RESEARCH OF THE PERIOD OF A DELAY OF IGNITION OF A GAS MIXTURE OF THE TRACTOR DIESEL ENGINE CONVERTED IN GAS-DIESEL

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Abstract. *Process of burning and the subsequent expansions of gases are base processes in a cycle of work of engines with internal combustion. In Gas-Diesel gas giving is carried out in the inlet pipeline where he has time to form till the ignition moment a homogeneous mix with air and with residual gases that allows using an air charge completely. Formation homogeneous a mix from gas and air allows to use completely a charge, that is effective burning of gas for lack of surplus of gas with smaller formation of soot and other products incomplete combustion diesel fuel, ignition and burning process is direct in the engine cylinder before the moment. At work Gas-Diesel theoretical calculations on definition of necessary quantity of air, products burning, degrees of a heat-conducting path of natural gas and diesel fuel have been executed; theoretical display diagrammes of the Diesel engine and Gas-Diesel have been constructed. Comparing specific warmth at burning mixes from natural gas and diesel fuel, it is possible to draw not correct conclusions about power characteristics Gas-Diesel in comparison with a diesel engine. As it has been proved by theoretical calculations diesel engine transfer in Gas-Diesel, speak about possibility reception of the same working capacity on gas, as well as on solar oil.*

Rezumat. *Procesul de ardere şi ulterior dilatarea gazelor sunt procese de bază a ciclului de lucru la motoarele cu ardere internă. În Gazo-Diesel debitarea gazului se îndeplineşte prin conducta de aer, unde el dovedeşte să se formeze până la momentul de inflamare practic amestec omogen cu aer şi cu gazele remanente. Formarea amestecului omogen de gaz-aer permite complet să se folosească încărcătură de aer, adică de ars efectiv gazul în lipsa surplusului de aer considerabil cu formarea mult mai mică a funinginii şi altor produse a arderii necomplete a combustibilului Diesel, injectat nemijlocit în cilindrul motorului înainte de inflamare şi în procesul de ardere. La analiza lucrului Gazo-Dieselului au fost efectuate calcule teoretice la determinarea cantităţii necesare de aer, produselor de ardere, puterea calorifică a gazului natural şi combustibilului lichid; sunt construite diagramele teoretice indicate a Gazo-Dieselului şi Dieselului.Comparând căldura specifică de ardere amestecurilor stecheometrice de gaz natural şi combustibil Diesel, se poate de făcut concluzie greşită despre caracteristicile de putere reduse ale Gazo-Dieselului comparativ cu a Dieselului. Însă, cum s-au dovedit calculele teoretice trecerea Dieselului în proces Gazo-Diesel mărturisesc despre posibilitatea primirii aceleiaşi puteri la lucru cu gaz precum ca şi la combustibil Diesel.*

RESULTS AND DISCUSSIONS

In Gas-Diesel gas giving is carried out in the inlet pipeline where he has time to form till the ignition moment a homogeneous mix with air and with residual gases that allows using an air charge completely.

Diesel fuel, injected directly ahead of ignition and in the course of burning forms a heterogeneous mix. The certain share of gas worsens conditions of spontaneous ignition of diesel fuel. As a result of the resulted factors the period of a delay of spontaneous ignition increases. Duration of this period appreciably defines speed of increase of pressure at combustion both fuels, i.e. smoothness of work of the engine.

Attempts of theoretical calculation of the period of a delay of ignition as functions of temperature, pressure and energy of activation are represented basically by indicative functions. The basic influence renders thermal stress of the engine.

Professor A. I. Tolstov, being based on the analysis of display diagrammes of eleven various high-speed engines with spontaneous ignition [1], has offered the general formula for definition of a delay of ignition δ depending on pressure and temperature of air, frequency of rotation of the engine and properties of fuel

$$\delta = \beta_0 (T/P)^m \cdot (1 - k \cdot n) \cdot e^{E/RT}$$

Where *P, T* - average pressure and air temperature for the period δ;

n - frequency of rotation of the engine;

E - energy of activation;

R - a gas constant;

m, k, and β_o - skilled factors.

Using the given expression we make theoretical calculation of the period of a delay of ignition a convertible diesel engine of series D-240.

As a result of theoretical researches a number of the curves representing indicative functions of dependence of the period of a delay of ignition from temperature of a fresh charge of air for different corners of the moment of an advancing of injection (fig. 1) is received. Intensity of a steepness of curves influences both a corner of an advancing of injection φ, and temperature of fresh charge $^{/}{}_{0}$. T

The range of the period of a delay of ignition for high-speed engines which tractor diesel engines concern also, according to professor O.I. Vyrubova [2] makes 0,5 … $2 \cdot 10^{-3}$ seconds. On the received theoretical curves fig. 1 this range are noted by the shaded surface. The range is characterized by the greatest steepness of curves that testifies to fast transition from almost stable value of the period of a delay of ignition δ to as table (sharply varying).

The Main role of such sharp transition in the specified zones the temperature of a fresh charge and to each moment of an advancing of injection plays the temperature limits. In a zone of heats the moment of injection of fuel makes insignificant impact on the period of a delay of ignition and for value of corners of injection 0º, 10º and 15º the size δ is rather insignificant. In process of increase in a corner of injection (20º, 25º, etc.) δ even value starts to increase in a zone of heats. In the field of low temperatures of a fresh charge the period of a delay of ignition grows promptly and can quickly reach the moment when diesel fuel will not ignite.

