RESEARCH ON THE BLOCK-PORTION SEPARATOR PARAMETERS INFLUENCE ON THE ADJUSTMENT RANGE OF OPERATING ELEMENTS SPEED
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ДОСЛІДЖЕННЯ ВПЛИВУ ПАРАМЕТРІВ СИСТЕМИ ГІДРОПРИВОДІВ БЛОЧНО-ПОРЦІЙНОГО ВІДОКРЕМЛЮВАЧА НА ДІАПАЗОН РЕГУЛЮВАННЯ ШВИДКОСТІ РОБОЧИХ ОРГАНІВ

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ABSTRACT
The article focuses on solving the problem of reducing the energy intensity of the separating ensilage fodder process from trench silo with the block-portion method by developing and substantiating the parameters and operating modes of the hydraulic drives system of the block-portion separator. This allows adjusting the operating modes of the cutting mechanism drive and the vertical feed drive of the П-shaped frame. The system allows adjusting the feed of the П-shaped frame in accordance with the change in the cutting effort that makes an effect on the cutting mechanism. As a result, we get stabilization of energy consumption in the process of separating an ensilage fodder block portion if the parameters that determine the cutting process characteristics fluctuate. It was proven that the expansion of the actuating hydro-motors speed adjustment range and, accordingly, the hydraulic drive system responsiveness increase is possible by the appropriate choice of the slide valve parameters. The most effective of the speed range adjustment expansion of the cutting mechanism hydraulic motor and the hydraulic cylinder of the П-shaped frame drive is provided by reducing the width of the slide valve working edges. The influence of the hydraulic system parameters of the ensilage fodder block-portion separator on the speed adjustment range of the operating elements has been studied. The hydraulic drives system parameters which have the greatest influence on the expansion of the hydraulic drives operating modes adjustment range were established. This allows increasing the responsiveness and efficiency of the proposed block-portion separator of ensilage fodder hydraulic drives system by identifying the rational values of these parameters. Recommendations on the design parameters choice are given.

РЕЗЮМЕ
Стаття присвячена розв'язанню проблеми зменшення енергоємності процесу відокремлення консервованих кормів з траншейних сховищ блочно-порційним методом шляхом розробки та обґрунтування параметрів і режимів роботи системи гідравлічних приводів блочно-порційного відокремлювача, яка дозволяє узгодити режими роботи двох приводів – привода різального механізму та привода вертикальної подачі П–подібної рамки. Система передбачає регулювання подачі П–подібної рамки відповідно зміни зусилля різання, яке діє на різальний механізм, в результаті чого відбувається стабілізація енерговитрат на відокремлення блок-порції консервованого корму при умові коливання параметрів, які визначають характеристики процесу різання. Встановлено, що розширення діапазону регулювання швидкостей виконавчих гідродвигунів та, відповідно підвищення чутливості системи гідроприводів можливе шляхом відповідного вибору параметрів золотникового роздільника. Найбільш ефективно розширення діапазона регулювання швидкостей гідромотора різального механізму та гідроцилíндра привода П–подібної рамки забезпечується шляхом зменшення ширини робочих кромок золотника. Досліджено вплив параметрів системи гідроприводів блочно-порційного відокремлювача консервованого корму на діапазон регулювання швидкості робочих органів. Встановлено параметри системи гідроприводів, що мають найбільший вплив на розширення діапазону регулювання режимів роботи системи гідроприводів, що дозволяє шляхом визначення раціональних значень даних параметрів підвищити чутливість та ефективність запропонованої системи гідроприводів блочно-порційного відокремлювача консервованих кормів. Дано рекомендації з вибору конструктивних параметрів.

INTRODUCTION

Recent development of agricultural machinery involves further increase in hydraulic drives operating elements development level. They are aimed at increasing their productivity, power, as well as reducing energy consumption and improving dynamic characteristics (*Andrenko P.N., Lurye Z. Ya., 2016*).

