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MATHEMATICAL MODELING EXPLOITATIONISTS WORK OF MACHINE-TRACTOR AGREGATIA DIESEL BIOFUEL

G. A. Golub, doctor of technical Sciences,

V.V. Chub, engineer

The mathematical modeling is given andtheoretical curvesobtainedchangingthe operatingparameters of themachine-tractor units when the load changesandthe use ofbiodieselon the basis offatty acid methyl estersof vegetable oil.

Machine-tractor units,dynamics, biodiesel.

Assessment of the opportunities for implementation of the capacity energonasos in the composition MTV those or other operating conditions when appropriate agricultural machinery and fuel type remains the main operational issues.

Energy indicators MTA when interacting with the operating environment change in rather wide limits, which in turn affects the feasibility indicators, first of all, the fuel consumption and time of performance of technological operations. The decision of a question vsamom assume parameters MTA when technological operations allows you to simulate a major change pokajnica to get data to perform optimzation MTA.

In [5, 3] MTA is considered as a system of rigid bodies connected rigid and elastic elements, in which the entire system of bodies performs translational ruheri this forces and moments are presented, based on the power balance equations and moments of inertia rotational macromania movement of the unit and the balance of moments in [4] is presented as a gain in kinetic energy equal to the work of all the forces acting in the points of application. A significant contribution to the study of automotive engines throuwn. Baltinski that in [1] leads to equations that allows to take into account the uneven change of the dynamic characteristics of the engine and resistance unit based on the equations of moments Narni in [2] obtained dependence traction force MTA on the type of fuel and its supply, which permits on the basis of geometrical parameters of fuel and its type, to determine the thrust and torque to the drive wheels to Energoatom.

The purpose of research. Theoretical dependences of the operational characteristics of the MTA when the load changes, and how to use different types of fuels.

Materials and methods of research. The study of dynamics of movement of Toprovide using methods of mathematical modeling. The analysis of the theoretical dependences of the operational characteristics of the MTA was performed by the method of selection of the most important parameters affecting its work and parvenah numeric values for different fuel types.

The research results. For the decision of a task of namilyango analysis of the forces and moments acting Namtha (Fig. 1.)

