ON THE ISSUE OF REDUCING THE HARMFUL INFLUENCE OF THE MOBILE AGRICULTURAL SYSTEMS UNITS ON THE SOIL

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Abstract: *The article is devoted to the problem of increasing the efficiency of using mobile agricultural aggregates by reducing the impact of their running systems on the soil. The work on the efficiency of the use of mobile agricultural units based on the automobile chassis in agroindustrial production is analyzed, which shows the results of studies on the changes in their designs with the purpose of reducing the harmful influence of chassis running systems on soil. One of the ways to reduce the harmful influence of running systems of mobile agricultural units on Execution of technological operations, both in field conditions and in transport operations while driving along the road Mobile roads. The main ways that will ensure the effective use of the automobile chassis in field conditions and on highways are analyzed. It has been found that the most effective is the equipment of automobile chassis with wide – profile tires with adjustable internal air pressure and a tire – pumping control system, which makes it possible to effectively use the chassis both in the main technological operations (in the field) and in transport operations (on the roads). The influence of the air pressure in the tire of the wheel of the running system of the KrAZ – 6322 automobile chassis and the normal load on the contact area of the tire with the supporting surface and pressure on it is established. To use the automobile chassis for performing agricultural operations in field conditions, it is necessary to equip it with wide – profile tires with adjustable internal air pressure and a tire – pumping monitoring system that will reduce the negative impact on the soil of the mobile agricultural unit and expand the list of technological operations on which it can be used.*
KEYWORDS: *UNDERCARRIAGE, AUTOMOBILE CHASSIS, TIRES, AIR PRESSURE IN TIRES, GROUND PRESSURE, TIRE CONTACT AREA.*

1. Introduction

With the growth of the country's economy, the agricultural sector every year increases its share in it. Conducting intensive production of agricultural products allowed to increase the yield of crops. To minimize crop losses, adequate technical support is needed, which in turn should be formed on energy resources with a high annual load and versatility. To address these issues, you can use mobile agricultural units (MAU), formed on the basis of a car chassis for performing technological operations. They are becoming more and more widespread among producers of agricultural products and more and more factories of manufacturers of trucks are creating their modifications for agricultural production [1 – 11]. However, the issue of the influence of running chassis systems on the ground is not given much attention in terms of reducing their negative impact.

2. Preconditions and means for resolving the problem

2.1. Analysis of recent research and publications

With the development of technological progress, the tractor as an energy tool for performing agricultural operations loses its monopoly. Automobile plants Mercedes, MAN, Tatra, KamAZ, Ural, KrAZ, Joskin [1 – 11] create automobile chassis that can be used in agro – industrial production for technological operations with: introducing various technological materials, tillage, sowing, crop care , Transport operations and the like. In the spring period, when the soil has high humidity and is prone to compaction, special attention is paid to the influence of running systems on the soil, but the MAU must have high traction values. To solve this problem, the above – mentioned plants equip the automobile chassis with low – pressure tires with large structural dimensions and an improved terrain protector. Such tires work effectively in field conditions, and on highways will quickly wear out. The speed of movement of such MAU is limited by the characteristics of the tire and will average 25 – 30 km·h^{-1}.

Under such conditions, the main advantage due to which cars have in front of tractors and can reduce the cost of production of crop production is the increase in the transport speed of traffic on the roads and, as a derivative of it, the use of straight – through schemes for the introduction of technological materials – is leveled. Installations on the car chassis of the serial tires used for road traffic will lead to ultra – high pressure of its running systems on the soil, low load – bearing capacity, and as a result, crop losses [12, 13], increase in energy costs for production due to increased skid .

The foregoing leads to a contradiction, the essence of which is that the MAU based on the automobile chassis are effective in transport operations when driving roads, and at the same time have low possibility in field conditions and have a negative impact on the soil and vice versa: MAUs that have high cross – country capability In field conditions, and compact the soil a little, develop a low transport speed on highways and have a high intensity of tire wear.

2.2. Purpose of the research

The aim of the research is to find ways to expand the technological capabilities of the automobile chassis by reducing the harmful impact of its running system on the soil.

3. Results and discussion

The autofactory KrAZ plant produces KrAZ-6322 automobile chassis, MAU [14, 15] (Fig. 1) was developed at the National Research Center "Institute for Mechanization and Electrification of Agriculture", which are devoid of the drawbacks mentioned above.

The KrAZ-6322 automobile chassis (Fig. 2) is equipped with a centralized control system for pumping the tires of the wheels, which allows reducing the air pressure in them while performing technological operations in the field up to 80 – 150 kPa and increasing it to the recommended 300 – 350 kPa for transport crossings. Also, the pneumatic system allows you to adjust the air pressure during the process operation as the amount of process material in the hopper of the attachment is reduced.