According to the Strategy for the agrarian economic sector development for the period until 2020, the national agricultural machinery must reach a fundamentally new level of development. In order to achieve the set goals it is necessary to solve a number of actual problems. The problems in the engineering industry include the lack of innovative potential and weak development of the Ukrainian agricultural machinery. This results in the increase of the industry dependence on technologies and equipment import (*Privalov F.I., 2017*). A significant increase in the number of hydraulic developments for the machines and equipment is the trend in modern agricultural machinery. The hydraulic drive is demanded to carry out several operations simultaneously. It is conditioned by both economic and functional requirements for hydraulic machines and equipment (*Shylo I.N., Tolochko N.K., Romanyuk N.N., Nukeshev S.O., 2016*). There are many machines and technological equipment such as harvesters, loaders, manipulators. Their work mainly requires simultaneous operation of several operating elements. Besides, such systems always require precise speed control adjustment during operation, for example, to maintain the assigned kinematics of their movement. The adjustment accuracy should be ensured even under variable loadings on the operating elements (*Andrenko P.N., Lurye Z. Ya., 2016; Galukhin N.A., 2014*).

Therefore, the research on the influence of the block-portion separator hydraulic drives parameters on the speed range of the operating elements adjustment is an actual scientific problem for the country's agricultural and industrial complex. The solution to the problem will increase the mechanization level in loading and unloading operations, the quality of technological operation while separating fodder and reducing the agricultural products cost price.

The block-portion separators of ensilage fodder which are now used at the Ukrainian enterprises, as well as other national agricultural machines are equipped with hydraulic drives of fixed flow control valve which do not meet modern requirements for speed, reliability and power consumption related to these machines (*Ivanov M.I., Hrytsun A.V., Podolyanyn I.M., Rutkevych V.S., 2010*). The main disadvantages of the drives are significant power losses when it is necessary to perform precise movements or to regulate the flow of hydraulic oil used in operating elements (hydraulic motors). Some unconnected hydraulic motors of the separator’s cutting mechanism drive and the hydraulic cylinder of the feeding drives lead to applying hydraulic motors with increased capacity (*Ivanov N., Shargorodskiy S., Rutkevych V., 2013; Ivanov M.I. et al., 2013*). As a result, the power of each of these machine’s drives increases to 25 kW under condition of identifying the maximum required power of the cutting mechanism drive within the separator in the range of 4.5-6.0 kW, and the drive of the feeder – up to 0.8 kW by using calculation and experimental method (*Rutkevych V.S., 2017*). That is why the world's leading hydraulic equipment manufacturers from Parker Hannifin, Bosch Rexroth, Bucher Hydraullics, Hunger Hydraulik, Turbo, Moog and others pay much attention to the "intellectual drives" development and the existing drives redesigning and upgrading (*Kozlov L.G., 2013*). As a rule, the main problem that arises in the independent simultaneous adjustment of several operating elements speeds of the hydraulic drive is the energy losses excessive level and unacceptably low efficiency coefficient of the hydraulic system (*Sidorenko V.S.et al., 2017*).

MATERIALS AND METHODS

The experimental part of the work was carried out at the laboratory stands within the "Machinery and equipment for agricultural production" department at Vinnytsia National Agrarian University. The experimental research was intended to prove the development effectiveness of the hydraulic drives system in the block-portion separator of ensilage fodder and the reasonableness in the choice of the determined drive to ensure the compliance of the two drives operation – the cutting mechanism drive and the П-shaped frame vertical feeding drive. During the theoretical studies of the hydraulic drives system in the block-portion separator, recommendations were made for the choice of its parameters. The parameter values should ensure the absence of unstable (oscillatory) processes and the precise operation of the controlled signal by the slide valve for the flow with increasing torque on the hydraulic motor. The adequacy of the theoretical analysis results to the real performance of the developed system in hydraulic drives of the block-portion separator was verified by studying the system operation on an experimental stand. Mathematical modelling results and experimental studies of the physical model comparison make it possible to prove the results reliability.

Theoretical analysis of the processes that determine the characteristics and the quality of the block-portion separator hydraulic drives system was carried applying the mathematical modelling methods, using the fundamental laws of hydraulics, hydromechanics and theoretical mechanics with the use of differential calculus. A numerical experiment based on the mathematical model was performed applying modern software packages Mathcad and Delphi.

