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ASSESSMENT AND WAYS TO IMPROVE THE QUALITY OF THE WORKING PROCESS OF DIESEL ENGINES UNDER THE CONDITIONS OF JSC «O‘ZBEKISTON TEMIR YO‘LLARI»

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Abstract– The paper presents an analysis of the operating modes of diesel engines in the conditions of JSC "O‘zbekiston temir yo‘llari". With the help of a mathematical model of a diesel engine, the influence of a change in the gas distribution phases on the main technical and economic parameters of a diesel engine is determined. The criterion of optimality, which characterizes the quality of working processes in the piston part of a diesel engine, is determined.

Key words– Automatic control valve, effective efficiency, valve timing, diesel.

I INTRODUCTION

The subject of the study is the influence of changes in valve timing on the quality of technical and economic parameters of diesel locomotive diesel engines using automatically controlled drives of the gas distribution mechanism.

The purpose of the study is to determine the influence of changes in valve timing when a diesel engine is running on its main technical and economic parameters.

To achieve this goal, the following tasks were set and solved:

1. Analysis of the distribution of the time budget of locomotive diesel engines depending on the position of the driver's controller.
2. Study of the influence of changes in valve timing on the main technical and economic parameters of a diesel engine.
3. Determination of criteria for the optimality of the work process and development of a control algorithm for controlled gas distribution drives.

A practical analysis of the operating time budget of diesel locomotive diesel engines shows that in operation, diesel engines are mainly operated in non-nominal, intermediate positions of the driver's controller. The establishment of operating modes of locomotive diesel engines depends on many external and design factors. Almost all the main technical and economic parameters of diesel engines are calculated for their nominal operating modes [1,2].

Basically, for intermediate modes, calculations and adjustments of units and components are not carried out [3].

As a result, in intermediate modes the working processes of the piston part of the diesel engine do not proceed optimally. In turn, this leads to a deterioration in the quality of mixture formation and a significant reduction in the indicator efficiency of the piston part of the machine [5,6].

Figure 1 shows the distribution of the diesel operating time budget of a real diesel locomotive of the UzTE16M2 series No. 042 of section“B” from the position of the driver's controller.

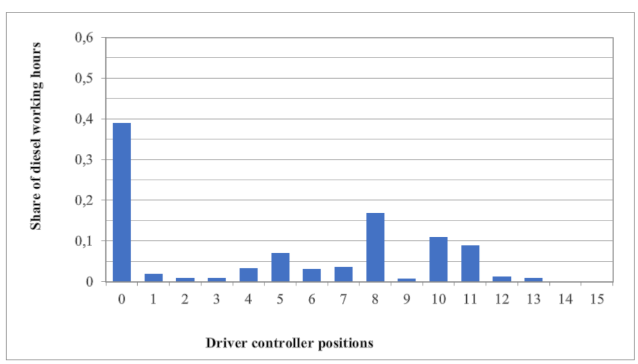

Fig. 1: Distribution of the locomotive diesel operating time budget

The diagram shows that a locomotive diesel engine mainly operates at idle and in non-rated modes. There are different ways to improve the working processes of the piston part of

