of engineering methods of calculation, and also substantiation of ways of improvement of internal engines indicators underinternal engines in mountain conditions represents scientific value.
When operating cars under mountainous conditions, there is a deterioration of the following parameters of engines:

- Loss of power, over-consumption of fuel and increase of thermal tension of the details;
- Increased smoke and toxicity of exhaust gases;
- Increased vibration and noise;
- Increase of carbon deposition in cylinders, contamination and the untimely aging of the carter oil;
- Deterioration of starting qualities;
- Premature wear of units and parts, increase of spare parts consumption.

Proceeding from the above points, it is possible to say that studying of working process of engines inder mountain conditions at movement of transport is a very actual scientific problem.
Mountain ranges-Ala-Tau, Tien-shan, Pamir and others are located in the territory of Central Asia. Highways, laid in the mountains of Central Asia, are characterized by the presence of a large number of mountain crosses, located at the altitude of over 3000 m and reaching in some cases 4500-4800 m above sea level. Typical mountain crosses in these localities are following:Akbaytal (4800 m);Kyzylart (4200 m);Barskun (4200 m);Torugart (3752 m);Tyzasha (3586 m);Anzoa (3379 m);Kamchik (2474 m), etc.
It is necessary to note, that a number of works (1, 2, 3, 4, 6, 7, 8, 9). Researches of modes of operation of auto tractor engines and their influence on dynamic and economic qualities, and also on reliability and durability of automobiles and tractors are devoted to this problem.

II. MAIN CONTENTS

A.INFLUENCE OF MOUNTAIN CONDITIONS ON EFFECTIVE INDICATORS OF ENGINES

With increasing altitude above sea level, the temperature, density and air pressure decrease, which changes the temperature at the end of compression and the duration of the ignition delay? It has been established that the reduction

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of pressure on the inlet entails an increase the period of ignition delay and leads to a more rigid operation of the engine, which reduces its reliability. The graphs showing the height above sea level on parameters of air, boiling point of water and on change of parameters of the engine are given. On Fig.1, a and B (experimental data are received a. I. Tolstoy and D. A. Portnov).The analysis of these graphs shows that under mountainous conditions the engine's performance deteriorates mainly due to the reduction of the mass filling of the cylinder with a fresh charge. Table 1 shows our data on changing the environmental parameters from altitude deteriorates mainly due to the reduction of the mass filling of the cylinder with a fresh charge. Table 1 shows our data on changing the environmental parameters from altitude.

Table-1: Change of environmental parameters from height H

Air parameters	Altitude above sea level, H			
	1200m	2200m	3200m	4200m
Barometric pressure B, Mmri. CT/kpa	646/86,5	570/76,5	512/68,4	456/60,2
Air density ρv, kg/m3	0,983	0,904	0,835	0,743
Air temperature, OC	32	20	12	12

Figure-1: Influence of altitude above sea-level on-air parameters, boiling point of water and change of engine indicators.

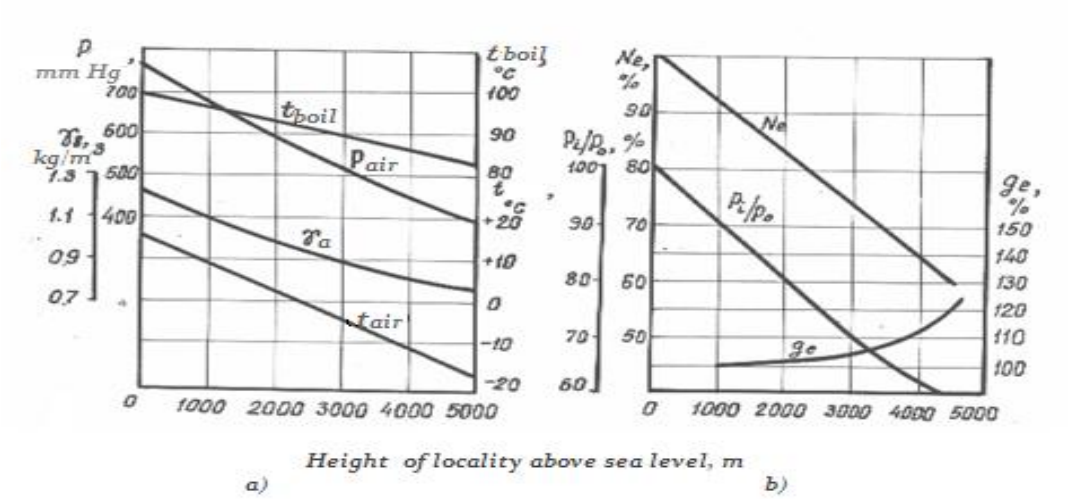

Figure-2: The curves of changes in the energy and economic performance of the YAMZ-236 diesel engine. For every 1000 m height increase the deterioration of Ne and GE increases. Fig. 2. Influence of altitude of the terrain above sea level on the indicators of diesel YAMZ-236