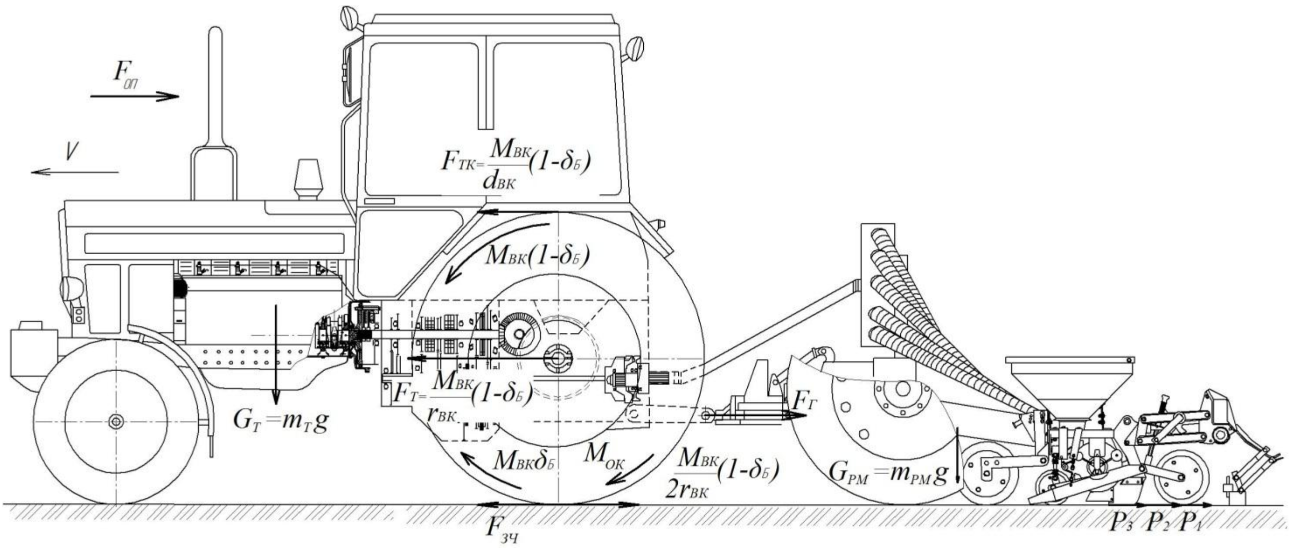

Fig. 1. The scheme force and torque acting on the MTA:

M_{BK}– torque wheels; M_{OK} – time to overcome rolling resistance; F_{TK} – power pull tractor torque on the wheel; F_T – power pull tractor, refer to the axis of the wheel; $F_{ЗЧ}$ – force of coupling of wheels with the surface; $F_Г$ – traction force of resistance of the working machine; $F_{ОП}$ – the force of air resistance; G_T – the weight of the tractor; G_{PM} – working machine weight

Also obtained equation of motion dynamics MTA depending on the load, type of fuel, the geometrical parameters of fuel and operational parameters of the unit, the gear ratio of transmission, changes effective efficiency of the engine depending on operation mode engine and parameters characterizing agrotechnologies environment:

$$\frac{(m_T + m_{PM})r_{BK}(1-\delta_Б)}{i_{TPBK}}\frac{d\omega}{dt} =$$
$$= \left(\frac{S_{ПЛ} l_{ПЛ} \rho_П k_{ПЛ} i Q_H (\varepsilon\omega^2 + \beta\omega + \gamma) k_{ЗМДБП}}{2\pi} - \frac{H_{PM} Q_{PM}}{\eta_{PM}\omega_{PM} i_{TPBBП}\eta_{TPBBП}}\right) r_{BK}^{-1} \times$$
$$\times (1-\delta_Б)\eta_{TPBK} i_{TPBK} - f m_T g - \frac{k_{OП} S_{ЛОБ} \omega^2 r_{BK}^2 (1-\delta_Б)^2}{i_{TPBK}^2} - f^{/} m_{PM} g - kab -$$
$$- \theta ab\left[\frac{\omega}{i_{TPBK}} r_{BK}(1-\delta_Б)\right]^2, \quad (1)$$

where m_T – is the mass of the tractor, kg; m_{PM} – mass production machine, kg; r_{BK} – is the radius of the driving wheel, m; $\delta_Б$ – coefficient of power loss on slipping wheels, Rel. units; i_{TPBK} – drive ratio transmission from the engine to the drive wheels, a unit; the angular acceleration of the crankshaft of the engine of a tractor, rad/S2; $S_{ПЛ}$– area plunger pair, m2; $l_{ПЛ}$ – active course of the plunger, m; $\rho_П$ – the fuel density, kg/m3; $k_{ПЛ}$ – coefficient of fuel supply the fuel pump plunger; i – quantity of fuel injection for one revolution of the engine, on-1; Q_H – lower heating value of fuel, j/kg; ω – angular speed of crankshaft tractor engine,rad/s; α, β, γ – the coefficients of approximating dependence of changes effective efficiency of the engine on angular frequency of crankshaft rotation, Rel. $k_{ЗМДБП}$– is the factor reducing the effectiveness of efficiency of the engine with the use of biodiesel, Rel. units; H_{PM} – pressure created by the fan working machine, PA; Q_{PM} – volumetric air flow rate fan working machine, m3/s; η_{PM}– efficiency fan working machine; Rel. units; ω_{PM} – angular velocity of the rotating parts of the working machine, rad/s; $i_{TPBBП}$ – drive ratio transmission from engine to the shaft of the power take-off unit; $\eta_{TPBBП}$ – efficiency transmission valadi power, Rel. units; η_{TPBK} – efficiency transmission to Energoatom, Rel. units; i_{TPBBK} – drive ratio transmission from the engine to the drive wheels, a unit; f – coefficient of resistance to rolling of wheels, Rel. units; g – the acceleration of gravity, in m/S2; $k_{OП}$– coefficient of resistance of air, N C2/M4; $S_{ЛОБ}$ – frontal resistance area MTA, sq.m.; $f^{/}$ –total coefficient of friction, which includes friction guns on the ground and rolling friction wheels plough, Rel. u; k – specific resistance of the soil deformation, N/m2; a – width the processed layer, m; b – depth processing layer, θ – is the coefficient that takes into account the ratio of speed of drop formation and speed the plow, your HC2/M4.