Phase change				**800 rpm**				**600 rpm**			
				Cyclic fuel supply (g)	**Air flow**			**Cyclic fuel supply (g)**	**Air flow**		
					G_1**=1,38 kg/sec**	G_2**=1,24 kg/sec**	G_3**=1,1 kg/sec**		G_1**=1,38 kg/sec**	G_2**=1,24 kg/sec**	G_3**=1,1 kg/sec**
Beginning of lifting of the intake valves (change limit ± 20 degrees from the nominal value by 10 degrees)											
10 degrees earlier	20 degrees earlier	Later by 10 degrees	Later by 10 degrees	$g_1 = 0,41$	Defined: N_i, N_e, η_i, η_e, P_i, T_{max}, T			$g_1 = 0,25$	Defined: N_i, N_e, η_i, η_e, P_i, T_{max}, T		
				$g_2 = 0,46$				$g_2 = 0,29$			
				$g_3 = 0,52$				$g_3 = 0,32$			
				$g_4 = 0,58$				$g_4 = 0,36$			
				$g_5 = 0,64$				$g_5 = 0,40$			
				$g_6 = 0,70$				$g_6 = 0,43$			
The end of the landing of the intake valves (change limit ±20 degrees from the nominal value by 10 degrees)											
10 degrees earlier	20 degrees earlier	Later by 10 degrees	Later by 10 degrees	$g_1 = 0,41$	Defined: N_i, N_e, η_i, η_e, P_i, T_{max}, T			$g_1 = 0,25$	Defined: N_i, N_e, η_i, η_e, P_i, T_{max}, T		
				$g_2 = 0,46$				$g_2 = 0,29$			
				$g_3 = 0,52$				$g_3 = 0,32$			
				$g_4 = 0,58$				$g_4 = 0,36$			
				$g_5 = 0,64$				$g_5 = 0,40$			
				$g_6 = 0,70$				$g_6 = 0,43$			
Exhaust valves begin to lift (change limit ± 20 degrees from the nominal value by 10 degrees)											
10 degrees earlier	20 degrees earlier	Later by 10 degrees	Later by 10 degrees	$g_1 = 0,41$	Defined: N_i, N_e, η_i, η_e, P_i, T_{max}, T			$g_1 = 0,25$	Defined: N_i, N_e, η_i, η_e, P_i, T_{max}, T		
				$g_2 = 0,46$				$g_2 = 0,29$			
				$g_3 = 0,52$				$g_3 = 0,32$			
				$g_4 = 0,58$				$g_4 = 0,36$			
				$g_5 = 0,64$				$g_5 = 0,40$			
				$g_6 = 0,70$				$g_6 = 0,43$			
End of landing of exhaust valves (change limit ± 20 degrees from the nominal value by 10 degrees)											
10 degrees earlier	20 degrees earlier	Later by 10 degrees	Later by 10 degrees	$g_1 = 0,41$	Defined: N_i, N_e, η_i, η_e, P_i, T_{max}, T			$g_1 = 0,25$	Defined: N_i, N_e, η_i, η_e, P_i, T_{max}, T		
				$g_2 = 0,46$				$g_2 = 0,29$			
				$g_3 = 0,52$				$g_3 = 0,32$			
				$g_4 = 0,58$				$g_4 = 0,36$			
				$g_5 = 0,64$				$g_5 = 0,40$			
				$g_6 = 0,70$				$g_6 = 0,43$			

TABLE 1: PLAN FOR CARRYING OUT COMPUTATIONAL CALCULATIONS: N_i - INDICATOR POWER; N_e - EFFECTIVE POWER; η_i - INDICATOR EFFICIENCY; η_e - EFFECTIVE EFFICIENCY; P_i - AVERAGE INDICATOR PRESSURE; T_{max} – MAXIMUM CYCLE TEMPERATURE; T - EXHAUST GAS TEMPERATURE

a diesel engine; one of the most effective is to replace traditional mechanical gas distribution drives with automatically controlled drives [4].

With the introduction of automatically controlled drives, it will be possible to control the valve timing of a diesel engine, regulate and control the timing, as well as the valve lift height. With the application, it will be possible to provide optimal gas exchange conditions for different diesel operating modes. In addition, automatically controlled valves allow individual control of the operating modes of each cylinder [7].

II METHODS AND RESULTS OF EXPERIMENTAL RESEARCH

In order to check the efficiency and feasibility of controlling the drive of the gas distribution elements of a diesel locomotive, an analysis of the influence of changes in valve timing on the main technical and economic parameters was carried out using a mathematical model of a diesel engine. The calculation was made for the corresponding crankshaft rotation speeds of 600 and 800 rpm, varying the nominal values of the valve timing. To get closer to real conditions, calculations were made for different air flow rates. The plan for conducting a computational experiment is given in Table 1.

For qualitative analysis, load characteristics were constructed based on calculation data. In the process of optimizing drive control, the effective efficiency values are was considered as a criterion for optimal control.

However, determining the effective efficiency in operation it is almost impossible due to the lack of possibility or complexity of prompt receipt.

III ANALYSIS OF THE RESULTS

Therefore, the problem of control optimization was solved by indirectly monitoring the value of the optimality criterion based on the results of measuring a certain set of engine parameters. Accordingly, changes in effective efficiency were analyzed from the load characteristics. depending on changes in other parameters. Examples of analysis of simulation results presented in Figures 2-4. In all graphs, the dependence of the change in the share of effective efficiency. from cyclic supply are indirectly compared with the change in exhaust gas temperatures for the same operating modes. The minimum values of exhaust gas temperature in almost all presented characteristics correspond to the maximum value of effective efficiency. engine.

When modeling, the values of the valve timing angles are changed from the nominal values by 10 degrees within 20 degrees in the direction of increasing and decreasing. The diagrams correspond to the following valve timing angles:

Thus, the temperature of the exhaust gases at the outlet of the cylinders is taken as an optimality criterion when implementing optimal drive control. An important advantage of this criterion is also the relative simplicity of its measurement.