For experimental research we used modern measuring and recording equipment. On the basis of the analogue-digital converter of m-DAQ 12 model a recording equipment set was created. That allowed accumulating and processing an array of measurement results. The experimental data processing was performed by regression analysis methods. Algorithmic computing was conducted using modern packages of applications Mathcad 17, Microsoft Excel 2003, Delphi. To simulate the laboratory installation design and the processes under study we used modern software packages SolidWorks, T-Flex. The reliability of the theoretical statements, scientific and practical results presented in the work, was confirmed experimentally under laboratory conditions.

RESULTS

The objective of the study is to set the block-portion separator for ensilage fodder hydraulic drives parameters which will allow expanding the speed adjustment of operating elements range with variable loading.

The system of hydraulic drives in block-portion separator was elaborated within the department of machines and equipment of agricultural production at Vinnytsia National Agrarian University. The system provides the adaptation of actuating hydraulic motors to the technological surface condition (*Rutkevych V.S., 2017*). The schematic diagram of the hydraulic drive system in the block-portion separator for ensilage fodder is shown in Fig. 1.

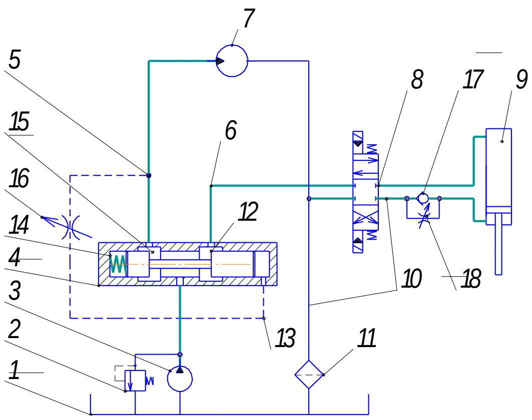


Fig. 1 - Hydraulic circuit in the hydraulic system of a block-portion separator for ensilage fodder

The system operation principle involves adjusting the feeding of the П-shaped frame according to the changes of the cutting effort that affects the cutting mechanism (*Ivanov M.I. et al., 2013*), which results in the energy consumption stabilization of the ensilage fodder block portion separator under the condition of fluctuating parameters that determine the cutting process characteristics.

The ensilage fodder block-portion separator drives system includes a hydraulic tank *1*, a safety valve *2*, a hydraulic pump *3*, a slide valve separator of the flow *4* with a control line *13*, a controlled slide valve *12*, a hydraulic motor *7*, pressure gauges *5,6*, a four-line three-positioned distributor with electrohydraulic control *8*, a hydraulic cylinder *9*, drain hose lines *10*, filter *11*, check valve *17*, chokes *16,18* and a spring *14* (Fig. 1). The suggested use of the flow divider *4* between the actuating hydraulic motor of the cutting mechanism 7 and the hydraulic feeding cylinder *9* (Fig. 1) allows co-ordinating the reduction of its feeding when the load on the cutting mechanism increases, which in turn, leads to a reduction in the cutting force. At the same time, hydraulic oil supply to the hydraulic motor of cutting mechanism drive increases, which also contributes to the reduction of the cutting force and the required power of the cutting mechanism hydraulic drive.

The study of the operation processes of hydraulic drives system in the ensilage fodder block-portion separator was carried out by means of a computational experiment. As a result of solving the problem on the PC, the transient processes that arise during the operation of the hydraulic system in the block-portion separator for ensilage fodder were determined.

The algorithm for determining transients in the specified system takes into account the variable load on the output elements of the actuating hydro-motors, which is actually the cause of the transient processes.

The operation of hydraulic drives system of ensilage fodder block-portion separator starts at zero load on the actuating hydraulic drives, which in general corresponds to the process of moving the П-shaped frame to the surface of the ensilage fodder monolith when the load on the output elements of the actuating hydraulic motors is minimal or absent.

At 400 ms from the operation beginning, occurs the increase in the load on the output elements of the actuating hydro-motors to the value that corresponds to the real value of the loading moment on the hydro-motor shaft M_{gm}=100 Nm and the force $F_{cutting}$ = 1200 N on the hydraulic cylinder rod. In further study of the process of hydraulic drives system operation the moment from the forces of cutting silage monolith and the effort to overcome the resistance strength when feeding the П-shaped frame corresponded to the value determined experimentally in the study of the block-portion fodder separating process from the silage monolith.