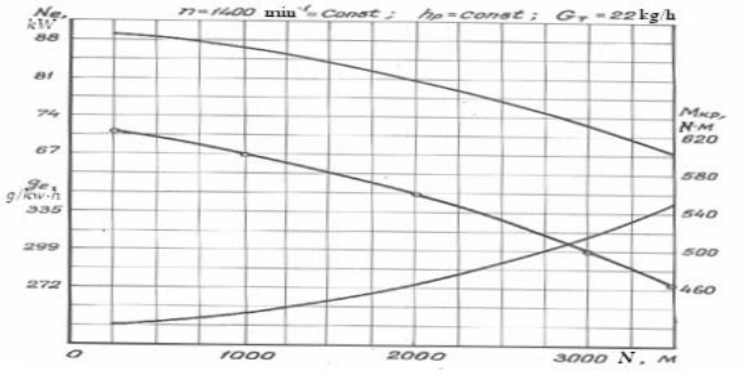

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Figure-3: A mobile laboratory with a complex of measuring equipment installed on the Kamaz-5320 vehicle for testing engines in operational conditions is presented below

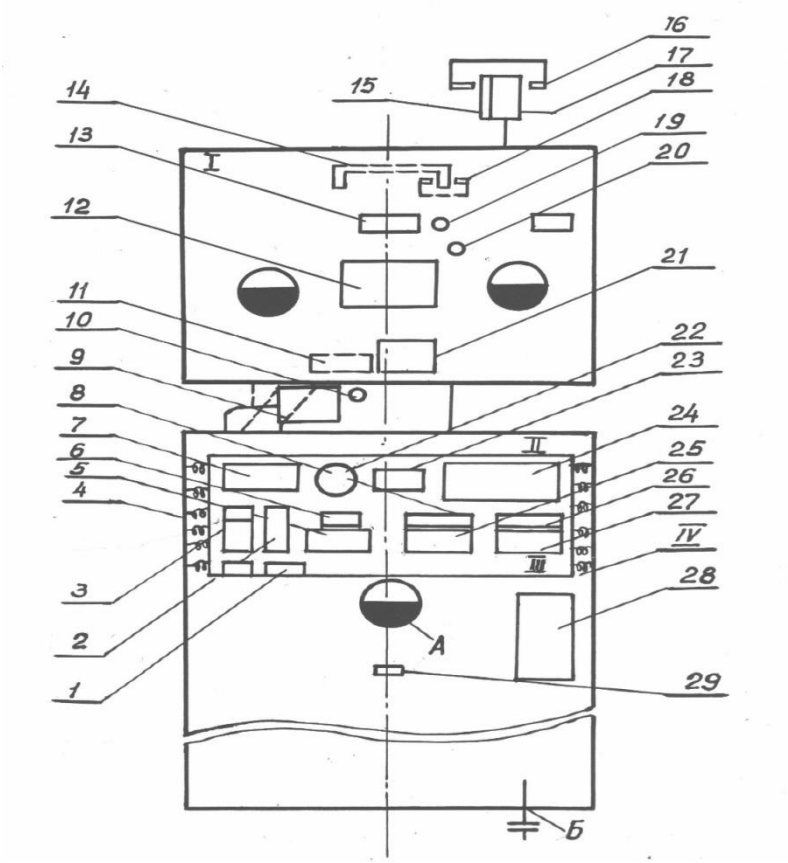

Figure-3: Diagram of the mobile Laboratory for the operational tests of the engine Kamaz-740: I-car cab; II – car body; III – stand where the devices are installed; IV – Springs for fastening of the stand to the car board; A – working place of experimenter; b – grounding circuit.

The mobile laboratory (see fig. 3) consists of: control panel (1);benzo electric unit of type 4-T 230-vmm2-zh, (28); autotransformer-Matora Aosn-8-220 (22); Voltage Stabilizers 220 V and 24v (7, 23);oscillograph N 115 with power supply P 133 (12, 13); DC POWER amplifier 24v (21); devices PCB-4 with the limits of measurements from 0 to 100 oc and from 0 to 1300 OC (25, 27); 8anch-7m amplifier with converter (5, 6); Turbine flowmeter-meter Turgas-800/3 and electronic unit of measurement of consumption Bir-3 220 (9.3); electronic small-size measuring equipment of the type EMA-P (2); fuel consumption meters Type IP-179 with electronic control units (4.11); counters of piece-group A1-ES2A (8, 26); systems for cooling of piezoelectric sensor (24); piezoelectric probe of the type LDK-6 for registration of pressure in the engine cylinder (19); angular markers of rotation of the crankshaft of the engine and the measuring Wheel (18.16); a pass-through current collector mounted on a joint shaft of the car for registration of change a crankshaft torque of the engine (29); measuring wheel and a disc with a hole to measure the road traveled (17, 15); Negotiating device (PU); THC and Then thermocouple (10, 20); disc with the slots mounted on the front end of the crankshaft to obtain angular marks and position of the WMT (14).
The engine is also equipped with water temperature and oil pressure sensors. The control Panel is equipped, except the above-mentioned devices, also by the barometer-altimeter VM-15k, aspiration psychrometer of type MV-4м which serves for measurement of humidity and temperature of ambient air. It should be noted that to reduce the influence of vibrations and fluctuations of the car on the readings of the devices they are installed on the shock absorbers, rubber cushions and shock-absorbing springs