The equation of motion dynamics Mama like this:

$$\omega = \frac{1}{2P}\left(J\left(\frac{2P\omega_{\Pi} + L + J\,\dfrac{(1-e^{tJ})}{(1+e^{tJ})}}{(2P\omega_{\Pi} + L)\dfrac{(1-e^{tJ})}{(1+e^{tJ})} + J} \right) - L \right), \qquad (2)$$

where ω_{Π} – initial frequency of engine crankshaft rotation, rad/s; om - end frequency of engine crankshaft rotation, rad/S.

Given runandopen dynamics of change of angular speed of a crankshaft of the engine when changing external parameters that characterize the work of the MTA in technological operations and fuel characteristics, which zastosowania the expression contains constants of differential equations, which depend only on the fuel supply and fuel - L (p-1), as well as from fuel injection, fuel and load MTA - P (Rel. units)iJ (s-1).

On the basis of the obtained mathematical models of dynamics of movement of the ITA and the solution of the calculations of change of operational parameters of the MTA on the basis of tractor Cue-14102 with engine D-245 when performing manufacturing operations plowing and the dependences of the variation of the angular speed of rotation of a cranked shaft of the engine and speed MTA (Fig. 2) and fuel consumption depending on the type of fuel, load change and parameters of fuel (Fig. 3).