Fig. 2 shows the calculating transient processes (as a result of a numerical experiment) in the hydraulic drive system of the block-portion separator caused by the change of the loading on the drive hydraulic motors actuating segments.

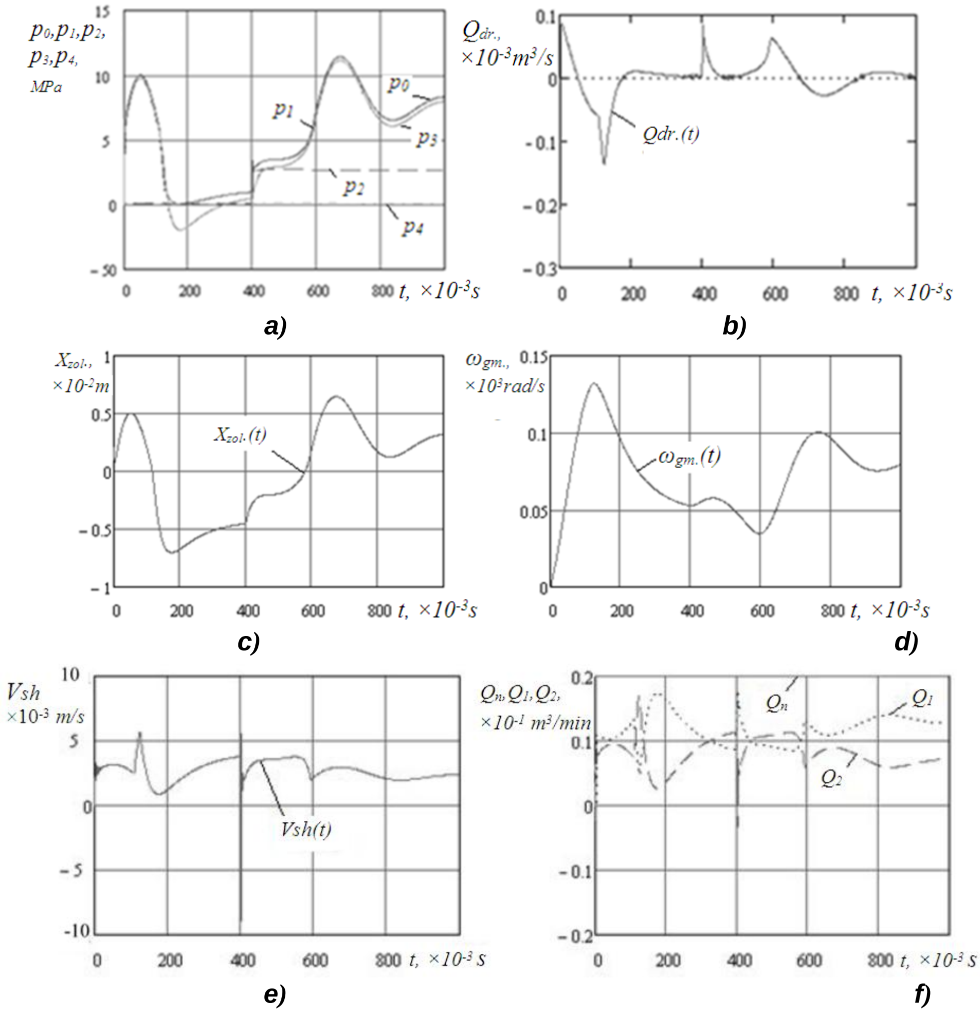


Fig. 2 - Transitional process in the hydraulic drive system of the block-portion separator at initial parameters values

a) change of pressure in the housings of the hydro-system; b) the flow of oil through the throttle; c) the displacement of the slide valve of the flow separator; d) the angular speed of the hydraulic motor shaft; e) the speed of the hydraulic cylinder supply; f) the flow of liquid consumed by the hydraulic motor (Q_1) and the hydraulic cylinder (Q_2).