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B. BRINGING THE CAPACITY OF DIESEL ENGINES TO THE STANDARD ATMOSPHERIC CONDITIONS

The tests were conducted up to a height of 4200 m above sea level and the pressure decreased to 60kPa. Therefore, it is necessary to develop a new analytical type of casting formula according to the experimental data obtained.
Prof. S. M. Kadyrov has proposed a formula to bring the indicators of diesel engines Yamz-236 with supercharged and non-supercharged, which characterizes the tests of motors under natural conditions of operation. He obtained generalized coefficients of Kne and Kge for two types of diesel engines:
Diesel without boost: $K_{Ne} = \left(\frac{P}{P_o}\right)^{0,9} \cdot \left(\frac{T_o}{T}\right)^{0,57}$ *and*

$$K_{ge} = \left(\frac{P_o}{P}\right)^{0,9} \cdot \left(\frac{T}{T_o}\right)^{0,64} ; \qquad (1.1)$$

Supercharged Diesel:

$$K_{Ne} = \left(\frac{P}{P_o}\right)^{0,9} \cdot \left(\frac{T_o}{T}\right)^{0,264} \text{ and}$$

$$K_{ge} = \left(\frac{P_o}{P}\right)^{0,9} \cdot \left(\frac{T}{T_o}\right)^{0,264}. \qquad (1.2)$$

The formula (1.1) for a non-supercharged case has some convergence with the test results of a Kamaz-5320 car under mountainous conditions.
As a result of calculation-theoretical researches we propose the following formulas of bringing the effective parameters of engine Kamaz-740 to normal atmospheric conditions:

$$N_e = N_{eo} \cdot \left(\frac{P}{P_o}\right)^{0,75} \cdot \left(\frac{T_o}{T}\right)^{0,57}, \qquad (1.3)$$

$$g_e = g_{eo} \cdot \left(\frac{P_o}{P}\right)^{0,75} \cdot \left(\frac{T}{T_o}\right)^{0,64}, \qquad (1.4)$$

Table-2:Shows the correction factors, taking into account the changes in barometric pressure of 1 kpa in the range from 60 to 105 kpa to adding Gost 14846-81 by them.

Conditions of application of correction factor	Высота на уровнем моря, m	Size of the amendment kv, 1/kpa
When changing the V_{oca} range:		
From 88 to 105 kpa	1200 ÷ 0	0.0072
From 78 to 88 kpa	2200 ÷ 1200	0,0075
From 69 to 78 kpa	3200 ÷ 2200	0,0078
From 60 to 69 kpa	4200 ÷ 3200	0.0081

Comparison of calculation results and experiment for engines YAMZ-236 without a boost (see fig. 4 and 5) and engine Kamaz-740 (see fig. 6 and 7). Represents a certain scientific interest. As you can see, from the drawings proposed in the work [4] the equations provide convergence of computational and experimental data within 1 to 10%, and the equations proposed by the authors provide convergence from 1 to 3%, which shows a great acceptance of them for engineering calculations and practical application.

III. CONCLUSIONS

For the first time the method of testing engines under natural conditions during transport movement is offered. The analytical type of the formula has been proposed to bring the effective indicators of diesels to normal atmospheric conditions, taking into account the change of pressure and temperature of high-altitude air. The correction coefficients for inclusion in GOST 14846-81 are offered, taking into consideration the change of barometric pressure in the range from 60 to 105 kpa.