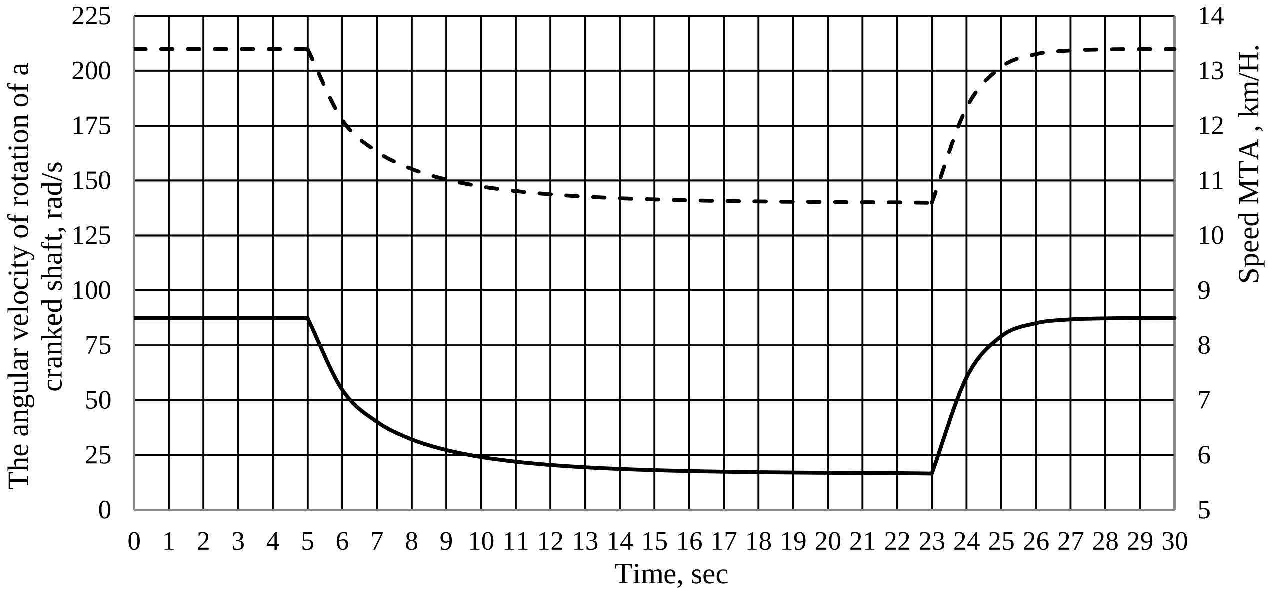

Fig.2 Tinamine the change in speed of the engine characteristics and Masolino from changes in load and fuel

Theoretical investigation showed that for the same load and its change for different types of fuel for the change in speed of the engine performance and the MTA are held according to the same law, it should be noted that the difference in fuel consumption, see(figure 3).

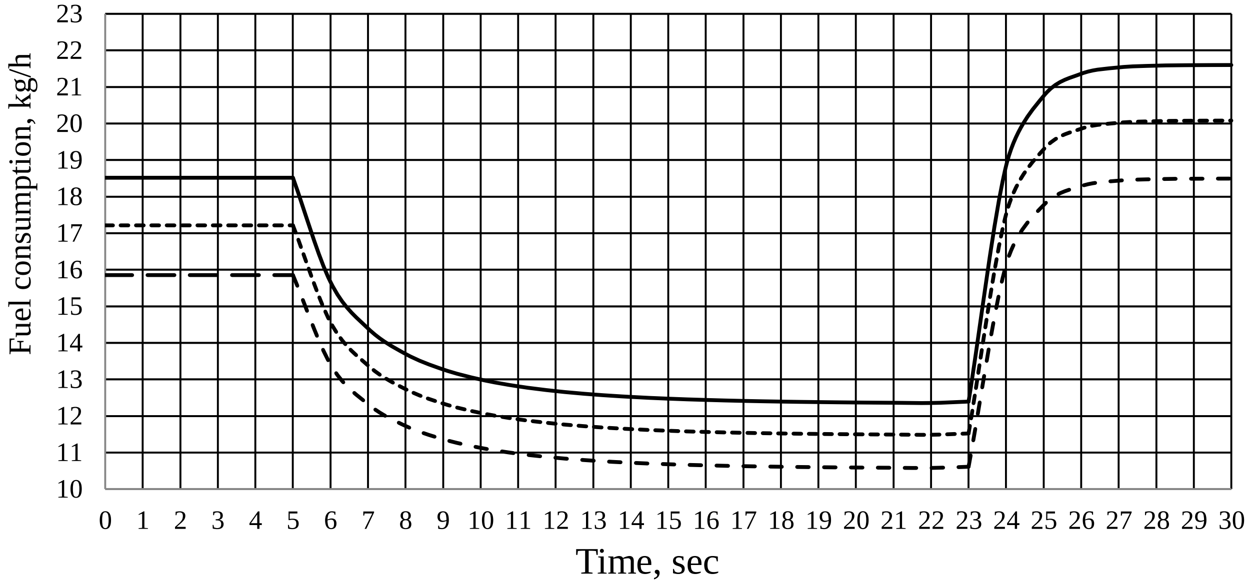

Fig. 3. Dynamics of fuel consumption, when changing the load and the different types of fuel

These differences when working on diesel and diesel biofuel is primarily due to their differing the lowest of teplotvornoj abilities and density, as well as combustion, which for diesel biofuel is also dependent on fuel temperature before injection into the engine cylinder.

On Fig. S the first to the fifth secundiflora initial straight sections graficzne angular speed of rotation of a cranked shaft of the engine and movement MTA is responsible uniform roguelegal on the field when the load mode.