The KrAZ-6322 automobile chassis is fitted with VI – 3 tires, which have the ability to withstand loads when the air pressure in them decreases. This is a diagonal tire with a protector of hanging patency, the maximum load on the tire is 39.3 kN, the pressure of compressed air can be in the range of 0.08 – 0.35 MPa [16].

a)

b)

Fig. 1. – MAU on the basis of the automobile chassis produced by PJSC AvtoKrAZ with machines for the introduction of solid: a) – mineral fertilizers MDA – 9A; B) – organic fertilizers AROD – 11.

Fig.2. – Car chassis KrAZ-6322

The influence of the running systems on the soil depends on the area of contact of the tire of the wheel and the normal load on it. The area of contact, in turn, depends on the size and design of the tire, the air pressure in it and the load on it. With increasing air pressure in the tire, the contact area decreases. An increase in the tire load at a constant pressure in it also increases its contact area.

For the VI – 3 tire, the contact area was determined (Fig.3) according to the standardized procedure GOST 7057 – 2003 [17].

a)

b)

Fig. 3. – Imprint of the tire model VI – 3 at a load of 17.1 kN and air pressure in the tire: a) – 0.20 MPa; b) – 0.08 MPa

As can be seen from Fig. 3 with a decrease in the pressure in the tire, the area of the support surface increases almost twofold, from 814.7 cm^2 at a pressure of 0.20 MPa to 1616.24 cm^2 at a pressure of 0.08 MPa. The wheel pressure on the bearing surface is 103.5 kPa with air pressure in the tire of 0.08 MPa, and at a tire pressure of 0.2 MPa, 205.5 kPa.

The results of experimental studies of the effect of air pressure in the tire tire on the area of its contact and normal load (17.1, 24.7 and 33.2 kN) are presented in Fig. 4.

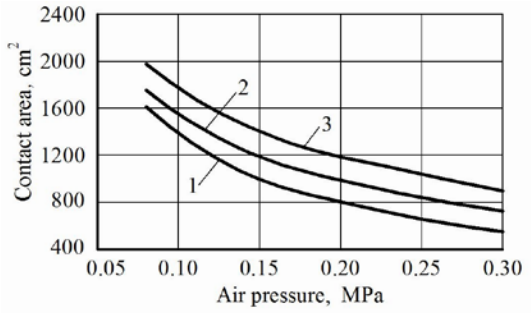

Fig. 4. – Dependence of the contact area of the tire model VI – 3 on the air pressure in it with the load on the wheel:
1 – 17.1 kN; 2 – 24.7kN; 3 – 33.2 kN

In this case, the average pressure on the reference surface will have the following relationship, which is shown graphically in Fig. 5.

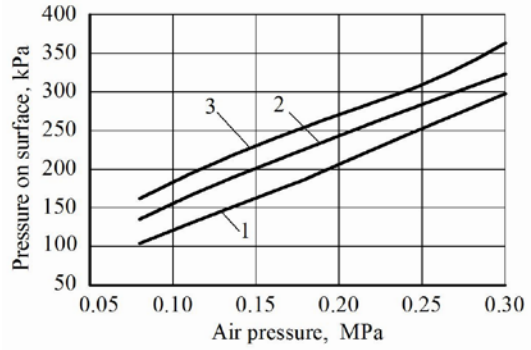

Fig. 5. – The dependence of the average pressure on the bearing surface of the wheel of the MAU on the air pressure in it with the load on the wheel:
1 – 17.1 kN; 2 – 24.7 kN; 3 – 33.2 kN

From Fig. 5 it can be seen that as the air pressure in the tire tire decreases, its pressure on the bearing surface decreases. So, for example, with a wheel load of 17.1 kN and an air pressure in the tire of 0.08 MPa, the pressure on the bearing surface is 103.6 kPa. As

the load on the wheel increases, the pressure on the bearing surface is predicted to increase. So, with a wheel load of 24.7 kN and an air pressure in the tire of 0.08 MPa, the pressure on the bearing surface is 138.0 kPa.

According to the state standard DSTU 4521: 2006 [18], which regulates the permissible maximum pressure on the soil, differentiated by the granulometric composition and humidity during the passage of running systems on the ground, at 0.6 – 0.7 HB permissible maximum pressure on the ground running systems Should be: in the spring 60 – 100 kPa; in summer and in autumn – 120 – 140 kPa.

Given that the contact area of the tire was determined on a solid support surface. In field conditions, due to soil compaction, the wheel will have a large contact area and will reduce the average pressure of the MAU running system to the soil.

Taking into account the above, the MAU on the basis of the KrAZ-6322 automobile chassis, which is fitted with the VI – 3 tire and the tire – pumping system for field operations, will create pressure on the soil within the limits of the DSTU standard 4521: 2006.

4. Conclusions

To use the automobile chassis for performing agricultural operations in field conditions it is necessary to equip it with wide – profile tires with adjustable internal air pressure and a tire – pumping monitoring system that will reduce the negative impact on the soil of the MCA and expand the list of technological operations on which it can be used.

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