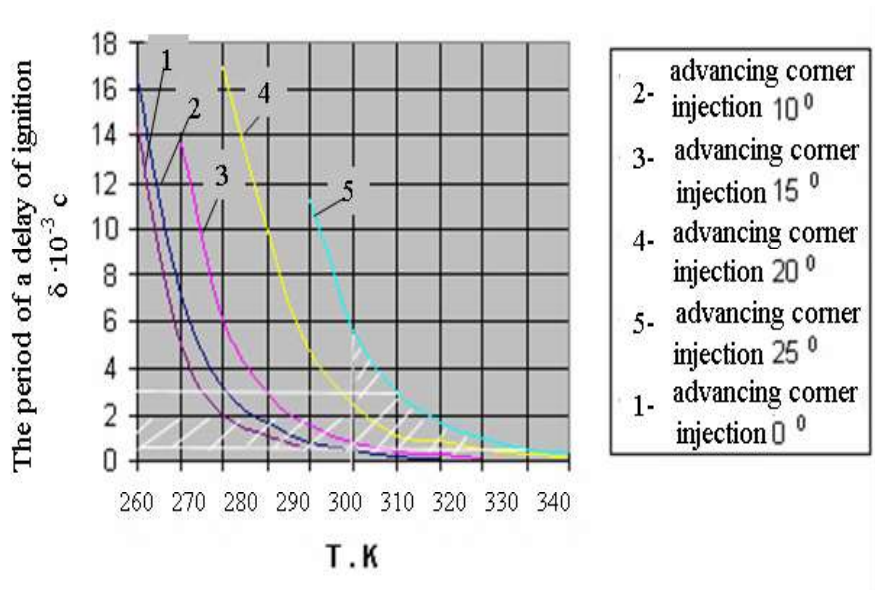
For counted engine D-240 the moment of the beginning of giving of fuel is equal 18º … 20º turn of a cranked shaft of the engine before piston arrival in HEDC, hence, the injection moment is approximately nearby 20º. The period of a delay of ignition for 310ºC already comes nearer to the top limit $2 \cdot 10^{-3}$ With, characteristic for high-speed

engines, and at 350ºC - to the bottom limit $0{,}5 \cdot 10^{-3}$ ºC. Vyhod for the top limit will lead to the big delay of the period of ignition and as result, to rigid work of the engine, and an exit for the bottom limit - will increase pressure of flash. Therefore the temperature of a fresh charge of the engine makes solving impact on process of combustion of fuel and, accordingly, not only on power and economic indicators of work of the engine, but also and on strength its parameters.

With reduction of a corner of an advancing of injection the period of a delay of spontaneous ignition decreases. The curves corresponding to a corner of injection 0º, 10º and 15º, having, located on the schedule under the same value δ, settle down more to the left, i.e. In a zone of lower temperatures.

To later corner of injection there corresponds the smaller period of a delay of spontaneous ignition at the same value of temperature of a fresh charge. Such phenomenon speaks pressure growth at the piston approach to HEDC. However at too small value of a corner of an advancing of injection the period complete burning increases, that leads finally to decrease power and economic indicators of the engine.

In engines with Gas-Diesel process a small share of diesel fuel 10 … 15 % from the general charge of all fuels are injected for a short time interval that allows reducing a corner of an advancing of injection.



During this period temperature and pressure high, and the small quantity of fuel has time to ignite and burn down completely. Thus, I phase (the period of a delay of ignition) is reduced and in the engine cylinder all diesel fuel arrives. In II phase (the period of increase of pressure) burns down all diesel fuel and from it the gas, which temperature of ignition in 2 … 2,2 times above, than at diesel fuel ignites.

Presence of many centers of burning and preliminary preparation of molecules of gas for reaction promotes that combustion process occurs completely in II phase and burning in III phase (complete burning) should be absent practically.

Combustion of all fuel in II phase can lead to increase in the maximum pressure of flash and, as result, to rigid work of the engine Rise in temperature and pressure in the beginning of II phase promotes acceleration heat exchanging processes, to an intensification of chemical reactions and in common leads to reduction of preparation of particles of gas to its fast involving in combustion process.

For gas the period of a delay of ignition coincides with II phase of combustion of diesel fuel. On all process of combustion the display diagrammed which has been removed by practical consideration can clear a real picture of influence of the given phenomenon only.

CONCLUSIONS

On the basis of theoretical calculations it is established, that the period of a delay of ignition in Gas-Diesel depends basically on temperature of a fresh charge and a corner of an advancing of injection.

The increase in temperature of a fresh charge and reduction of a corner of injection lead to decrease in the period of a delay of spontaneous ignition.

For converting of tractor diesel engines in Gas-Diesel it is necessary to define by practical consideration a corner of an advancing of injection and optimum temperature of a fresh charge.

REFERENCES

1. **Tolstov A. Č. K, 1951 -** *Teorii rabočego pročesa bystrohodnogo dvigatelâ s vosplamenenieni ot sžatiâ.* Statʼâ v sbornike N18 CNIDI – VNITOÈ, Mašgiz.
2. **Vyrubov D. N., 1946 -** *Smeseobrazovanie v dvigatelâh. Statʼâ v sbornike* „Rabocie procesy dvigatelej vnutrennego sgoraniâ i ih agregatov", Mašgiz.