The transient processes shown in Fig. 2 were calculated at the following initial values of the hydraulic system parameters in the block-portion separator: the volume supply of the pump Q_n = 2.38·10^{-4} m^3/s, which corresponds to the volumetric supply of a gear pump in the НШ-10 type with the power of the pump drive at five kW; the working edges width of the separator slide valve for the flow is a=1mm; the initial working windows opening value in the slide valve of the flow separator l_1=6 mm, l_2=2 mm;

flow rate of the hydraulic oil through throttle openings is μ=0.62; nominal pressure in the hydraulic system p_0=10.0 MPa; hydraulic oil density ρ=850 kg/m^3; the coefficient of the housing compliance of the hydraulic drive system, filled with the hydraulic oil is K=0.6·10^{-9} m^2/N, the diameter of the separator flow nozzle slide valve d_{zol}=25 mm; the moment of inertia in the rotating parts, which are connected to the shaft of the hydraulic motor I=100 kg·m^2; the mass of the ensilage fodder separator moving parts m_{mp}=45 kg is reduced to the П-shaped frame; the coefficient of viscous friction β=2.5·10^3 N·s; the diameter of the actuating hydraulic cylinder supplying the П-shaped frame D_z=63 mm; the volume of hydro-line that connects the actuating hydrostatic motors with a flow separator W_1= W_2= W_4= 100 cm^3; the volume of the hydro-line connecting the throttle with the torsion housing of the flow separator W_3=25 cm^3; the value of the flow separator slide valve displacement to the left of the stop b_1=1 mm; the value of the flow separator slide valve displacement to the right of the stop b_2=2 mm; stiffness of the spring installed in the interstitial housing of the flow separator slide valve C_{pr}=0.5 N/mm.

Fig. 2 shows the block-portion separator parameters change – the oil flow, the displacement of the flow slide valve, the angular speed of the hydraulic motor and the speed of the hydraulic cylinder rod which occur during the transition process that is caused by changes in the loads on the actuating hydraulic drives. The change in the rotation speed of the hydraulic motor shaft and the П-shaped frame feeding speed arose as a result of the flow slide valve displacement at 3 mm to the opening of the first working window connecting the pump with the hydraulic motor and reducing the opening of the second working window, respectively, the oil in the corresponding housings of the hydraulic motor and the hydraulic cylinder (Fig. 2, f). The oil volume supply Q_1, consumed by the hydraulic motor increases from 0.088×10^{-1} m^3/min to 0.136×10^{-1} m^3/min which corresponds to the increase in the rate of cutting of silage monolith by 57 %. At the same time, oil supply Q_2, consumed by the hydraulic cylinder decreases from 0.113×10^{-1} m^3/min to 0.075×10^{-1} m^3/min which corresponds to the decrease in the feed rate of the П-shaped frame by 43%.

Therefore, the oscilloscopes shown in Fig. 2 indicate that the proposed system of hydraulic drives for the block-portion separator works in a steady mode while providing a wide range in speed control of actuators. It allows stabilizing the cutting forces while changing the conditions of cutting and, thus, applying the reserves for reducing the power of the hydraulic drives used.

At the same time, it was found that certain parameters of the hydraulic system have a greater impact on the expansion of the hydraulic system operation adjustment range, which allows identifying rational values of the parameters and increasing responsiveness and efficiency of the proposed ensilage fodder block-portion separator hydraulic drives system.

The objective criterion for the efficiency of adjusting speed of the hydraulic motor shaft according to the change in feeding the hydraulic cylinder rod is the dependence of those parameters on the cutting tool load during the separation of the ensilage fodder bale. Thus, Fig. 2 shows the transition process in the hydraulic drive for the fodder block-portion separator calculated on the condition that the loading moment on the hydraulic motor shaft increases to the value of M_{gm}=100 N·m from the initial zero value. This process corresponds to the process of cutting into the monolith of ensilage fodder. According to the results, the feed of the rod decreases, as the supply of the oil (oil flow rate Q_2) to the hydraulic cylinder decreases. At the same time, the hydraulic motor shaft rotation speed increases, affecting the decrease of the cutting force.