To obtain the dynamics of changing of speed parameters of work MTA from the load completed smenauscheesa agrotechnological environment, namely increased resistance to deformation of the ground and the efforts at the drop of a reservoir at a constant supply of fuel that is actually consistent with the sudden change of density, humidity, soil type and leads to the sudden increase traction resistance of the working machine. The increase in traction resistance aggregateprincipal to lower engine speeds overload and, as a consequence, reducing engine speed is reduced accordingly hourly fuel consumption on the background of decreasing the speed of the unit, which in turn leads to decrease of its traction resistance. As a consequence, the system will attempt snitily new steady state. If such a condition will occur in settings that are in the operating range of the engine of internal combustion, the MTA stabilizes its movement at low speed and engine speed and less time consumption. The progress of this process is observed in the graphs figure 2 and figure 3 from 5 to 23 C. In the future, the MTA will come to a new sravnivaniem work and will continue to occur in uniform motion.

The increase traction resistance of the unit leads to the reduction of the working speed of the ITA, which in turn affect the performance of the unit operation for a time unit and can degrade the quality of execution of agrotechnical requirements to technological operations, such as incomplete turnover layers of soil or lack of its destruction. To increase the speed at constant fuel supply should decrease traction resistance of the unit by reducing the depth of processing or decrease shirinsefat unit. The first is unacceptable from the agrotechnical requirements,the second will decrease performance. Therefore, to achieve adequate performance and ensure implementation of agrotechnical requirements you need to increase the working speed of the ITA, which can be achieved by increasing the supply of fuel. The increase in fuel supply will lead to increase of angular speed of the engine, increasing capacity that develops the motor and, as consequence,to increase the speed and thus increase traction resistance of the unit. The MTA will begin to accelerate to establish a new corresponding equilibrium mode when the new parameters. The graphs figure 2 and figure 3, from 23 to 30 sec shows the process of acceleration MTA with instantaneous increase fuel, which meets the yield of MTA on the initial speed mode.

It should be noted that the characteristics figure 2 and reset change roboticon different types of fuel with a load change at strictly shape high-pressure pump or when using the fuel high-pressure pump, equipped only dvorianin controller, which works only at launch and increase the engine speed is above the maximum dopustimaja almost all of the high-pressure pumps for domestic agricultural machinery equipped seriennummern regulators that are at the decline in the angular velocity of rotation of a cranked shaft of the engine automatically increase cyclic fuel and napakiak fuel pumps of high pressure with centrobenessere regulators do not meet environmental requirements for the engine transient reimage with reduced engine speed is reduced fullness air cylinders by reducing the velocity of piston motion and speed intake Sarandon increases the quantity of fuel injected into the cylinder, which leads to a sharp deterioration in the environmental performance of engines of internal sgoraniya changes cycle counter in fuel pumps of high pressure with centraline regulators mechanical actions rather complex and depends on many design parameters and therefore its introduction in existing mathematical model (1)is sufficiently complex matematicheskaja.

Seregin regulators modern fuel injection systems of internal combustion engines based on computer control of fuel injection. The injection is carried out according to the given law changes his amounts in respect of engine parameters specified by the law can be easily integrated in existing mathematical models calculating the appropriate power and performance parameters of the MTA on its basis.

Conclusions

A mathematical model of the dependence of the dynamics of movement of the MTA of your settings agrotechnological and the type of fuel, has allowed to establish that the dynamics of the MTA does not depend on the fuel type and when the tractor's engine D-245 for technological operations plowing, the transition process when load was 18, and to accelerate from zero to the initial speed regime S. It is also established that during the transition process caused by the increasing load on the machine speed MTA is reduced with 8,5 up to 5,67 km/godfri this is a reduction of vitraliu on 33.27 %, i.e. for diesel fuel is reduced flow with 15.85 to 10.57 kg/h, for diesel biofuel without heating - with 18.51 up to 12 kg/h, and for diesel biofuel in the application of the heating - with 17,21 to 11.48 kg/H. To exit the unit on the initial speed (8.5 km/h) the need to increase the fuel supply to 16.65 % relative to the initial fuel or 74,88 % regarding the amount of the fuel supply at the speed 5,67 km/H.

The list lterature

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