

WAYS TO IMPROVE THE RELIABILITY OF GRAIN HARVESTING MACHINES TO ENSURE THE COUNTRY'S FOOD INDEPENDENCE

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Abstract. The issues of reliability of harvesting machines are considered, which largely depends on the technological process of their development and operation. The design features of domestic and foreign grain harvesting units, their susceptibility to technical failures, as well as the influence of operational factors on the wear of the main mechanisms are studied. The main types of failures are analyzed, including mechanical wear, abrasive damage, failures due to fatigue of materials, malfunctions of electronic and hydraulic systems. The need to increase the durability and reliability of units by using wear-resistant materials, protective coatings and improving structural solutions is substantiated. An approach to a comprehensive assessment of the reliability of the “machine - maintenance” system is proposed to minimize downtime and increase the efficiency of harvesting.

Keywords: reliability, harvesting machines, restoration, mechanical wear, resource-saving technologies, repair, maintenance, food supply, operational durability.

Grain harvesting machines working in difficult field conditions. When interacting with the flow of plants, sudden emergency damage to the working bodies is possible, especially when various foreign inclusions get in together with the stem mass. Emergency damage can also occur as a result of the tiring effect of cyclic loads, or overloads caused by uneven supply of stem mass [1].

Sudden emergency damage depends on the degree of contamination of the field with foreign inclusions, i.e.: the existing general agricultural crop, the structural strength of the working bodies and the use of special protection devices against possible emergency damage. Emergency damage is characterized by the intensity of their manifestation and, unfortunately, occupies a significant place among the causes of failure of the working bodies of harvesting machines.

During the operation of corn harvesters, failures are encountered associated with various types of clogging of cooling, lubrication or cleaning systems. Failures are known due to leaks in hydraulic equipment, oil leakage, air suction, and vibration of pipelines [2].

Failures associated with a violation of the operation of electrical or electronic systems of combines are often encountered. They can occur suddenly or form gradually, leading to functional failures of certain systems of the combine.

Abrasive wear can be observed in cutting and crushing elements of corn harvesters. Under the action of abrasive particles, the turns of the screw transporting and unloading working bodies wear out. The screw working bodies wear out along the perimeter of the ends of the turns, which leads to an increase in the gaps between the screw and the casing and, as a result, loss of conveyor productivity. Wear and tear of bearing assemblies is also possible if they are structurally insufficiently protected from dust.

Analysis of mechanical transmission failures showed that it is necessary to pay special attention to the design process of individual drive assemblies. The correct choice of materials, geometric parameters, verification of kinematic and power characteristics will reduce the number of failures and extend the service life of the analyzed transmission [3].

When solving the problem of increasing the reliability of a harvesting unit, its reliability as a whole is often considered, which makes it difficult to find hidden reserves in its individual mechanisms. To ensure the required level of reliability of the entire harvesting machine, it is necessary to use additional measures in the form of the application of the necessary technical and organizational work, based on relevant research. In the designs of mechanical drives of corn harvesting machines, it is necessary to use anti-corrosion, wear-resistant and temperature-resistant materials of increased strength and reliability, as well as protective coatings and seals. In this case, each individual mechanism of the machine, each working body of the harvesting combine, as well as the technological process of its operation should be analyzed and refined. The reliability and durability of the unit's component elements should be brought to a level that does not exceed their equivalent. The motor resource of low-resource spare parts should be equal to the seasonal operating standard of the unit, and the rest - a multiple of it, so as not to cause stops for their replacement during the harvesting season.

In real operation, machines always age physically - this is due to the processes of wear, fatigue, corrosion, clogging, etc. The course of these processes inevitably leads to a decrease in the level of operability, which can be characterized by the magnitude of failure intensities [4].

At the same time, the repair and maintenance base of the technical service of machines can be in various possible states from a decrease in potential and capabilities (aging) to development due to the introduction of the latest technologies and methods of maintenance and repair.

For a comprehensive assessment of the state and trends in changes in the general level of ensuring reliable operation of machines, especially seasonal ones, it is necessary to consider the holistic system "machine - technical maintenance" in the dynamics of changes in their characteristics [5].

In previous studies of this issue, two concepts were established - the readiness function and the recovery function. If we superimpose the graphs of the obtained functions one on the other, we can obtain the intersection point of these curves, which

theoretically will make it possible to describe the necessary parameters in order to maintain the operability of a complex technical system.

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Анотація. Розглядаються питання надійності збиральних машин, що значною мірою залежить від технологічного процесу їх розробки та експлуатації. Досліджено особливості конструкції вітчизняних і зарубіжних зернозбиральних агрегатів, їхню схильність до технічних відмов, а також вплив експлуатаційних факторів на зношування основних механізмів. Проаналізовано основні види відмов, включаючи механічне зношування, абразивне пошкодження, поломки через втомлюваність матеріалів, несправності електронних і гідравлічних систем. Обґрунтовано необхідність підвищення довговічності та надійності агрегатів шляхом застосування зносостійких матеріалів, захисних покриттів та удосконалення конструкційних рішень. Запропоновано підхід до комплексної оцінки надійності системи «машина – технічне обслуговування» для мінімізації часу простою та підвищення ефективності збирання врожаю.

Ключові слова: надійність, збиральні машини, відновлення, механічне зношування, ресурсозберігаючі технології, ремонт, технічне обслуговування, продовольче забезпечення, експлуатаційна довговічність.