Fig. 3 shows the dependences on the change in the volume flow of the hydraulic oil to the actuating hydraulic motors, that is the cutting mechanism drive hydraulic motor and the П-shaped frame drive hydraulic cylinder. Q_1 and Q_2 show the dependence on the value of the load moment in the hydraulic motor M_{gm}. In the initial state, without loading on the drives of the operating elements in the cutting mechanism, the flow rate from the pumping station is evenly distributed between the hydraulic motors Q_1 = Q_2=0.10 ×10^1 m^3/min (Graph 1). Increasing the loading at the moment of cutting on a hydraulic motor shaft according to the predetermined algorithm for the operation of the hydraulic system leads to an increase in the flow (flow rate) Q_1 to the hydraulic motor of the cutting mechanism drive (Graph 2) and to the reduced supply of the oil Q_2 to the cylinder of the П-shaped frame drive (Graph 3). So, with the increase of the loading moment to the value M_{gm}=50 N·m, the oil flow Q_1 at the inlet of the hydraulic motor of the cutting mechanism increases from 0.10×10^{-1} m^3/min in the initial state to 0.115×10^1 m^3/min, i.e. increases by 15%. Accordingly, there is a decrease in the oil flow rate Q_2 at the inlet of the hydraulic cylinder of the П-shaped frame. If there is an increase of loading on the hydraulic motor to M_{gm}=50 N·m, the flow rate Q_2 decreases accordingly to 0.085×10^{-1} m^3/min, i.e. decreases by 15%. In case of further increase of the loading moment to M_{gm}=100 N·m, the flow rate Q_1 increases to 0.13×10^{-1} m^3/min, that is, the growth of flow rate is 30% of the initial value.

In this case, the flow rate of the oil Q_2 decreases to 0.07×10^{-1} m^3/min which means a 30% decrease in the Q_2 rate and, accordingly, a decrease in the feed speed of the П-shaped frame that unloads cutting mechanism and provides the total power of the drives at the level which does not exceed 5 kW.

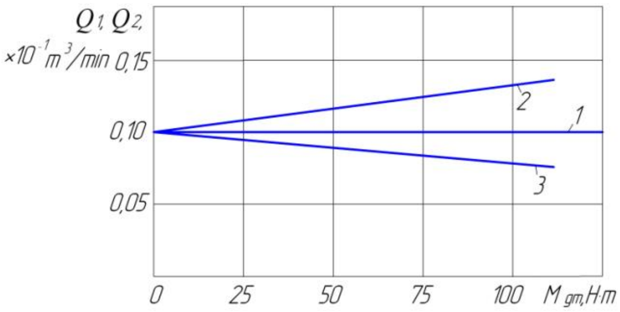
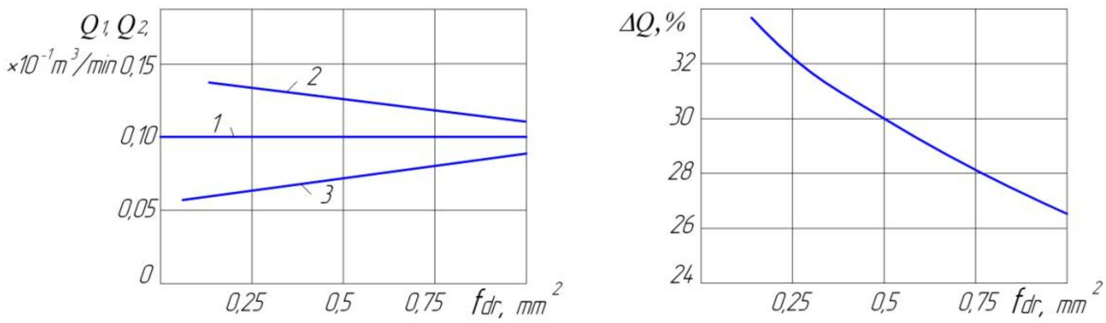


Fig. 3 - The influence of the cutting mechanism drive hydraulic motor load moment on the change of the oil flow Q_1 at the input of the hydraulic motor and Q_2 at the input of the hydraulic cylinder

1- flow rates Q_1 and Q_2 without loading, 2 - dependence of the flow rate Q_1 on the loading moment M_{gm}, 3 - dependence of the flow rate Q_2 on the loading moment M_{gm}

Further increase in the loading moment on the hydraulic motor of the cutting mechanism drive at the value M_{gm}=150 N·m increases the pressure in the injection line to a value exceeding the value of the pressure in setting the safety valve, which is 16 MPa. In this case, the periodic opening of the safety valve leads to the self-sustained wave process, which is unacceptable in terms of the agricultural machine performance. In this case, other hydraulic drives system parameters of the ensilage fodder block-portion separator were of initial values.