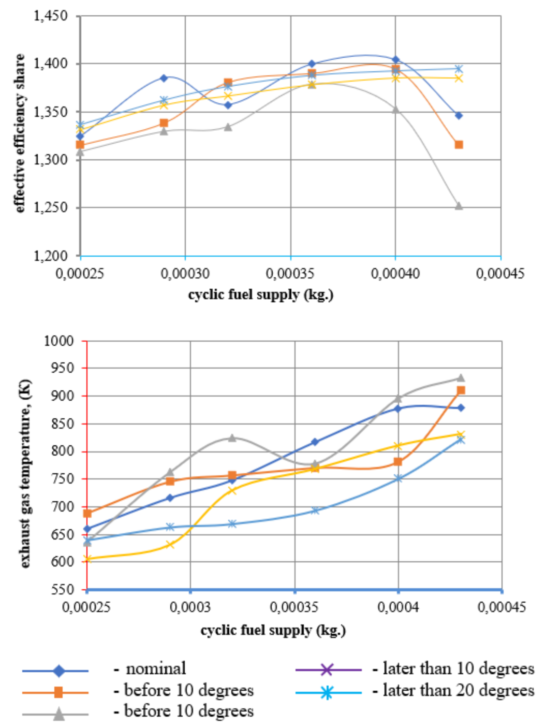

Fig. 2: Changing the opening angles of the intake valves. Air flow G=0,78 kg/sec, crankshaft speed n=600 rpm.

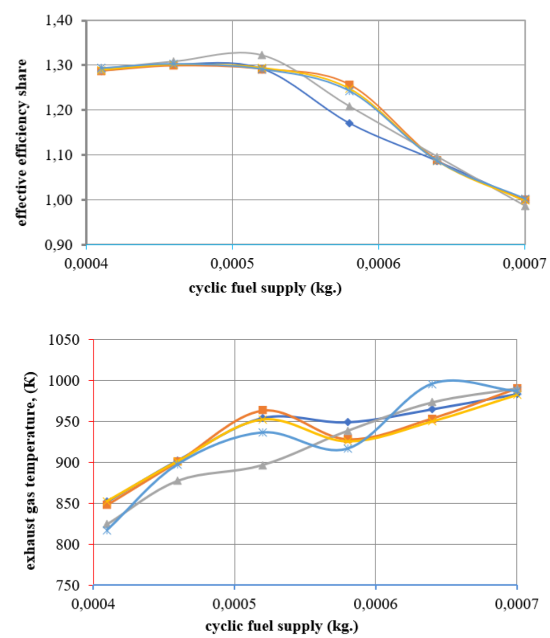

Fig. 3: Changing the angles at the end of closing (landing) of the intake valves. Air consumption G=1,24 kg/sec, crankshaft speed n=800 rpm.

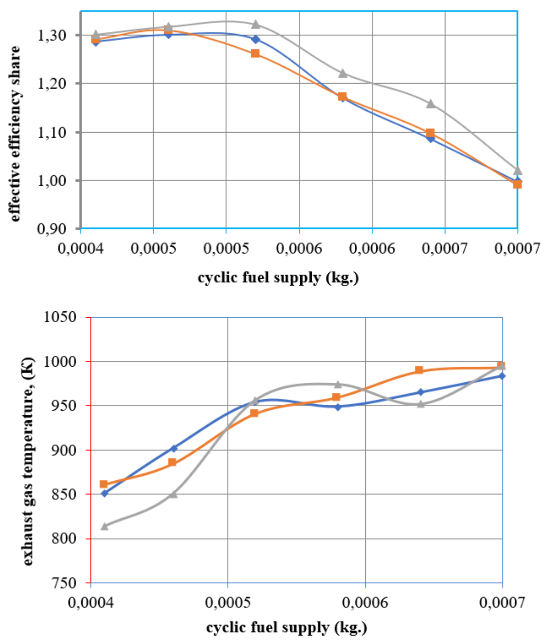

Fig. 4: Change in the catch of the end of closing (landing) of the exhaust valves. Air flow G=1,24 kg/sec, crankshaft frequency n=800 rpm.

IV CONCLUSION

Diesel locomotive mainly operates in non-rated modes. As a result, work processes in these modes do not proceed optimally. Especially the quality of gas exchange in the piston part of a diesel engine in intermediate modes decreases.

With the use of automatically controlled gas distribution drives, the quality of the diesel operating process will significantly improve. Due to the complexity of determining the optimal quality criteria for the working process of the piston part of a diesel engine, they can be characterized indirectly. The exhaust gas temperature is ideal for this purpose. Analysis of the results of calculating the mathematical model showed that the highest value of effective efficiency coincides with the low value of exhaust gas temperature under the same diesel operating conditions.

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