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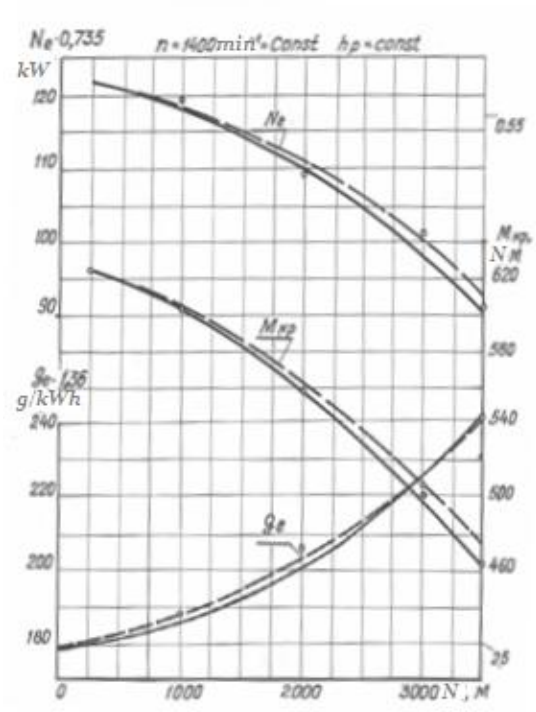

Fig.-4: Influence of altitude of the terrain above sea level on the indicators of diesel YAMZ-236: ____ Experiment;
_ _ _ Calculation

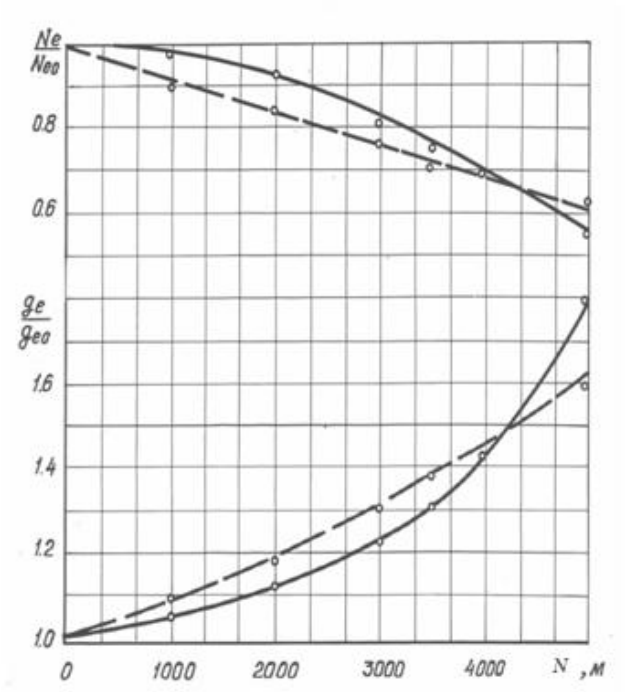

Fig-5: Experimental (____) and Calculated (_ _ _) values of the relative change of the parameters of the engine Yamz-238 depending on the altitude above sea level [11]

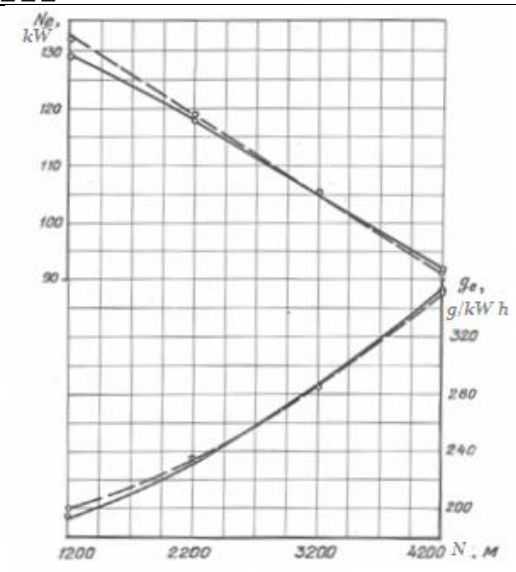

Fig-6: Influence of altitude of the terrain above sea level on the indicators of diesel KAMAZ-740 at n = 2600 min-1:
Experiment _ _ _ Calculation

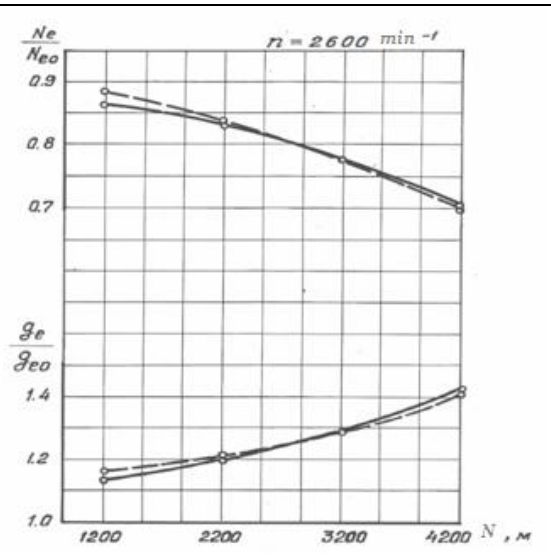

Fig.-7: Experimental (___) and Calculated (_ _ _) values of the relative change of engine parameters of Kamaz-740 depending on the altitude above sea level

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