Fig. 4 presents the dependence graphs of the oil volume flow change (flow rates) to the actuating hydraulic motors – the hydraulic motor drive of the cutting mechanism and the hydraulic cylinder drive of the П-shaped frame; the dependence of Q_1 and Q_2 on the surface f_{dr} of the throttle, through which the treated housing of the flow slide valve is connected with hydraulic line of the oil supply to the hydraulic motor. Fig. 4a shows the dependencies of the indicated flow rates on the throttle area, identified at different operating modes of the actuating hydraulic motors with and without loading.



a) ***b)***

Fig. 4 - Assessment of the influence of the throttle $f_{др}$ flow section area size on the change in the oil flow rate at the hydraulic motor Q_1 inlet and the hydraulic cylinder Q_2 inlet:

a) dependence of the flow rate Q_1 and Q_2 on the size of the area of the throttle f_{dr} (1 – the values of the flow rates Q_1 and Q_2 without loading, 2 - dependence of the flow rate Q_1 on the area of the throttle with loading, 3 - dependence of the flow rate Q_2 on the area of the throttle with loading), b) relative change in the flow rates Q_1 and Q_2 in case of changing the size of the throttle area f_{dr}.

Dependence 1 corresponds to the flow rate Q_1 and Q_2 in the process of the hydraulic drives system operation without loading. In fact, changing the size of the throttle surface does not affect the balance of the specified flow rates and their value, in this range of change of the throttle area, remains unchanged Q_1=Q_2=0.10×10^{-1} m^3/min. At the simultaneous feeding on the shaft of the hydraulic motor the loading moment M_{gm}=100 N·m and on the hydraulic cylinder rod with the force F_{rez}=1200 N, which occurs at 400th millisecond (0.4 s), there is a predicted change in oil flow rates because of the pressure of the block-portion separator hydraulic system.

The flow rate Q_1 with the value of the throttle area f_{dr}=1 mm^2 increases to Q_1=0.127×10^{1} m^3/min. (Graph 2), and the flow rate Q_2 decreases to Q_2=0.073×10^{-1}m^3/min. (Graph 3). With further decreasing the throttle area to the value f_{dr}=0.15 mm^2, there is an increase in the difference between the rates Q_1 and Q_2. The flow rate Q_1 increases to a value of Q_1=0.134×10^{-1} m^3/min, that is, increases in accordance with the original value by 33.6%, and the flow rate Q_2 decreases to Q_2=0.066 ×10^{-1} m^3/min (the decreases is 33.6%), namely, it becomes almost twice lower than the rate Q_1. The speed of the output parts of the hydraulic motors varies accordingly, which should reduce the cutting force and the torque on the hydraulic motor shaft. The responsiveness of the hydraulic drive system to the changes of the loading on the operating elements allows adjusting the loading on the cutting mechanism at a wider range. This is also facilitated by the range expansion of adjusting the feeding speed in the П-shaped frame.

Fig. 5 presents the graphs of the dependence of the volume feeds variation (rates) on the actuating hydraulic motors, particularly the cutting mechanism drive hydraulic motor and the П-shaped frame drive hydraulic cylinder; dependence of Q_1 and Q_2 on the width *a* of the slide valve operating edges.

The graphs of dependencies are plotted on the conditions that the parameters of the hydraulic system in the block-portion separator correspond to the initial values, and the value of the loading moment at the 400th ms of the hydraulic motor of the cutting mechanism drive is M_{gm}=100 N·m.

According to the graphs (Fig. 5) that show reducing the width of the flow slide valve edges considerably extends the range of feeding adjustments of Q_1 and Q_2. If at the initial value of the width of the flow slide valve edges *a*=1mm at the loading moment on the hydraulic motor of the cutting mechanism, the flow rate at the input of the hydraulic motor increases to Q_1=0.13×10^{-1} m^3/min, and at the cylinder inlet in the drive of the П-shaped frame decreases to 0.07×10^{1} m^3/min, then, with reducing the width of the operating edge of the slide valve to the value of *a*=0.5mm, the flow rate Q_1 increases to Q_1=0.16×10^{-1} m^3/min (Graph 2), and the flow rate Q_1 decreases to Q_2=0.04×10^{-1} m^3/min (Graph 3). As a result, the range of adjustment of the oil flow rates increases, which goes to the actuating hydraulic motors hydraulic drive system of the block-portion separator. As a result the responsiveness of the drives to the loading considerably expands. The accuracy in the analysis of the control corresponding signals of the hydraulic drive system operating mode improves.

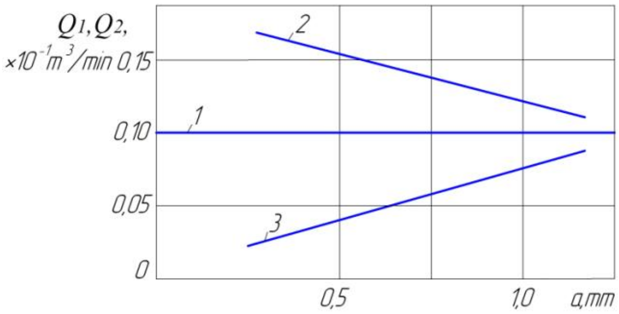


Fig. 5 - Influence of the width a of the flow separator slide valve edge on the oil flow rate change at the hydraulic motor Q_1 inlet and at the hydraulic cylinder Q_2 inlet

1- the value of flow rates Q_1 and Q_2 without loading, 2 - dependence of the flow rate Q_1 on the width of the slide valve edge of the flow separator under loading, 3 - dependence of the flow rate Q_2 on the width of the slide valve edge of the flow separator under loading.

The analysis of the influence of other block-portion separator hydraulic system parameters on the width of the volume control range of the flow rates in the hydraulic lines that provide the oil flow rate by the cutting mechanism drive hydraulic motor and the П-shaped frame drive hydraulic cylinder showed that the change in these parameters values in a wide range does not significantly affect the expanding speed adjustment range of the hydraulic motor and the hydraulic cylinder. At the same time, in this case there are unstable modes of operation of the hydraulic system and, as a result, it loses efficiency.

As a result of the study, it was found that by changing the operating widths of the separator slide valve in the direction of reduction, there is a significant increase in the responsiveness of the hydraulic drive system in the block-portion separator to the changes in the loading on the cutting tool. As a result, the adjustment range of the hydraulic cylinder feeding of the П-shaped frame, which increases the efficiency of stabilizing the separation process from the monolith of block-portion for ensilage fodder with a minimum power of the hydraulic drive system, is substantially expanded.

CONCLUSIONS

The results of the mathematical modelling prove the principle possibility to provide the given algorithm for the operation of the block-portion separator hydraulic drive system in the process of the proposed system in hydraulic drives, which must provide the speed control of the actuating hydro-motors in this hydraulic system in accordance with the load of the cutting mechanism. So, with increasing the load of the cutting mechanism, the supply of the hydraulic cylinder of the П-shaped frame decreases at the same time as the proportional increase in the rotation speed of the drive hydro-motor in the cutting mechanism.

The studies of the mathematical model showed the possibility to adjust the range of changes in the hydraulic motor speed and the feeding of the rod by the appropriate choice of rational values for a number of parameters of the hydraulic system in the block-portion separator. In the largest degree, the increase of the adjustment range is possible by reducing the width of the operating edges of the separator slide valve to the value a=0.5 mm, and the area of the throttle adjustment to the value f_{dr}=1 mm^2. The specified values of the parameters correspond to stable operating modes of the hydraulic system in the block-portion separator. Changing the values of other parameters of the hydraulic system in the block-portion separator does not cause a noticeable expansion of the speed adjustment range of the system in hydraulic drives of the block-portion separator.

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